CLEAN EDGE

THE CLEAN-TECH MARKET AUTHORITY

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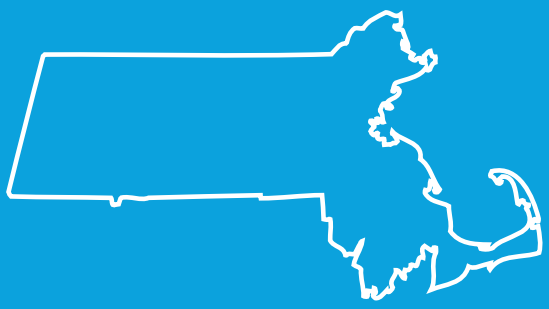

# A FUTURE OF INNOVATION AND GROWTH:

## *Advancing Massachusetts' Clean-Energy Leadership*

**A Clean Edge Report for the** MASSACHUSETTS CLEAN ENERGY CENTER

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# EXECUTIVE SUMMARY

By a range of different measures, Massachusetts stands out as a clean-energy leader among states in the U.S. It has made the growth of clean energy a clear legislative and economic development priority in the state, with strong results to date in leading-edge policies, industry expansion, job creation, and increased investment and deployment.

This report, prepared by Clean Edge Inc. for the Massachusetts Clean Energy Center (MassCEC), compares and contrasts Massachusetts' clean-energy leadership with other leading states by a variety of quantitative and qualitative measures. After an initial screening process to select the Top 15 clean-energy states in the U.S., we created a Leadership Scorecard comparing these states in 56 categories that encompass regulatory incentives, financial incentives, knowledge capital, and economic/workforce development. While this is not a definitive, weighted ranking, it provides an important and valuable benchmarking on states' performance. Massachusetts places second in this ranking, behind only California. Rounding out the Top 15 clean-energy states are OR, CO, NJ, CT, NY, MD, WA, AZ, IL, FL, PA and TX.

## CLEAN-ENERGY STATE LEADERSHIP SCORECARD

| State | Total Marks Earned (out of 56 possible) | Percent of Total Marks Possible |
|---|---|---|
| California | 48 | 86% |
| Massachusetts | 45 | 80% |
| Oregon | 43 | 77% |
| Colorado | 35 | 63% |
| New Jersey | 35 | 63% |
| Connecticut | 34 | 61% |
| New York | 34 | 61% |
| Maryland | 32 | 57% |
| Washington | 32 | 57% |
| Minnesota | 30 | 54% |
| Arizona | 28 | 50% |
| Illinois | 28 | 50% |
| Florida | 24 | 43% |
| Pennsylvania | 24 | 43% |
| Texas | 20 | 36% |

*Source: Clean Edge, Inc., 2010*

## Assessing Massachusetts Clean-Energy Assets and Barriers

The state's Top 2 ranking, and much of what we heard from more than 20 interviews with leading clean-energy stakeholders in the state, places Massachusetts in an impressive and enviable position. The state's world-class academic and innovation resources, strong government leadership, active venture capital community, highly educated workforce, and deep commitment to energy efficiency

are among the strengths that make Massachusetts a clean-energy hub known the world over. The state is home to MIT and other leading clean-tech universities in the U.S. and its reputation as a clean-energy business cluster, led by the New England Clean Energy Council and other organizations, is considered among the world's best.

Key barriers to clean-energy leadership that Massachusetts must address include the state's high costs of living and doing business; limited natural resources for clean energy; the lack of a national, DOE-sponsored energy lab; permitting delays and local NIMBYism; and a less robust innovation-to-commercialism track record than some other states, particularly California.

| Strengths/Assets | Weaknesses/Barriers |
|---|---|
| World-Class Academic, R&D, and Innovation Resources | High Costs of Living and Energy (high overhead for manufacturing) |
| Deep Commitment to Energy Efficiency | Innovation-to-Commercialization Gaps |
| Strong Government Leadership and Policy Support | Limited Natural Resources for Clean Energy |
| Robust Venture Capital Resources | Local-Rule Tradition/Permitting Delays/NIMBYism |
| High Energy Demand and Costs (easier for renewables to compete on price, good incentives for conservation/efficiency) | Risk-Averse Financial Community |
| Highly Educated Workforce | Lack of a National Energy Laboratory |
| Green-Minded, Supportive Citizenry | Limited Clean-Energy Manufacturing Infrastructure |

## Diversity and Innovation

Some states' claims to clean-energy fame come mainly from growth and excellence in one sector, such as Texas and Iowa in wind energy or New Jersey in solar power. Massachusetts is different. Its leadership is broad and diverse, covering a wide swath of clean technologies under the very large umbrella of innovation. Companies like A123 Systems in advanced electric batteries, EnerNOC in efficiency and demand-side management, Konarka in organic photovoltaics, Beacon Power in flywheels, and General Compression in large-scale energy storage are all considered top innovators. Some of these firms, and dozens more clean-energy players in Massachusetts, grew out of university research in the state whose academic resources and intellectual capital are widely regarded as second to none. As one interviewee put it succinctly: "We have a lot of smart people."

But innovation doesn't only occur in university research labs or corporate conference rooms. Governments can also innovate, especially regarding relatively new sectors like clean energy, and Massachusetts' public leaders and policymakers have done that. Governor Deval Patrick, Secretary of Energy and Environmental Affairs Ian Bowles, and Department of Energy Resources Commissioner Philip Giudice all earn generally high marks for leadership on clean energy from this report's

interviewees and high rankings in this report's comparative analysis matrices. The Global Warming Solutions Act, the Green Communities Act, and the Green Jobs Act (creating the MassCEC) lead a healthy list of leading-edge, aggressive policy initiatives. The state's leadership in the Northeast states' Regional Greenhouse Gas Initiative (RGGI), arguably the most successful cap-and-trade systems for carbon emissions in the U.S., has also been exemplary.

## Three Key Sectors: Energy Efficiency, Solar, and Energy Storage

While the state's clean-tech activities are broad, three areas in particular rise to the top: energy efficiency, solar, and energy storage.

Massachusetts (and most of New England) is blessed – some might say cursed – with an ideal set of factors that make energy efficiency and conservation attractive: extreme climate, high energy prices, and aged building stock. All these factors make Massachusetts a ripe area for efficiency, the sector that many call clean-tech's "low-hanging fruit." State government, utilities, and industry have all shown strong leadership on efficiency, with companies like EnerNOC and Conservation Services Group emerging as key innovators in the sector.

Massachusetts may not come immediately to mind as a sunny state. But many early advances in solar PV were pioneered here, and by the end of 2010, Massachusetts solar PV installations are projected to show 18x growth over four years from 3.5 megawatts (MW) to 63 MW. The number of in-state solar installers has quadrupled in 18 months. The state's Commonwealth Solar rebate program, sold out in 2009 and renewed in 2010, offers up to $10,500 in rebates for residential PV systems and up to $5,500 for commercial systems of 5 kilowatts (kW) or less. We expect to see even more startup companies joining a robust roster of Massachusetts innovators that includes Evergreen Solar, Konarka, Solectria, 1366 Technologies, Spire Solar, and Wakonda Technologies.

The third key industry sector showing strong Massachusetts clean-energy leadership is advanced energy storage – from electric-vehicle batteries to utility-scale electricity storage. It's a fast-growing, increasingly important niche that depends heavily on the type of R&D breakthroughs in which Massachusetts excels, at MIT and many other institutions. Bay State companies such as A123 Systems, Boston-Power, Evercel, General Compression, Premium Power, and others give the state a solid cluster of storage innovation and commercialization.

## The Keys to Success: Innovation and Diversity

For the greatest impact, the state should play to its nation-leading strength in research, development, and innovation, across a range of clean-energy sectors. Efficiency, solar, and energy storage deserve special attention and policy support as key leadership sectors, but not to the exclusion of innovation, breakthroughs, and successful startups in a range of other sectors, including offshore wind, wave and tidal power, low-carbon and green materials, cellulosic biofuels, and wood pellets and other biomass sources. It is that diversity that will continue to attract the best students, entrepreneurs, financiers, and policy experts from across the country and around the world – and

keep Massachusetts-educated talent seeking to stay in the state. Ultimately, Massachusetts' greatest clean-energy leadership is as a birthplace of ideas.

## Strategy and Recommendations

In order to best leverage its strengths and overcome its biggest barriers to advance its already strong clean-energy leadership, we recommend nine key actions that the state should take:

### 1. Establish an energy-efficiency innovation center and pursue a national Department of Energy (DOE) laboratory.

The presence of a high-profile, multiple-stakeholder center for research in efficiency technologies would help attract targeted funding and cement the state's stature as a world hub in this sector. A Massachusetts-based national DOE lab is the optimum scenario. The state is already applying for the DOE's Energy Efficient Building Systems Design Energy Innovation Hub – one of three such new hubs announced in December 2009. The hub will be the core of a $129.7 million federal Energy Regional Innovation Cluster – exactly what Massachusetts needs.

### 2. Adopt aggressive financial incentives for clean energy.

Massachusetts is already taking a number of key steps to finance clean energy in the state, most notably its RPS solar carve-out program, which took effect in 2010. The state must closely monitor the results of this program to ensure it is on pace to meet the state's solar deployment targets. Other potential incentives for solar and other technologies include a well-structured, carefully calibrated feed-in tariff and production and/or investment tax credits for clean-energy projects.

### 3. Establish a Massachusetts "Green Bank" to accelerate funding for clean-energy and energy-efficiency startups and projects.

We believe that an independent, government-sponsored enterprise that provides loan guarantees, debt instruments, and other financing tools to stimulate private-sector lending and investments in clean energy can work on the state level. We recommend that Massachusetts become the first state to do this. Policy analysts say a Green Bank can leverage public spending by 10x to 20x – a $10 million state outlay could attract $100 million to $200 million in private capital. This could help engage the state's large traditional financial players in the clean-energy space where they have not been active to date, address the shortage of seed-stage investments, and help keep capital within the state for local projects, companies, and job creation.

### 4. Continue to increase commercialization of clean-energy research advances.

The gap from lab innovation to market commercialization is a key clean-energy weakness in Massachusetts. The state took a big step to address this in March 2010 with the launch of the Company Catalyst Program, which brings MassCEC funds to the Massachusetts Technology Transfer

Center (MTTC) with the specific goal of commercializing clean-energy technologies. It is a great step and we recommend that the state continue to focus additional resources in this area, and explore the possibility of a creating a fulltime clean-energy technology transfer position to oversee this critical area statewide.

### 5. Institute an on-bill repayment system for energy-efficiency enhancements.

On-bill repayment allows a state's residents and small businesses to pay off the cost of energy-efficiency enhancements over several years through a monthly charge on their utility bills. It is gaining popularity at the state and city level around the U.S. as an effective mechanism enabling energy-efficiency growth. Massachusetts is already actively exploring this possibility, with a Massachusetts Energy Efficiency Advisory Council working group studying the issue. We recommend that the state work with its utilities to implement such a system.

### 6. Boost regulations for building efficiency.

Massachusetts is a national leader in this area, but should go even further. The state should join California in mandating statewide energy performance scoring (EPS) – an energy-usage audit whenever a building is sold. And Massachusetts should improve its contractor certification requirements for clean-energy and energy-efficiency installers, such as making the North American Board of Certified Energy Practitioners' solar PV installer certification mandatory rather than voluntary.

### 7. Streamline and hasten the local permitting process for clean-energy projects.

Many clean-energy developers continue to be frustrated by delays in permitting at the local level in Massachusetts. The Oceans Act of 2008 was a good first step for offshore wind. The legislature should pass the pending Wind Energy Siting Reform Act for onshore wind, and the state should consider similar streamlining efforts for other clean-energy projects.

### 8. Take carbon-reduction leadership to the next level: nationwide.

Massachusetts' aggressive greenhouse gas reduction targets, its success to date, and its active participation in RGGI give the state a powerful platform. Massachusetts officials can continue to lead by stepping up and speaking out about the economic payoffs of carbon reduction – for the nation and for other individual states as well.

### 9. Play to the state's strengths.

Clean energy is a highly diverse industry and no one state or region can lead in all of its sectors. The best strategy is to pick your strengths and focus policies and resources on those. Massachusetts' three key areas of focus should be energy efficiency, solar PV including thin-film, and advanced batteries/energy storage. Although the state should seek to attract and retain manufacturing where

possible, it should mainly focus on extending its leadership as a hub of research breakthroughs and innovation excellence in clean-energy technologies and business models. This globally influential, innovation-centric approach will continue to create high-level scientific, technical, and business management jobs, as well as thousands of green collar jobs in installing, operating, and maintaining these technologies.

# INTRODUCTION

Without question, Massachusetts is one of the top clean-energy leaders in the United States. The Bay State is home to a robust range of assets for building a clean-energy economy, including world-class university and research resources; strong state government leadership; solid venture capital investment; and a rich heritage of entrepreneurialism and technology development. Particularly in the past three years, the state has elevated clean energy to one of its top economic development priorities, along with high tech and biotechnology, with a range of public policy advances and financial levers. Among other initiatives, the Green Communities Act, the Green Jobs Act, and the Global Warming Solutions Act have clearly cemented the state's position as a national leader in smart, proactive policies promoting clean-energy development.

Around the U.S. and beyond, Massachusetts enjoys a reputation as a robust hub of clean-energy innovation and wealth creation. To cite just one example, the Cambridge-based New England Clean Energy Council has been named one of the top 10 clean-tech cluster organizations in the world for 2010 by Sustainable World Capital, an Atlanta-based firm that facilitates investments in clean-energy and sustainability companies.

*Around the U.S. and beyond, Massachusetts enjoys a reputation as a robust hub of clean-energy innovation and wealth creation*

Our primary and secondary research for this report bears this out. Our ranking matrix of the Top 15 clean-energy states – assessing those states' strengths and weaknesses in 56 categories of regulatory and financial policy, knowledge capital, and economic development – puts Massachusetts in second place among all U.S. states, behind only California. In our interviews with 21 key Massachusetts clean-energy leaders and principals in government, industry, academia, advocacy, research, and finance, we asked each one to give the state two different grades from a low of 1 to a high of 10. On the metric of where the state rates in clean-energy leadership compared to other states, the average grade was an excellent 7.9. But on the question of how Massachusetts performs compared to where they think it could or should be, the average grade dropped to 5.8.

Clearly there is no time to rest on any laurels – not when competing with states across the U.S. and regions around the world for talent, jobs, and funding in what we believe is the key economic-growth sector of the 21st century. There is no question that Massachusetts can improve its clean-energy stature and improve its growth in job and wealth creation, carbon emissions reduction, and technology innovation.

In this report, we map out paths for the state to do that. After examining Massachusetts' top clean-energy assets and barriers/weaknesses, we delve into the Leadership Scorecard, a detailed analysis of how Massachusetts and the other Top 15 states measure up in Regulatory Incentives and Drivers, Financial Incentives and Drivers, and Knowledge Capital and Economic/Workforce Development. We then present a Nine-Point Action Plan, outlining policy recommendations and specific steps that the state can take to continue driving its clean-energy economy forward – and perhaps move up in any future state rankings.

# CLEAN-ENERGY STATE LEADERSHIP SCORECARD

To create Clean-Energy State Leadership Scorecard, Clean Edge first analyzed all 50 states for a range of clean-energy initiatives and activities, from overall clean-energy patent and investment activity to clean-tech supportive policies and institutions. This analysis enabled Clean Edge to cull the list down to the Top 15 states. After narrowing the list, Clean Edge evaluated the Top 15 states in 56 different categories. All categories were weighted equally to come up with our Top 15 ranking of CA, MA, OR, CO, NJ, CT, NY, MD, WA, MN, AZ, IL, FL, PA, and TX. California, Massachusetts and Oregon topped the list, meeting 86 percent, 80 percent, and 77 percent of our criteria respectively. No. 15 Texas, by comparison, rated positively in only 36 percent of our categories. Detailed definitions of each category can be found in the report's Appendix on page 49. The report presents in-depth discussions and analysis of the results in each sub-section of the matrix beginning on page 23 in the Leadership Scorecard section.

It's important to note that this report, and all of the state-by-state matrix data within it, represents a snapshot of the Massachusetts and U.S. clean-energy landscape in April 2010. This is a fast-moving sector on both the industry and policy fronts, and things can change on a weekly basis or faster. As just one example, during the final preparation of this report, Colorado Gov. Bill Ritter signed a bill raising his state's renewable portfolio standard (RPS) mandate from 20 percent to 30 percent by 2020 – the most aggressive in the nation.

States across the country are clearly vying for clean-energy leadership, continuing to push the envelope on policy and economic development initiatives. One year or even six months from now, the Leadership Scorecard could look significantly different. Today's leaders can quickly become tomorrow's laggards, and vice versa. It is imperative that Massachusetts, while celebrating its deserved successes, continue to push forward and seek new aggressive, innovative strategies and policies that will advance its position as a leading clean-energy state.

While this is not a definitive, weighted ranking, it provides an important and valuable benchmarking on states' performance. See matrix research on the following two pages.

REGULATORY INCENTIVES AND DRIVERS

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **STANDARDS** | | | | | | | | | | | | | | | |
| Appliance/Equipment Efficiency Standards Beyond Federal | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | | | | |
| Contractor Certification | ● | ● | ● | | | ● | | ● | | | ● | | ● | | |
| Energy Efficiency Resource Standard | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | ● | | ● | ● |
| Procurement Mandates | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | |
| Renewable Energy/Energy Efficiency Technology Certification | ● | | ● | | | | | | | ● | ● | | ● | | |
| Statewide Renewable Fuel Standard | ● | ● | ● | | | | | | ● | ● | | | ● | ● | |
| **BUILDING CODES** | | | | | | | | | | | | | | | |
| Current Building Energy Codes Meet or Exceed Latest IECC and ASHRAE Standards | ● | ● | | | | | | ● | | | | ● | | ● | |
| LEED Green Building Requirements for State-Owned Buildings | ● | ● | ● | ● | ● | ● | | | ● | | ● | ● | ● | | |
| Mandated Energy Performance Scoring Statewide for Residential or Commercial Buildings | ● | | | | | | | | | | | | | | |
| Mandated Energy Efficiency Improvements for State-Owned Buildings | ● | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **UTILITY REGULATIONS** | | | | | | | | | | | | | | | |
| Decoupling | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | | |
| Public Benefit Fund | ● | ● | ● | | ● | ● | ● | | | ● | ● | ● | | ● | |
| Cost Recovery Other Than Public Benefit Fund | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Smart Meters Penetration Greater Than 5% of State's Electric Meters | | | | | | | | | | | | | ● | ● | ● |
| Standardized Power Purchase Agreement | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | | | ● | ● |
| Strong Interconnection Law/Policy | ● | ● | ● | ● | ● | | ● | ● | | | | ● | | ● | |
| Strong Net-Metering Law/Policy | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ● | ● | |
| **RENEWABLE PORTFOLIO STANDARD** | | | | | | | | | | | | | | | |
| 20% or Higher by 2020 or Earlier; or 25% by 2025 | ● | ● | ● | ● | ● | ● | ● | | | ● | | ● | | | |
| Enforceable | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | | | ● | ● |
| Incentives | | | | ● | | | | | | | | | | | |
| Inclusion of Set-Asides | | ● | | ● | ● | | ● | ● | | ● | ● | ● | | ● | |
| No Clean Coal or Nuclear Power | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● |
| No Large Scale Hydro (30 MW or Greater) | ● | ● | | ● | ● | ● | ● | ● | | | ● | | | | ● |
| Penalties | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | | | ● | ● |
| **CARBON REDUCTION COMMITMENT** | | | | | | | | | | | | | | | |
| Climate Action Plan | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | |
| GHG Reduction Target Using 1990 Levels or Better by 2020 or Earlier | ● | ● | ● | | ● | ● | ● | | ● | | | ● | | | |
| GHG Reduction Targets Mandated by Law | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | |
| Membership in Regional Climate Initiative | ● | ● | ● | | ● | ● | ● | ● | ● | ● | | ● | | | |
| **SOLAR AND WIND EASEMENT AND ACCESS LAWS** | | | | | | | | | | | | | | | |
| Solar | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | | |
| Wind | | | ● | ● | ● | | | | | ● | | | ● | | |

FINANCIAL INCENTIVES AND DRIVERS

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMMERCIAL TAX INCENTIVES** | | | | | | | | | | | | | | | |
| Investment Tax Credit | | | ● | | | | ● | ● | | | ● | | ● | | |
| Production Tax Credit | | | | | | | | ● | ● | | | | ● | | |
| **RESIDENTIAL AND INDIVIDUAL TAX INCENTIVES** | | | | | | | | | | | | | | | |
| Income Tax Exemption or Reduction | | ● | ● | | | | ● | ● | | | ● | | | | |
| Property Tax Exemption or Reduction | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | | ● |
| Sales Tax Exemption or Reduction | | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | |
| **INVESTMENT ACTIVITY** | | | | | | | | | | | | | | | |
| State Equity Fund | ● | ● | | | | ● | | | | | | | ● | ● | |
| Venture Capital and Other Private Investment ($400M+, 2007-09) | ● | ● | ● | ● | | ● | ● | ● | | | | ● | | | |
| Venture Capital and Other Private Investment (30+ Deals, 2007-09) | ● | ● | | ● | | | | | | | | | | | ● |
| **UTILITY INCENTIVES** | | | | | | | | | | | | | | | |
| Renewable Energy and/or Energy Efficiency Loans Offered by More Than 5% of Utilities | ● | ● | ● | ● | | ● | | | ● | | | | ● | | |
| Renewable Energy and/or Energy Efficiency Rebates Offered by More Than 20% of Utilities | ● | ● | ● | ● | | ● | | ● | ● | ● | | | ● | | |
| State Performance Incentives for Utilities | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ● | | | |
| **LOAN/CASH INCENTIVES** | | | | | | | | | | | | | | | |
| Direct Loan Programs | ● | ● | ● | | ● | ● | ● | ● | ● | ● | | | ● | ● | ● |
| Grant Programs | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● |
| Loan Guarantees | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| PACE Financing Program and/or Legislation | ● | | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | | ● |
| On-Bill Repayment Mandate | ● | ● | ● | | ● | ● | | | ● | | | ● | | | |
| Renewable Energy Certificate Incentives | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | ● |
| Statewide Feed-In Tariff Program or Legislation | ● | | ● | | | | | | ● | | | | | | |

KNOWLEDGE CAPITAL AND ECONOMIC/WORKFORCE DEVELOPMENT

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **KNOWLEDGE CAPITAL** | | | | | | | | | | | | | | | |
| At Least One Global Top-Ranked Green MBA Program | ● | ● | ● | ● | | ● | ● | ● | ● | | ● | ● | | ● | ● |
| Campus Climate Commitment Member (20% or More) | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | | | |
| Innovative Clean Energy Academic Programs (5% or More) | ● | ● | ● | ● | | | | | | | ● | | | | |
| Top-Ranked Overall Green Universities (10% or More) | ● | ● | ● | ● | ● | ● | ● | | ● | | | | | | |
| **ECONOMIC/WORKFORCE DEVELOPMENT** | | | | | | | | | | | | | | | |
| Clean-Energy Jobs as a Percentage of Total Jobs (0.5% or More of State Total) | ● | ● | ● | ● | ● | | | | ● | ● | | | | ● | |
| Clean-Energy Patents Registered (3% or More of U.S. Total, 2002-09) | ● | ● | | | ● | ● | ● | | | | | ● | ● | | ● |
| Presence of a Clean Energy Alliance Business Incubator | ● | | | | ● | | ● | | | | | | ● | | ● |
| Presence of a Department of Energy National Lab | ● | | ● | ● | ● | | ● | | ● | | | ● | | ● | ● |

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total Marks** | 48 | 45 | 43 | 35 | 35 | 34 | 34 | 32 | 32 | 30 | 28 | 28 | 24 | 24 | 20 |
| **Percent of Total Marks Possible** | 86% | 80% | 77% | 63% | 63% | 61% | 61% | 57% | 57% | 54% | 50% | 50% | 43% | 43% | 36% |

## Report Methodology

For *A Future of Innovation and Growth*, Clean Edge used a comprehensive research methodology including external interviews and primary and secondary research. The report is based on:

- Expert interviews. We spoke with more than 20 interviewees representing a range of interests in Massachusetts including industry, government, finance, research, and academia. These one-on-one interviews explored Massachusetts' strengths and weaknesses; past and current policy, financial, and academic initiatives; and opportunities for the state to move forward in clean energy.
- Detailed matrix analysis. We reviewed more than 200 sources in evaluating and benchmarking Massachusetts against the Top 15 states. This analysis resulted in 56 separate criteria on which we evaluated and ranked the top states.
- Online research of technology, financial, and policy news and announcements in Massachusetts and throughout the U.S.

*Interview participants in alphabetical order: (affiliations listed represent those held at the time interviews were conducted)*

Bill Aulet
*MIT Entrepreneurship Center*

Abi Barrow
*Massachusetts Technology Transfer Center*

Howard Berke
*Good Energies/Konarka*

Ian Bowles
*Commonwealth of Massachusetts*

Patrick Cloney
*Massachusetts Clean Energy Center*

Nicholas D'Arbeloff
*New England Clean Energy Council*

Rob Day
*Black Coral Capital*

John deVillars
*BlueWave Strategies*

Gregg Dixon
*EnerNOC*

Eric Emmons
*Siemens Venture Capital*

Andrew Friendly
*Advanced Technology Ventures*

Dan Goldman
*Great Point Energy*

B. Eric Graham
*Fraunhofer Center for Sustainable Energy Systems*

Berl Hartman
*Environmental Entrepreneurs*

Marc Hoffman
*Consortium for Energy Efficiency*

Stan Kowalski
*FloDesign Wind Turbine*

Galen Nelson
*Boston Redevelopment Authority*

Bic Stevens
*Stevens Capital Management*

Hemant Taneja
*General Catalyst Partners*

Susan Tierney
*Analysis Group*

David Vieau
*A123 Systems*

# MASSACHUSETTS ASSETS AND BARRIERS

As befits its position of leadership, Massachusetts enjoys an abundance of key assets that support the state's intentions and successes in growing its clean-energy economy. The state also has weaknesses in some areas – barriers that will need to be overcome for Massachusetts to significantly advance its clean-energy leadership. Our interviews and research uncovered seven major assets and seven significant barriers or weaknesses.

| Strengths/Assets | Weaknesses/Barriers |
|---|---|
| World-Class Academic, R&D, and Innovation Resources | High Costs of Living and Energy (high overhead for manufacturing) |
| Deep Commitment to Energy Efficiency | Innovation-to-Commercialization Gaps |
| Strong Government Leadership and Policy Support | Limited Natural Resources for Clean Energy |
| Robust Venture Capital Resources | Local-Rule Tradition/Permitting Delays/NIMBYism |
| High Energy Demand and Costs (easier for renewables to compete on price, good incentives for conservation/efficiency) | Risk-Averse Financial Community |
| Highly Educated Workforce | Lack of a National Energy Laboratory |
| Green-Minded, Supportive Citizenry | Limited Clean-Energy Manufacturing Infrastructure |

## Top State Clean-Energy Assets

### WORLD-CLASS ACADEMIC, R&D, AND INNOVATION RESOURCES

Clearly topping the list of Massachusetts' clean-energy assets are its second-to-none university, research, and innovation resources. Virtually every expert we interviewed cited this strength, and usually cited it first. The "education capital of the world," in the words of one interviewee, feeds the Massachusetts clean-energy economy with research breakthroughs, business ideas, and workers skilled in engineering, materials sciences, biochemistry, entrepreneurship, policy expertise, and many other relevant disciplines.

MIT is clearly the leader in this area and the envy of other regions vying for clean-energy leadership. "We need an MIT," said one Pacific Northwest principal in a 2008 Clean Edge/Climate Solutions report, *Carbon-Free Prosperity 2025*, which examined that region's clean-energy leadership. MIT also earned kudos from interviewees for allying more with other institutions than it has in the past; Fraunhofer USA's Center for Sustainable Energy Systems at MIT, launched in 2008 to focus on advanced research in solar and building efficiency technologies, is a prime example.

But Massachusetts' innovation resources extend far beyond MIT's Cambridge campus. Harvard, Boston University, Western New England College, UMass campuses in Amherst, Boston, Dartmouth,

and Lowell, and dozens of other universities and business schools throughout the state combine to form a rich resource, with new clean-energy-related curricula and activities springing up on a regular basis. On The Aspen Institute's 2009 ranking of the world's Top 100 Green MBA programs, Massachusetts is particularly strong with seven programs: Babson, Bentley, Boston College, BU, Brandeis, MIT, and UMass-Boston. And the Bay State's campuses 'walk the walk' as well; Harvard's 20 LEED-certified buildings and renovation projects – spawning "Green is the New Crimson" banners in Harvard Yard – are the most of any higher-education institution in the world.

### DEEP COMMITMENT TO ENERGY EFFICIENCY

Massachusetts' extreme winter and summer climates, older building stock, and high energy prices (see section below) make it a perfect place to realize the benefits of energy efficiency, and the state has responded with efficiency leadership by its public officials, industry, and utilities. Home to such efficiency pioneers as EnerNOC, Conservation Services Group, and Next Step Living, the Bay State is a clear national leader in this fast-growing, labor-intensive, job-creating sector.

Among many progressive policy initiatives, the 2008 Green Communities Act's least-cost procurement mandate requires that the state's utilities invest in all energy-efficiency deployments deemed cheaper than new supply. As a result, the state's investor-owned utilities are expected to spend $1.3 billion on efficiency in the next three years.

### STRONG GOVERNMENT LEADERSHIP AND POLICY SUPPORT

Governor Deval Patrick's administration has clearly made clean energy a top priority, establishing the Massachusetts Clean Energy Center (MassCEC) and working with the legislature to pass a great deal of supportive legislation, most notably the Green Communities Act, the Global Warming Solutions Act, and the Green Jobs Act. Secretary of Energy and Environmental Affairs Ian Bowles earns high leadership marks from this report's interviewees, as does Department of Energy Resources Commissioner Philip Giudice, a former senior VP at EnerNOC. Massachusetts was the first state to consolidate energy and environmental affairs into one cabinet post, a move that many feel should be a model for other states, and ultimately the nation.

"Clean-tech leaders have great access to the secretary and the governor," said one respondent. "You'd be hard-pressed to find a group as dedicated as this one," said another. Massachusetts has also been a leader within the Northeast's Regional Greenhouse Gas Initiative (RGGI), and the state's representatives in Congress, most notably Rep. Edward Markey and Sen. John Kerry, have been top clean-energy leaders on the national stage. In ARPA-E grants for R&D announced in October 2009, Massachusetts companies received 23 percent of these available federal stimulus dollars. Massachusetts officials, competing with California in a Red Sox/Yankees-like rivalry, enjoy pointing out that this was well ahead of California's 14 percent.

### ROBUST VENTURE CAPITAL RESOURCES

Massachusetts has a rich venture-capital heritage from Route 128's high-tech heyday in the 1980s, and in clean energy, its VC community and funding levels are the envy of every other state except one: California. From 2007 to 2009, Massachusetts' clean-energy companies lured $1.1 billion in VC and private investment deals, well ahead of third-place New York's $855 million, according to

Bloomberg New Energy Finance data. Not surprisingly, California led the field by a wide margin with $7 billion.

Pioneering Massachusetts venture firms like RockPort Capital Partners, Flybridge Capital Partners, Advanced Technology Ventures, @Ventures, General Catalyst Partners, and Braemar Energy Ventures give Massachusetts' clean-energy entrepreneurs a strong resource from which to draw. Many interviewees, however, feel that Massachusetts VCs have become too risk-averse and less willing to lead with new ventures, particular at early stages of funding. We address this in more detail in the Top State Barriers section on page 17 and the 9-Point Action Plan discussion on page 44.

*High kilowatt-hour prices also greatly incentivize energy savings through efficiency and conservation*

### HIGH ENERGY DEMAND AND COSTS

Because of the climate issues noted in the efficiency section above, Massachusetts and its surrounding region create high energy demand. On top of that, with few local conventional, fossil-fuel energy resources, Massachusetts' and New England's electric grid relies heavily on fuels piped in from outside the region: natural gas and oil. A very low percentage of coal in New England's energy mix – less than nine percent in 2009, according to ISO New England – is good news for regional carbon emissions. But it means that nearly two-thirds (63 percent) of the region's electricity comes from two of the most expensive and volatile power sources in the nation, natural gas (38 percent) and oil (25 percent) – giving Massachusetts some of the highest electric rates in the U.S.

Why is this an asset? It means that in Massachusetts, clean-energy sources like wind and solar – with their costs generally declining over time – can more easily compete with natural gas and oil to reach grid parity. High kilowatt-hour prices also greatly incentivize energy savings through efficiency and conservation, another key to Massachusetts' leadership in that area.

### HIGHLY EDUCATED WORKFORCE

The combination of the rich academic assets discussed above, and the high quality of life offered in New England, gives Massachusetts' clean-energy sector a local workforce that's well trained in relevant skills. Some 40 percent of people earning PhD degrees from MIT, for example, choose to stay in the state. "The sheer amount of brainpower in places like Cambridge and Amherst is impressive," said one interviewee. The state has "a very rich and deep strength in technology skills," said another. And beyond its residents with four-year and graduate degrees, the state is working to train community college students and low-income residents in clean-energy skills like solar panel and weatherization installation with programs like Pathways out of Poverty.

### GREEN-MINDED, SUPPORTIVE CITIZENRY

Despite notable pockets of NIMBYism that we will discuss next in the Barriers section, Massachusetts residents are generally quite supportive of clean energy and carbon emissions reduction. An overwhelming 67 percent of Bay State voters support a national cap-and-trade system, with just 21 percent opposed, according to a Benenson Strategy Group poll taken in January 2010 just after Republican Scott Brown's victory in the state's special U.S. Senate election. In the poll, Massachusetts Republicans supported cap-and-trade by 47 to 38 percent, and those who voted for Brown favored it by a 50-36 percent margin.

Massachusetts' long history of environmental awareness and activism has been a double-edged sword at times, pitting local 'enviros' against clean-energy project developers. But the false dichotomy of environment vs. *economy* that's present in many states is generally not the prevailing view in Massachusetts. The message that clean energy is a key part of the state's economic future has resonated with the public, and that has helped the state's political leadership move ahead on many clean energy fronts – even in a recessionary, tight-budget period.

## Top State Clean-Energy Barriers

### HIGH COSTS OF LIVING AND ENERGY

Although the high energy costs cited in the Assets section are great incentive for renewables and energy efficiency development and deployment in Massachusetts, they bring a major downside of high overhead for businesses and enterprises of all types. Clean-energy companies, large and small, are no exception. And energy is just one component of a slew of high costs for office and factory space, labor, and housing; Massachusetts is among the most expensive states in the U.S. in all those categories.

This poses challenges for the state in starting, expanding, retaining, and attracting clean-energy companies. "It's hard to launch and grow a business here," one interviewee said bluntly. "It's a high-cost state." It's a particular challenge for clean-energy businesses with labor-intensive, production-line operations, like manufacturers of wind turbines and related components. When Massachusetts competes against lower labor-cost states like Michigan and North Carolina for clean-tech manufacturers, said one respondent, it is a bit like the larger manufacturing competition between the U.S. and China. This barrier is one of several key reasons why we urge Massachusetts to focus on its strength as a leader in high-value innovation, which we discuss in detail in the Clean-Energy Industry Leadership section on page 19.

### INNOVATION-TO-COMMERCIALIZATION GAPS

No one questions Massachusetts' bona fides in clean-energy research talent and engineering advances in its labs and universities, from thin-film solar and demand-side management systems to energy storage, cellulosic biofuels, wind turbine blade design, electric vehicle batteries, and scores of other important technologies. But too often, these lab breakthroughs never "break through" to commercial success. Interviewees blamed a range of factors for this, among them risk-averse local financiers, lack of university-entrepreneurial partnerships, and an overall academically focused research culture.

Some experts that we surveyed pointed to California and Silicon Valley as a much better model for bringing innovation from lab to market. "Academics here do not have the same tradition of turning innovations into commercial products," said one expert. "It's just a lack of that culture. They actively distrust venture capitalists, and [breakthroughs] sit on the shelf here." Many interviewees agreed. "We have the best resources for developing new technologies, bar none," said another. "But we're lacking in building out test beds and getting to commercialization."

## LIMITED NATURAL RESOURCES FOR CLEAN ENERGY

Falling squarely in the "through no fault of its own" category, Massachusetts is a small state with comparatively limited resources for solar energy, onshore wind power, geothermal, and biomass. For onshore wind especially, there just isn't much open space; Massachusetts ranks third behind only New Jersey and Rhode Island in population density among the 50 states. (Only four of the Top 15 are small states: Massachusetts, New Jersey, Connecticut and Maryland). So Massachusetts is not the place where we'll see large, utility-scale wind or solar deployments of the type in California, Texas, and the Midwest. Compared with other states and regions, Massachusetts' best clean-energy resources are in two sectors still nascent and largely untapped in the U.S. today: offshore wind and wave/tidal power. The Marine Renewable Energy Center on UMass-Dartmouth's campus in Fall River focuses on R&D in those sectors.

It should be noted, however, that the absence of Arizona or California-caliber solar resources need not thwart the development of a thriving, job-creating solar industry. Germany, the world's largest solar PV market, has proven that. Massachusetts should continue to expand its focus on innovation and deployment in solar.

## LOCAL-RULE TRADITION/PERMITTING DELAYS/NIMBY-ISM

There's no question that some clean-energy deployments are environmentally harmful and should not be sited, but in the opinion of many, Massachusetts has taken this opposition to the extreme. A combination of New England's strong town-government system, local environmental activism, and the plain old 'not in my backyard' (NIMBY) syndrome has frustrated many clean-energy developers in the state. Even though the state's citizenry strongly supports clean-energy growth in general, specific local projects can be another story. "A lot of people may want a project but a few don't, and our distributed governance model makes it fairly easy for them to stop or delay it," said one expert.

***Many experts say Massachusetts-based VCs and other investors are falling even farther behind as risk-takers***

Local opposition to the massive offshore Cape Wind project in Nantucket Sound is the most prominent example, known the world over, but many other smaller-scale projects in Massachusetts have also faced significant delays. The 12 megawatt (MW) Minuteman Wind project in the Berkshires took six years for approval. Opposition to Madera Energy's 47 MW combined heat and power biomass plant in Greenfield has helped lead to a 2010 statewide ballot measure that would severely limit CO2 emissions from biomass plants. A single 600 kilowatt (kW) wind turbine in a Newburyport industrial park took more than three years from proposal to operation. It's no coincidence that the nation's leading anti-wind coalition, National Wind Watch, is based in Massachusetts. Some frustrated clean-energy developers say that things have gone beyond NIMBY to an even more colorful acronym, BANANA – "build absolutely nothing anywhere near anything." State clean-energy leaders acknowledge this barrier and have started legislative actions, including the Ocean Act (passed in 2008) to ease offshore wind development, and the Wind Energy Siting Reform Act (pending in the legislature) to streamline permitting for onshore wind.

### RISK-AVERSE FINANCIAL COMMUNITY

Massachusetts is rightfully proud of its status as the No. 2 state for clean-energy venture capital, behind California. But it is a distant second, and many experts say Massachusetts-based VCs and other investors are falling even farther behind as risk-takers backing new, leading-edge ventures in the state. As one example, the three VC firms funding FloDesign Wind Turbine, the promising Wilbraham-based wind innovator, are all Silicon Valley firms, including Kleiner Perkins Caufield & Byers. "There's a large pool of capital here," said one interviewee, "but not enough seed-stage funding is getting done."

Another big barrier is the absence of the large traditional Boston institutional finance players, like Fidelity Investments, State Street Bank, and the state's pension funds, in clean-energy investing. "It's not just a lack of money – you just don't see them," said one respondent. "They're not even surveying the landscape."

### LACK OF A NATIONAL ENERGY LABORATORY

As discussed above in the Assets section, Massachusetts boasts world-class clean-energy research resources in its universities and other institutions. The one big omission in its research arsenal is the lack of a national Department of Energy (DOE) research lab. Nine of the Top 15 states, and six of the top eight, have at least one such DOE lab within their borders. "It would be a good focus of funding and job creation," said one respondent. But the state is already moving actively to rectify this weakness, with MIT, UMass, Fraunhofer Institute, and the MassCEC joining forces to apply for DOE's planned $122 million Energy Innovation Hub for designing energy-efficient building systems, one of three such hubs announced by Secretary of Energy Dr. Steven Chu in December 2009.

### LIMITED CLEAN-ENERGY MANUFACTURING INFRASTRUCTURE

From shoes and textiles to computers and disk drives, Massachusetts has seen many waves of manufacturing begin in the state and then move elsewhere. The clean-energy industry, just growing up now, is not likely to establish a significant presence for large-scale manufacturing here. It may have been possible five or more years ago, but today, with heated global competition to build local and regional clean-tech economies, the state's high costs (discussed in the first Barrier above) make it unrealistic to compete with Ohio or China for large-scale production facilities.

The state can rightly point to some great individual success stories – Konarka manufacturing solar PV thin film, for example, at a former Polaroid plant in New Bedford. And there is no lack of potential for clean-energy job creation at all levels, from advanced materials research to home weatherization installation. "We should just keep priming that engine of innovation, bring all the R&D jobs that we can," said one expert. "But promising vast numbers of manufacturing jobs here is not being in touch with the new world order."

# LEADERSHIP SCORECARD: MASSACHUSETTS IN THE TOP 15 CLEAN-ENERGY STATES

In this section of the report, we explore Massachusetts' current clean-energy leadership in detail. What specific policies and actions have made the state a leader, and how does it stack up against other leading states in a wide range of policy, financial, and economic development criteria? Before examining the national clean-energy leadership landscape uncovered by the research in our state-by-state comparison matrices, we begin with a discussion highlighting the key facets behind Massachusetts' rise to a prominent position in the clean-energy sector.

Some states' claims to clean-energy fame come mainly from growth and excellence in one sector, such as Texas and Iowa in wind energy or New Jersey in solar power. Massachusetts is not like that. Its leadership is broad and diverse, covering a wide swath of clean technologies under the very large umbrella of innovation. Its leading clean-energy players – as seen by this report's interviewees and industry experts around the world – may not be the largest developers or manufacturers, but are considered leading technology pioneers in their sectors.

Companies like A123 Systems in advanced electric batteries, EnerNOC in efficiency and demand-side management, Konarka in organic photovoltaics, Beacon Power in flywheels, and General Compression in large-scale energy storage are all considered top innovators. Some of these firms, and dozens more clean-energy players in Massachusetts, grew out of university research in the state whose academic resources and intellectual capital are widely regarded as second to none. As one interviewee put it succinctly: "We have a lot of smart people."

Although Massachusetts boasts a wide array of clean-energy prowess at academic institutions across the state, MIT is its unquestioned leader. Sustainable World Capital named MIT the No. 1 clean-tech university in the U.S. in its 2010 rankings, calling the venerable Cambridge campus "a true clean-tech spinoff machine." MIT's clean-energy impact goes far beyond its world-class training of engineers. The $200,000 MIT Clean Energy Prize for students is the most coveted of its kind in the U.S.; 113 teams from 40 universities across the country entered the competition in 2009. The MIT Energy Initiative, with the motto "linking science, innovation, and policy to transform the world's energy systems," was founded in 2006. MIT pioneered business-plan competitions in clean energy, and its Ignite Clean Energy Competition recently partnered with California's similar Cleantech Open effort to create the first true nationwide competition. The MIT Entrepreneurship Center, founded in 1990, now has a strong focus on clean-technology businesses. The list goes on, and MIT continues to launch key research initiatives in solar, energy efficiency, and other areas.

## Innovation in the Statehouse

But innovation doesn't only occur in university research labs or corporate conference rooms. Governments also can and should think and act in new, innovative directions, especially regarding relatively new sectors like clean energy, and Massachusetts' public leaders and policymakers have

done that. Governor Deval Patrick, Secretary of Energy and Environmental Affairs Ian Bowles, and Department of Energy Resources Commissioner Philip Giudice all earn generally high marks for leadership on clean energy from this report's interviewees. Among the state's key advances under their stewardship are:

- Consolidating energy and environment under Bowles in one Cabinet post, the first state in the nation to do that.
- Instituting the nation's first exemption from a state gasoline tax for cellulosic biofuels.
- The Global Warming Solutions Act, which many consider the strongest greenhouse gas (GHG) reduction act in the U.S., mandating a 10 to 25 percent reduction from 1990 levels by 2020 and 80 percent by 2050. A February 2010 analysis by Eastern Research Group in Lexington, Mass., projected that the state is on target to reduce statewide emissions by 18.6 percent by 2020.
- Establishment of the MassCEC under the Green Jobs Act of 2008. MassCEC is the first state authority in the U.S. exclusively devoted to job creation and economic development in the clean-energy sector.
- The Green Communities Act, which includes one of the nation's most aggressive energy-efficiency programs with $2 billion in public and private investments – three times more per capita than the amount invested in California. Massachusetts also established a "stretch" goal for cities and towns to set building efficiency standards 20 to 30 percent higher than the statewide building code.
- Joining and leading within RGGI. The Northeast's regional cap-and-trade system has generated $79 million in carbon credits to date for Massachusetts – with most of the money going to further investments in efficiency.
- Continuing to fund and sometimes expand these programs through a major economic downturn with severe pressure on state budgets.

## The Crown Jewel: Energy Efficiency

Government policy leadership on energy efficiency makes sense, as this sector is a natural fit for the state. Massachusetts (and most of New England) is blessed – some might say cursed – with an ideal set of factors that make energy savings attractive. Its legendary cold winters and often hot, humid summers create high demand for heating or cooling roughly eight months of the year. Electric rates and heating oil prices are high. The aged building stock is often poorly insulated. All these factors make Massachusetts a ripe area for the sector that many call clean-tech's "low-hanging fruit:" conservation and efficiency. A large majority of this report's interviewees agree that the state should continue to focus economic development efforts in this area, including the pursuit of a U.S. DOE national lab for efficiency technologies.

Gov. Patrick agreed to lend his name to a key private-sector efficiency initiative, the Governor's

Clean Energy Challenge, launched by the New England Clean Energy Council in 2009. This challenge asks Massachusetts-based enterprises to reduce their GHG emissions by at least 10 percent over the next three years. Participants receive free on-site energy assessments, access to a large network of relevant in-state vendors, and significantly, reimbursement of 30 to 70 percent of project costs from their utilities. More than 100 enterprises have joined, including the Boston Symphony Orchestra, General Dynamics, MassMutual Financial Group, and the Lowell Spinners minor league baseball team.

## The Solar Opportunity

Massachusetts may not come immediately to mind as a sunny state. But many early advances in solar PV were pioneered here, and PV manufacturer Evergreen Solar, despite its up-and-down financial history, remains a Massachusetts clean-energy mainstay after 16 years in the business. After efficiency, solar was the clean-energy sector cited most often by our interview respondents as the state's best opportunity for economic growth and job creation.

Many success metrics in solar have already been achieved. By the end of 2010, Massachusetts solar PV installations are projected to show 18x growth over four years from 3.5 MW to 63 MW. The number of in-state solar installers has quadrupled in 18 months. In solar manufacturing and installation combined, employment in the state doubled in 2008 and increased an additional 50 percent in 2009, according to MassCEC. The state's Commonwealth Solar rebate program, sold out in 2009 and renewed in 2010, offers up to $10,500 in rebates for residential PV systems and up to $5,500 for commercial systems of 5 kW or less.

In the Nine-Point Action Plan later in this report on page 44, we offer specific policy recommendations for Massachusetts to further strengthen its solar industry and installation capacity. But it's clearly a strong sector already, and we expect to see even more startup companies joining a robust roster of Massachusetts innovators that includes Evergreen, Konarka, Solectria, 1366 Technologies, Spire Solar, and Wakonda Technologies.

## Leveraging Innovation: Energy Storage

The third key industry sector showing strong Massachusetts clean-energy leadership is advanced energy storage. It's a fast-growing, increasingly important niche that depends heavily on the type of R&D breakthroughs in which Massachusetts excels. This sector spans a wide range of technologies, from electric-vehicle batteries to utility-scale electricity storage that can help address the intermittency issues of wind and solar power on the grid. Bay State companies such as A123 Systems, Boston-Power, Evercel, General Compression, Premium Power, and others give the state a solid cluster of storage innovation and commercialization, and MIT and other technology education leaders bring considerable focus to this area.

## The Keys to Success: Innovation and Diversity

As we discussed in the Barriers/Weaknesses section, we don't expect Massachusetts to be a leader in large-scale clean-energy manufacturing or deployment. Rather, the state should play to its nation-

leading strength in research, development, and innovation, across a range of clean-energy sectors.

Research centers such as the MassCEC's Wind Technology Testing Center in Charlestown and the Marine Renewable Energy Center (for both wave/tidal and offshore wind technologies) on UMass-Dartmouth's Fall River campus are a testament to this. So are the pockets of excellence across the state in low-carbon and green materials, LED lighting, cellulosic biofuels, wood pellets and other biomass sources, and many other clean-energy niches. Energy efficiency (including smart grid), solar, and energy storage/advanced batteries deserve attention and policy support as key leadership sectors, but not to the exclusion of innovation, breakthroughs, and successful startups in a range of sectors. It is that diversity that will continue to attract the best students, entrepreneurs, financiers, and policy experts from across the country and around the world – and keep Massachusetts-educated talent seeking to stay in the state. Ultimately, Massachusetts' greatest clean-energy leadership is as a birthplace of ideas.

The next three sections of this report analyze the landscape of the Top 15 clean-energy states, and where Massachusetts compares and contrasts, in three broad categories: Regulatory Incentives and Drivers, Financial Incentives and Drivers, and Knowledge Capital and Workforce Capital. Within each category are several sub-categories, with a state-by-state comparison matrix and discussion text.

# REGULATORY INCENTIVES AND DRIVERS

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **RENEWABLE PORTFOLIO STANDARD** | | | | | | | | | | | | | | | |
| 20% or Higher by 2020 or Earlier; or 25% by 2025 | ● | ● | ● | ● | ● | ● | ● | | | ● | | ● | | | |
| Enforceable | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | | | ● | ● |
| Incentives | | | | ● | | | | | | | | | | | |
| Inclusion of Set-Asides | | ● | | ● | ● | | ● | ● | | ● | ● | ● | | ● | |
| No Clean Coal or Nuclear Power | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● |
| No Large Scale Hydro (30 MW or Greater) | ● | ● | | ● | ● | ● | ● | ● | | | ● | | | | ● |
| Penalties | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | | | ● | ● |

## RENEWABLE PORTFOLIO STANDARD

An RPS (also referred to as a renewable energy/electricity standard or RES) is an essential regulatory mechanism for a state to effectively drive clean-energy policy goals. RPS mandates have become such standard and instrumental state clean-energy policy that only one of our Top 15 states, Florida, does not have one. However, an RPS is a relatively complex set of components that needs to be carefully considered and thoughtfully tailored to be effective and meaningful. Below is a discussion of RPS components and how each one relates to the overall strength of a state's RPS mandate.

Overall, Massachusetts has a strong, comprehensive, and smart RPS. In addition to its RPS meeting our percentage thresholds, being enforceable, having low hydroelectric limits, and no clean coal or nuclear allowed, Massachusetts leads the other states in targeting in-state renewable energy generation. Starting in 2010, retail electric suppliers must provide a portion of their load from qualified in-state, interconnected solar facilities. In addition, Massachusetts has a second tier requirement, RPS Class II, that focuses on renewable projects installed prior to 1998 and waste-to-energy projects. The RPS Class II requires utilities to purchase RECs for 3.6% and 3.5% respectively for their load. Massachusetts could improve its standing in the RPS category, however, by providing utilities with incentives, and raising its RPS standard even further to be among the most aggressive.

### RENEWABLE PORTFOLIO STANDARDS BY STATE

| STATE | PERCENT SHARE FOR RENEWABLES | TARGET DATE |
|---|---|---|
| California | 20% | 2010 |
| Massachusetts | 22.1% | 2025 |
| Oregon | 25% | 2025 |
| Colorado | 30% | 2020 |
| New Jersey | 22.5% | 2021 |
| Connecticut | 27% | 2020 |
| New York | 29% | 2015 |
| Maryland | 20% | 2022 |
| Washington | 15% | 2020 |
| Minnesota | 25% | 2025 |
| Arizona | 15% | 2025 |
| Illinois | 25% | 2025 |
| Florida | n/a | n/a |
| Pennsylvania | 18% | 2021 |
| Texas | 5,800 MW | 2015 |

*The RPS information reported in this table is based on official state legislation targets. It does not include governors' executive orders or other nonbinding renewable energy goals, such as California's 33 percent by 2020 target.*

## RPS Goals: Percentage and Date

The first area of consideration in assessing the overall strength and effectiveness of an RPS is the amount of clean energy it demands from utilities as a function of time. In ranking the Top 15 states, we have qualified that an RPS should have minimum percentages and corresponding dates of at least 20 percent by 2020 or 25 percent by 2025 to be considered a leader. In some places, targets are increasing. Colorado recently expanded its RPS to 30 percent by 2020, making it the leading RPS in the nation. And some executive orders, such as Gov. Arnold Schwarzenegger's 33 percent by 2020 in California are driving additional activity, although not in the form of an official RPS.

There is also a push for "smarter" portfolio standard policies, like the one in Massachusetts which not only covers renewable energy, but also establishes an energy efficiency goal that at least 25 percent of the state's electric load by 2020 is met with demand side resources (energy efficiency, load management, demand response, and customer-sited generation). Oregon is another example, with a goal of at least eight percent of retail electric supply to come from small-scale renewable-energy projects (below 20 MW) by 2025.

Another important percentage in evaluating an RPS is the amount of total electricity generation that is actually covered within a state. Minnesota leads the way with 100 percent of its electric supply covered by its RPS, while Arizona's RPS "coverage" is only about 60 percent of generation. That's

because Arizona's RPS applies only to power from rural electric cooperatives and investor-owned utilities – excluding all municipal and publicly owned utilities. Furthermore, Arizona law allows a utility to request a waiver from any provision for "good cause." States should be keenly aware of crafting legislation that covers as close to 100 percent of their utility sector as possible.

## Enforceability and Penalties

In order to ensure genuine efforts toward achieving the percentage and time goals of an RPS, there need to be enforceable penalties for non-compliance. While this is a very simple and logical concept, the reality of implementation can be complicated and difficult. Most of the states we reviewed in this report have enforceable penalties for non-compliance.

In most of the Top 15 states, penalties are issued and enforced by the public utility commissions in the form of alternate compliance payments (ACPs). Generally, the ACP in each state ranges from $45 to $65 per MW of shortfall. In Connecticut, the public utility commission can revoke an electric retailer's license for non-compliance. Arizona is an example of a state with very weak penalties in place. No set penalty amount exists, utilities can request waivers for "good cause," and penalties are arbitrarily enforced by the Arizona Corporation Commission.

## Inclusion of Set-Asides or Carve-Outs

States can influence levels of direct financial investment into specific renewable energy technologies and applications through the inclusion of set-asides or carve-outs in their RPSs. In most cases, this tool is used for solar and distributed generation assets. For example, New Jersey's RPS has a 2.12 percent solar set-aside requirement by 2021. This mandate created a specific type of REC referred to as a solar REC, or SREC. The SRECs have historically traded at a significantly higher value than generic New Jersey RECs, and therefore New Jersey has seen a significant investment into solar projects. According to *NJcleanenergy.com*, there have been 5,189 solar projects in the state from 2001 to January 2010 for a total of 133,205 kW, creating total SRECs worth more than $308 million. States with set-asides or carve-outs for distributed generation systems include Arizona, Colorado, and New York.

## Clean Coal and Nuclear

Currently, no states reviewed in this study include nuclear power in their RPS portfolios. We agree that nuclear does not fit within the definition of clean or renewable energy. A legislative proposal in Arizona to include nuclear in its RPS, which would have essentially meant the state had already reached its RPS target and would need no more solar development, was quickly withdrawn after intense opposition in February 2010.

Only Pennsylvania includes "clean coal" as part of its RPS, which includes waste coal, coal mine methane, and integrated gasification combined cycle. While advanced "clean coal" technologies are incrementally better than conventional coal combustion, they too do not fit within our definition of clean or renewable energy due to the negative environmental impacts associated with extraction of coal, the health issues associated with its handling and emissions, and the fact that it is a finite resource with a limited supply.

## Hydro Power

Some regions, particularly the Pacific Northwest and Ontario, Canada, have very rich hydroelectric power resources. For these regions it makes sense to consider responsibly designed and managed hydro infrastructure as part of a clean-energy resource portfolio. Qualifying hydro power should be certified by a third-party verification organization in order to receive clean-energy status. Hydro power that places a strain on natural fisheries and ecosystems is not part of a sustainable future. Oregon and Pennsylvania require that hydro power be certified as Low Impact Hydro by the independent Low Impact Hydro Institute. New York and New Jersey also require low-impact hydro but they rely on state agencies to make that determination. Nine states in the Top 15, including Massachusetts, simply exclude all large-scale hydro (30 MW or more) from their RPS mix.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CARBON REDUCTION COMMITMENT** | | | | | | | | | | | | | | | |
| Climate Action Plan | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | |
| GHG Reduction Target Using 1990 Levels or Better by 2020 or Earlier | ● | ● | ● | | ● | ● | ● | | ● | | | ● | | | |
| GHG Reduction Targets Mandated by Law | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | |
| Membership in Regional Climate Initiative | ● | ● | ● | | ● | ● | ● | ● | ● | ● | | ● | | | |

## CARBON REDUCTION COMMITMENT

Accounting for and managing carbon emissions are two of the most impactful ways for a government to support clean-energy economic development. In the absence of a federal standard for carbon accounting and reduction requirements, individual states are mandating overall GHG reductions within their territories. Massachusetts' Global Warming Solutions Act, which mandates that the state set a 10-25 percent GHG reduction from 1990 levels by 2020, is a great example. In February 2009, the state announced that existing strategies, policies, and laws will achieve 18.6 percent reductions from 1990 levels by 2020. State policymakers are currently going through a stakeholder process to establish final limit targets later this year, that are expected to be between 18.6 and 25 percent.

Because GHG emissions don't stop at political/jurisdictional borders, many states have formed regional coalitions to standardize the management of carbon. The three predominant regional efforts to manage carbon are the Western Climate Initiative (WCI), RGGI, and the Midwestern Greenhouse Gas Reduction Accord. While these three efforts are similar, there is one key and distinct difference that makes RGGI the superior initiative: the direct monetization of carbon. And Massachusetts' GHG reductions have resulted in proceeds of $79 million in allowance auctions by the end of 2009, which the state has used to fund investments in energy efficiency.

Regulating GHGs by establishing caps or "allowances" on the carbon emissions of the private sector with a corresponding value for the privilege or "allowance" to emit carbon is possibly the most effective strategy/scheme for catalyzing market-based innovation for a low-carbon and clean-energy economy. As allowances are reduced over time and the penalties or taxes for emissions that exceed the allowances are enforced, low-carbon business solutions will become more valuable in the marketplace.

Massachusetts could continue to show leadership in carbon reduction strategies by legislating a more aggressive individual GHG reduction target and by pushing for a national carbon accounting and management standard modeled after the successful components of RGGI.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BUILDING CODES** | | | | | | | | | | | | | | | |
| Current Building Energy Codes Meet or Exceed Latest IECC and ASHRAE Standards | ● | ● | | | | | | ● | | | | ● | | ● | |
| LEED Green Building Requirements for State-Owned Buildings | ● | ● | ● | ● | ● | ● | | | ● | | ● | ● | ● | | |
| Mandated Energy Performance Scoring Statewide for Residential or Commercial Buildings | ● | | | | | | | | | | | | | | |
| Mandated Energy Efficiency Improvements for State-Owned Buildings | ● | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | ● | ● |

## BUILDING CODES

It is commonly referenced that the operation of commercial buildings account for 40 percent of carbon emissions in the U.S. Or as noted green architect Ed Masria likes to say: "It's the architecture, stupid." In order to reduce emissions from buildings, they need to consume less energy. Establishing building codes for new and existing structures that result in more efficient buildings can be a huge driver for clean-energy technologies and solutions while contributing to GHG reduction goals.

California has instituted a program called CalGreen, the most stringent building code standards of any state in the nation. It requires builders to install plumbing that cuts indoor water use, divert 50 percent of construction waste from landfills to recycling, use low-pollutant paints, carpets and floorings, and in nonresidential buildings, install separate water meters for different uses. It mandates the inspection of energy systems by local officials to ensure that heaters, air conditioners, and other mechanical equipment in non-residential buildings are working efficiently. And it will allow local jurisdictions, such as San Francisco, to retain their stricter existing green building standards, or adopt more stringent versions of the state code if they choose.

Massachusetts, along with California, Illinois, Pennsylvania, and Maryland, are the only states in the Top 15 to have building code legislation in place which meets or exceeds 2009 IECC standards for residential buildings and 2007 ASHRAE standards for commercial buildings.

All but five of the Top 15 states mandate that new construction and/or renovation of state-owned buildings must be built to some level of Leadership in Energy and Environmental Design (LEED), depending on the scope and size.

Energy rating systems have been around for a while, and are available in most states, but only a few states have mandated statewide home energy rating system programs. Florida has had a system in place for a while as part of its energy efficiency building code, but California has the most successful comprehensive example, the California Home Energy Rating System. It is overseen by the California Energy Commission and establishes a systematic process for the delivery of whole-house home-energy ratings. These provide California homeowners and home buyers with information about the energy efficiency of the homes they live in or homes they are considering for purchase.

The ratings also provide evaluation of the cost-effectiveness of options to achieve greater energy efficiency in those homes.

Washington has also passed legislation for a comparable mandated energy rating system and Oregon is considering similar legislation.

A more innovative and market-based solution for driving demand for energy efficient buildings is the concept requiring an energy performance score for buildings at the time of sale. There are a number of organizations across the U.S. like the Earth Advantage Institute that are pioneering the development and implementation of energy performance scoring for buildings. By scoring buildings on their energy performance, appraisers and purchasers can incorporate the score into the overall value/price of a building. Conservation Services Group in Westborough, Mass. is the licensee and contact for the Earth Advantage Homes program in the six New England states and New Jersey.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UTILITY REGULATIONS** | | | | | | | | | | | | | | | |
| Decoupling | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | | |
| Public Benefit Fund | ● | ● | ● | | ● | ● | ● | | | ● | ● | ● | | ● | |
| Cost Recovery Other Than Public Benefit Fund | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Smart Meters Penetration Greater Than 5% of State's Electric Meters | | | | | | | | | | | | | ● | ● | ● |
| Standardized Power Purchase Agreement | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | | | ● | ● |
| Strong Interconnection Law/Policy | ● | ● | ● | ● | ● | | ● | ● | | | | ● | | ● | |
| Strong Net-Metering Law/Policy | ● | ● | ● | ● | ● | ● | | ● | | | ● | ● | ● | ● | |

## UTILITY REGULATIONS

Regulation of the utility industry is handled at the state level and is a highly fragmented and complicated landscape on a state-by-state comparison basis. While utility industry regulation is a very critical topic for states to address in advancing their clean-energy goals, it is also a topic that requires a great deal of detailed analysis and discussion.

However, there are a few key elements of utility regulation to point out. The first is the standardization of contracts required for renewable energy production. There are three key contracts needed for most renewable energy projects to move forward: net-metering agreements, interconnection agreements, and power purchase agreements. By standardizing these legal contracts, a state can significantly reduce project risk barriers associated with the legal process and high fees often required to negotiate unique arrangements with each utility. If a utility company feels threatened by or is opposed to a renewable energy resource of a third party investor/generator, and it is not properly mandated by law to allow for equitable access to the transmission grid, a utility can easily bog down a project and kill it with legal fees.

Most states do net metering and interconnection well. Only three of the Top 15 states – Washington, Minnesota, and Texas – according to an assessment by The Network for New Energy Choices, receive low grades for both net metering and interconnection. Interconnection appears to be more

challenging for states than net metering. Six states fail to make the grade for interconnection as compared to four states with net metering. Allowing third-party ownership of renewable-energy projects and providing standardized power purchase agreements is also something that all but four of the Top 15 states are doing.

Public benefit funds as a result of utility industry regulation can be another very effective way to drive clean-energy development. The Energy Trust of Oregon and Vermont Energy Investment Corporation are among the leading examples of public benefit funds.

Decoupling a utility company's profits from the addition or growth of new energy assets is essential and critical to advancing energy efficiency markets. For example, if a natural gas company can only make more money by selling more natural gas, it will never be incentivized to support its customers using less gas through energy efficiency measures. States that are clean-energy leaders understand decoupling and are actively working to address concerns and motivations of utilities. At present, 11 of the Top 15 states have some form of decoupling, but more work needs to be done.

In many states, decoupled utility companies are allowed to adjust their rates for energy on an annual basis to ensure a certain level of financial return to the shareholders. For example, if an electric utility sells less kWh of electricity than forecasted for a year it can adjust its rates upward for the following year forecasts in order to ensure profitability. Utilities are generally concerned most with having enough capacity for peak load hours. If these peak load hours can be decreased through efficiency and distributed energy technologies, a utility can profit from a higher incremental rate for kWh but a lower charge to customers for the "capacity" investments needed to guarantee power at peak load hours.

| SOLAR AND WIND EASEMENT AND ACCESS LAWS | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | | |
| Wind | | | ● | ● | ● | | | | | ● | | | ● | | |

## SOLAR AND WIND EASEMENT AND ACCESS LAWS

When making a long-term investment into a renewable-energy project like solar PV or wind, it is critical that the investor is confident in the rights to the solar or wind resource. For example, if a solar PV array is installed on a three-story building rooftop, it is critical to have clear legal protections providing rights to complete access to the solar resource. A clear and effective access law in this case would disallow any new man-made structure, or even a tall tree, from impeding direct access to the sun.

All but four of the Top 15 states have solar access laws. Wind is much less protected; only five states have established wind access laws. Massachusetts does not have a state wind access law, but with its limited onshore wind resource, this is likely not a critical area. Apart from the specific issue of access law, Massachusetts does face big challenges with regard to delays in the permitting process at the local level, but has taken recent actions at the state level to make permitting more timely and uniform.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **STANDARDS** | | | | | | | | | | | | | | | |
| Appliance/Equipment Efficiency Standards Beyond Federal | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | | | | |
| Contractor Certification | ● | ● | ● | | | ● | | ● | | | ● | | ● | | |
| Energy Efficiency Resource Standard | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | ● | | ● | ● |
| Procurement Mandates | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | ● | ● | ● | |
| Renewable Energy/Energy Efficiency Technology Certification | ● | | ● | | | | | | | ● | ● | | ● | | |
| Statewide Renewable Fuel Standard | ● | ● | ● | | | | | | ● | ● | | | ● | ● | |

## STANDARDS

Clear standards and certifications are important for consumer confidence in new clean-energy innovations. Another critical aspect of setting standards is to drive and demand innovation from manufacturers to produce energy-efficient and non-toxic goods.

Here are some quick overviews on the standards we reviewed:

### Appliance/Equipment/Technologies

When both the federal government and a state have adopted efficiency standards for the same type of appliance or equipment, the stricter standard applies. States that excel in this category – and have received marks in our matrix – have standards that apply to a larger number of products than are covered by federal standards.

### Contractor Certification

Requiring licensing or training for contractors working in the renewable energy or energy efficiency space helps ensure that contractors have the necessary experience and knowledge to install systems properly. Maryland has a Home Performance with Energy Star program that trains contractors on the "whole home" approach. California has a Building Performance Contractors Association with a similar mission. We recommend that Massachusetts follow these examples and adopt contractor certification.

### Procurement Standards

States have different requirements for state government-purchased goods and services, but the requirements usually advocate for the use of recycled products, products made through carbon-neutral manufacturing, or without the use of hazardous chemicals. Equipment-procurement policies often mandate the use of the most efficient equipment, such as equipment that meets the federal Energy Star standard for new buildings. All of the Top 15 states except Maryland, Arizona, and Texas have procurement standards in place.

### Renewable Fuel Standards (RFS)

Massachusetts is among the seven states with statutory requirements that establish specific volume

standards for cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel that must be used in transportation each year. Massachusetts' Clean Energy Biofuels Act also mandates a minimum biofuel content for home heating oil, the first such provision in the U.S. In some states, requirements also include criteria for both renewable fuels and the feedstocks used to produce them, including new GHG thresholds for renewable fuels. Oregon, for example, mandates biodiesel and ethanol in Oregon's motor fuels and requires the Oregon Department of Agriculture to study and monitor ethanol fuel production, use, and sales in Oregon and to implement the RFS. California's low carbon fuel standard requires fuel providers to ensure that the mix of fuel they sell into the California market meets certain standards for GHG emissions. The standard becomes increasingly stringent over time.

## Energy Efficiency Resource Standard (EERS)

This is a simple, market-based mechanism to encourage more efficient generation, transmission, and use of electricity and natural gas. An EERS consists of electric and/or gas energy savings targets for utilities, often with flexibility to achieve the target through a market-based trading system. All EERSs include end-user energy-saving improvements that are aided and documented by utilities or other program operators. Sometimes distribution system efficiency improvements and combined heat and power (CHP) systems and other high-efficiency distributed generation systems are included as well. EERSs are typically implemented at the state level and are either included as part of a state's RPS or as standalone legislation. Massachusetts implemented an EERS as part of its Green Communities Act signed in 2008, serving as one more example of its leadership in energy efficiency.

# FINANCIAL INCENTIVES AND DRIVERS

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LOAN/CASH INCENTIVES** | | | | | | | | | | | | | | | |
| Direct Loan Programs | ● | ● | ● | | ● | ● | ● | ● | ● | ● | | | ● | ● | ● |
| Grant Programs | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● |
| Loan Guarantees | ● | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| PACE Financing Program and/or Legislation | ● | | ● | ● | | | ● | ● | ● | ● | ● | ● | ● | | ● |
| On-Bill Repayment Mandate | ● | ● | ● | | ● | ● | | | ● | | | ● | | | |
| Renewable Energy Certificate Incentives | ● | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | | ● | ● |
| Statewide Feed-In Tariff Program or Legislation | ● | | ● | | | | | | ● | | | | | | |

## LOAN/CASH INCENTIVES

The limitations of available commercial credit resulting from the financial meltdown that started in the fall of 2008 present extraordinary challenges to financing clean-energy projects. While many public incentives are helpful to augment private financing of projects, two of the most effective are cash incentives and subsidized loans offered directly to project owners or developers. Tax credits, for example, have recently become very difficult to leverage as many potential tax credit investors have experienced severe losses of income – hence the loss of tax liability – making tax credits and deductions unattractive to many. We discuss this in detail in the Commercial Tax Incentives section on page 36.

### Feed-In Tariffs (FITs)

FITs are cash payments, made by public agencies or utilities, directly to renewable energy project owners for the delivery of electricity. This mechanism of cash incentives – over and above the market-rate revenue from the amount of electricity sold – is more familiar to bankers and investors than tax credits or incentives that require additional fees and complex counsel from lawyers and tax accountants.

FITs have been used, to varying degrees of success, in the European Union and elsewhere. Legislation for FIT programs is now also on the rise in the United States. Numerous legislatures, governors, and state-energy offices have begun to evaluate FIT successes and shortcomings, and are attempting to deploy successful programs in their own states.

Currently, there are only three legislated, statewide FIT programs out of the Top 15 states included in this report, in California, Oregon, and Washington. California's FIT program payments are based on a utility's avoided cost and not on the actual cost of clean-energy projects. It applies to small-scale clean-energy systems and investor- and publicly-owned utilities with at least 75,000 customers. California has a cap on both project and program size, currently limiting the ability of the FIT to drive large-scale clean-energy deployment in the state. Washington passed voluntary FIT legislation in February 2009. The state's HB 1086 calls for a full system of FITs for all renewable energy technologies, and includes differentiated tariffs for both solar and wind energy. Oregon recently

implemented a pilot FIT for solar PV. The initial program is very limited (25 MW) and rates have not yet been set.

In considering a FIT, one of the most important components to take into account is the rate paid to the developers of the renewable energy systems. Some programs base FIT payments on the cost to develop the renewable energy generation project plus a stipulated return set by policy makers, regulators, or program administrators. Others base FIT payments on a utility's avoided cost or on arbitrarily set fixed-price incentives.

Spain and Germany are the most oft-cited examples of FIT programs. Germany's FIT, one of the most successful programs, has been primarily responsible for enabling the country, despite a limited solar resource in its northern European climate, to lead the world in solar deployment with more than 8,000 MW in cumulative installations. Germany has also captured a significant share of global PV manufacturing. In Germany, utilities are required to purchase the electricity from new solar installations at a rate significantly higher than the market rate, about 30 to 40 euro cents per kWh, but the tariff declines over time. Germany is currently preparing to ratchet back the program, and what it pays out for solar-generated electricity, but there are many positive lessons to glean from the German FIT program.

Spain's experience, however, was less positive. The country had to redesign its program after its initial FIT was set at an extremely high price per kWh, creating a boom that included inefficient solar plant construction and speculation in solar building permits. Spain initially guaranteed high-tariff rates, without a plan to decrease these rates, and without a cap on the amount of solar electricity that could be plugged into the system. The government recently corrected the problem by introducing a variable premium-price FIT design with both a price cap and a price floor. It ensures that the FIT premium payment increases or declines as electricity prices fluctuate. In addition, there is now a hard cap (500 MW), and Spain has introduced a computer tracking system to monitor both the speed and timing of solar installations and connections to the grid.

Closer to home, many observers are watching Ontario's newly-implemented FIT (with varying rates of approximately 40 to 80 Canadian cents per kWh, depending on system size and application type). Some observers wonder if an outcome similar to Spain's may be in the offing.

The most notable FIT example in the U.S. is not a statewide FIT, but the solar PV program passed by the municipal utility in Gainesville, Florida, in February 2009. (This is not included in the matrix for Florida because it is not a state program.) It is considered the only U.S. FIT policy structured in much the same way as many successful European FIT policies: it is based on the cost to develop the renewable generation project plus a stipulated five to six percent return over a 20-year period. The program has only been in place for a year so outcomes will need to be monitored.

We believe that carefully structured FITs can be a major driver for renewable-energy project development, and for clean-tech manufacturing as well, depending on how they are structured. Massachusetts can be an early adopter and leader in this type of program should it determine that a FIT policy is politically and financially feasible. That can be a tall order in a time of tight budgets, but it deserves strong consideration.

## Renewable Energy Certificates

RECs are another mechanism or incentive instrument that can provide direct cash subsidy and support for a renewable-energy project. The buyers of RECs can include utilities, who use them to help meet their RPS mandates. There are also voluntary investors in RECs who wish to support the development of community-scale renewable projects. The Energy Trust of Oregon, for example, delivers its direct financial incentives for renewable projects in the form of REC purchases. It calculates the "above-market cost" of the project and that serves as the value of retiring the RECs from the project.

Of the Top 15 states with RPS mandates, New York is the only one that does not allow utilities to use RECs to count towards its RPS requirements. The rest of the states with RPSs allow the use of RECs, and some states even provide REC incentives as a tool to incentivize utilities to achieve RPS targets. Oregon is the only state that caps the amount of unbundled RECs that utilities can use (at 20 percent) to meet RPS obligations. Arizona, Colorado, and Washington offer REC multipliers. Multipliers are targeted to specific renewable energy technologies and reward utilities and investors for supporting these technologies by multiplying the value of a single REC by as much as three times.

New Jersey is an excellent example of how RECs can be used to stimulate investment into particular technologies. New Jersey's SREC program provides a single SREC in the customer's account each time their system generates one MWh of electricity. SRECs can then be sold on the SREC tracking system, providing revenue for the first 15 years of the system's life. In January 2010, New Jersey SREC prices on average were $533 per MWh – incredibly high when contrasted with the range in values of a traditional REC ($5-$90 per MWh).

Massachusetts has a specific set of renewable energy technologies within its Class I resources list for its RPS. In addition, Massachusetts has a solar carve-out requiring that a portion of its renewable energy be provided from in-state, interconnected solar facilities, and that a certain percentage of renewable energy be generated from existing resources. The state also has an aggressive SREC program with the price ceiling, known as the solar alternative compliance payment, set at $600 per MWh for 2010. Almost every Top 15 state with an RPS carve-out has a complimentary REC multiplier or REC incentive program to help boost compliance by utilities and direct investment into this technology.

## PACE & On-Bill Repayment Programs

The property-assessed clean-energy (PACE) financing program was primarily advanced in 2009 by an initiative in Berkeley, California, called BerkeleyFIRST. PACE allows home and business owners to avoid the steep up-front cost of solar PV or energy-efficiency improvements by paying over time via their property tax bills. It has attracted extraordinary interest as a way for local and state governments to deploy their energy efficiency and conservation block grant (EECBG) funding allocations established by the American Recovery and Reinvestment Act of 2009. PACE was featured as a "Breakthrough Idea for 2010" in the January/February 2010 issue of *Harvard Business Review*.

Although administered by cities or counties, PACE programs require enabling legislation at the state

level that will vary on a state-by-state basis due to unique constitutional and legal issues of each individual state. Ten of the Top 15 states have PACE-enabling legislation, but Massachusetts is not yet among them. California is a clear leader in PACE program adoption, with 11 cities and counties currently offering or soon to be implementing PACE programs. Colorado is also a leader in implementing a successful PACE program in Boulder County, called the Climate Smart Loan Program.

With PACE, a city or county essentially runs a clean-energy and/or energy-efficiency financing program for private property owners. The policy reasoning is that the environmental and economic benefits from financing private-property solar installations and efficiency retrofits are beneficial to the greater community, and therefore justify the use of municipal bonding authority to capitalize the program. Bond market investors are willing to purchase these bonds because the property owner agrees to repay the financing through a property tax assessment that includes the "super-lien" status of property taxes in the event of default and foreclosure of the property. But PACE programs face several challenges in the current economy.

Municipal bond rates currently average around 6 percent, which is not necessarily an affordable cost of capital for a financing program. The Berkeley program, for example, offered financing to homeowners at 7.75 percent – a number that turned out to be more expensive than other sources of financing available to some homeowners – and was one factor in Berkeley discontinuing the program in early 2010. Another significant challenge to the PACE model is the fragmentation of the repayment collection process, which relies on participation from local tax assessment offices with widely varied business processes and often, budget and staffing constraints.

On-bill repayment programs like Clean Energy Works Portland are another financing vehicle for private property energy-efficiency and renewable-energy upgrades. On-bill repayment programs usually require state legislation mandating that utilities participate. Utility participation in programs delivering energy efficiency retrofits makes sense for two reasons. The first is the low delinquency rates of utility bill payments – a good risk-mitigation consideration for the program's underwriters and investors. Second, the program can leverage the utility usage and payment history for screening its participants, as well as utilities' ongoing monitoring of property energy consumption to assess the effectiveness of different building performance improvements.

On-bill repayment programs are supported through revolving loan funds that can attract and leverage private capital by using public investments like EECBG as credit enhancements, and loan loss reserves that absorb and reduce risk to private capital investment. Challenges to the success of on-bill repayment programs include ensuring utility company participation, and programs' relatively unproven track record to date.

PACE and on-bill repayment are both promising models to deploy public investment into clean-energy projects while also leveraging private capital resources. They are both in early-stage development phases that will likely require constant innovation and collaboration to meet the policy goals that they are intended to deliver.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COMMERCIAL TAX INCENTIVES** | | | | | | | | | | | | | | | |
| Investment Tax Credit | | | ● | | | | ● | ● | | | ● | | ● | | |
| Production Tax Credit | | | | | | | | ● | ● | | | | ● | | |

## COMMERCIAL TAX INCENTIVES

Investment tax incentives are offered as a percentage of the overall eligible costs associated with the development of qualifying clean-energy projects. The best-known example is a federal tax incentive simply called the investment tax credit (ITC). This is a tax credit offered on qualifying projects at a rate of 30 percent of the total project cost. The federal ITC is now being temporarily offered as a cash grant to qualifying projects in order to remain effective as many potential investors have experienced significant decreases in taxable income as a result of the economic catastrophe of 2008.

At the state level, only five of the Top 15 states have an investment tax incentive for clean energy, and the most aggressive by far is the Oregon Business Energy Tax Credit (BETC). The BETC is a tax credit offered to qualifying renewable and energy efficiency/conservation installations at a rate of 50 percent of eligible project costs that is recognized over a five-year period by project investors (10 percent each year). For the years 2007 and 2008, Oregon's BETC program provided a total of $218.3 million in tax credits, generating $745.8 million in net incremental spending – which contributed $502 million in additional economic output over what would have occurred without the BETC, according to a study by EcoNorthwest, a Portland-based economics, finance, and planning firm, on behalf of the Oregon Department of Energy.

The credit has some very positive features, such as the ability to be traded or "passed-through" to third-party tax equity investors in the event that a project host does not have a tax liability. This is particularly attractive for municipal and non-profit entities that can't benefit from a tax incentive because they don't pay taxes.

While the BETC is largely considered a successful program in stimulating renewable energy development, it has recently come under great scrutiny from many Oregon citizens and policymakers. There were complaints of program abuse committed by some large project developers who were circumventing the maximum project cost eligibility of $20 million by "carving" large installations into $20 million "sub-projects." The necessity of the incentive for certain technologies, particularly large wind farms, also came into question. The BETC program was recently updated and revised to address some of these issues. The key takeaway here, similar to feed-in tariff program management, is that periodic oversight and continual monitoring of eligible projects and credit values are essential components of any successful investment tax incentive program.

Offering tradable tax incentives/credits like Oregon's BETC is a very strong feature that Massachusetts should consider if implementing tax incentives/credits of any kind. However, Massachusetts or any state should also heed the lessons of Oregon's BETC experience, carefully defining eligibility and making sure that the program is closely monitored to prevent abuse.

The strongest clean-energy incentive is a straight cash/grant incentive, but these can be more politi-

cally difficult to implement due to their effect on the general fund and budget of the state. Still, they have the potential to be significantly more effective in the current economic slowdown than tax-driven incentive programs.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **INVESTMENT ACTIVITY** | | | | | | | | | | | | | | | |
| State Equity Fund | ● | ● | | | | ● | | | | | | | ● | ● | |
| Venture Capital and Other Private Investment ($400M+, 2007-09) | ● | ● | ● | ● | | ● | ● | ● | | | | ● | | | |
| Venture Capital and Other Private Investment (30+ Deals, 2007-09) | ● | ● | | ● | | | | | | | | | | | ● |

## INVESTMENT ACTIVITY

Of the Top 15 states, only five – Massachusetts being one – have established state clean-energy funds. These investment vehicles are often executed in partnership with a private financial firm or as an extension of an existing public benefit energy fund. By providing equity to projects, companies, and other clean-energy related activities, these funds aim to accelerate development and deployment of clean energy in the state.

### VENTURE CAPITAL AND OTHER PRIVATE INVESTMENT ACTIVITY BY STATE

| STATE | Number of Deals (2007-09) | Amount Invested, in $ Millions (2007-09) |
|---|---|---|
| California | 286 | $7,084 |
| Massachusetts | 63 | $1,116 |
| Oregon | 11 | $546 |
| Colorado | 34 | $695 |
| New Jersey | 8 | $186 |
| Connecticut | 9 | $641 |
| New York | 25 | $856 |
| Maryland | 10 | $469 |
| Washington | 26 | $230 |
| Minnesota | 6 | $48 |
| Arizona | 12 | $125 |
| Illinois | 10 | $402 |
| Florida | 8 | $15 |
| Pennsylvania | 11 | $178 |
| Texas | 36 | $346 |

*This data is based on state-level private investment deals tracked by Bloomberg New Energy Finance from January 1, 2007 to December 31, 2009. Investment deals include venture capital financing rounds, private equity expansion capital, and private equity buyouts. The above table reports on the total number of deals and total amount of invested capital by state.*

The Clean Energy States Alliance (CESA), established in 2002, is a nonprofit group that helps its members best utilize public clean-energy funding. CESA is comprised of 18 state clean-energy funds and agencies – including MassCEC's Renewable Energy Trust. Massachusetts' membership in CESA showcases its leading efforts in state clean-energy investment, but the state also excels in the arena of private investment.

Data provider Bloomberg New Energy Finance (BNEF) has tracked global investment deals in the clean-energy sector for nearly a decade. According to BNEF's database, Massachusetts trails only California in terms of venture capital and private investment – both in terms of total investment and number of deals. Deal types tracked include venture capital financing rounds, private equity expansion capital, and private equity buyouts.

From January 2007 through December 2009, eight of the Top 15 states attracted at least $400 million in venture capital and private investments to companies headquartered in their state. California was head and shoulders above the rest with investments exceeding $7 billion. Massachusetts, the only other state breaking the $1 billion threshold over the last three years, has the second-largest total with more than $1.1 billion.

Judging by the number of investment deals completed – an important measure of investment activity given the variations in businesses' capital intensiveness – California stands far ahead of other states with 286 California-based company investment deals completed in the last three years, according to the BNEF database. Massachusetts' 63-deal total earned it another second-place ranking behind California. Texas, with a distant third-place finish, saw 36 investment deals from 2007 through 2009.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **UTILITY INCENTIVES** | | | | | | | | | | | | | | | |
| Renewable Energy and/or Energy Efficiency Loans Offered by More Than 5% of Utilities | ● | ● | ● | ● | | ● | | | ● | | | | ● | | |
| Renewable Energy and/or Energy Efficiency Rebates Offered by More Than 20% of Utilities | ● | ● | ● | ● | | ● | | ● | ● | ● | | | ● | | |
| State Performance Incentives for Utilities | ● | ● | ● | ● | ● | ● | ● | | | ● | ● | ● | | | |

## UTILITY INCENTIVES

Given the growing popularity of other financing mechanisms available for renewable energy projects (RECs, FITs, tax credits, etc.) it is not surprising that most utilities focus their incentives on energy efficiency. Of the Top 15 states, only California and Oregon have more than 20 percent of their utilities offering renewable-energy rebates, and only Oregon, Washington, Colorado, and Florida have more than five percent offering clean-energy loans.

States that place a priority on energy efficiency will want to consider not just the incentives that utilities offer customers, but the performance incentives that states offer to utilities for demand-side management and other conservation and efficiency activities. In many cases, performance

incentives are a key means of addressing utility management's concerns about lost sales revenue from conservation and efficiency, as they provide positive financial impact. States that are aggressively pursuing energy-efficiency incentives also tend to have enacted regulatory policies such as decoupling. Massachusetts is a clear leader here, making energy conservation part of its portfolio standards package and provides support to utilities to help reach this goal.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **RESIDENTIAL AND INDIVIDUAL TAX INCENTIVES** | | | | | | | | | | | | | | | |
| Income Tax Exemption or Reduction | | ● | ● | | | | ● | ● | | | ● | | | | |
| Property Tax Exemption or Reduction | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | | ● |
| Sales Tax Exemption or Reduction | | ● | | ● | ● | ● | ● | ● | ● | ● | ● | | ● | | |

## RESIDENTIAL AND INDIVIDUAL TAX INCENTIVES

Tax incentives can be offered to homeowners for renewable-energy installations, appliance purchases, and energy-efficiency upgrades. They can take the form of income tax incentives, property tax exemptions, or sales tax breaks. This area of policy and financial support for clean energy is highly fragmented and contingent on each individual state's tax structure. As a tool, these instruments can be effective, but are also subject to consumer confusion associated with the general challenges of completing tax forms. Residential tax incentives should be considered a supplementary, not primary, way to advance clean-energy economic development policy.

# KNOWLEDGE CAPITAL AND ECONOMIC/WORKFORCE DEVELOPMENT

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **KNOWLEDGE CAPITAL** | | | | | | | | | | | | | | | |
| At Least One Global Top-Ranked Green MBA Program | ● | ● | ● | ● | | ● | ● | ● | ● | | ● | ● | | ● | ● |
| Campus Climate Commitment Member (20% or More) | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | | | |
| Innovative Clean Energy Academic Programs (5% or More) | ● | ● | ● | ● | | | | | | | ● | | | | |
| Top-Ranked Overall Green Universities (10% or More) | ● | ● | ● | ● | ● | ● | ● | | ● | | | | | | |

## KNOWLEDGE CAPITAL

Academic institutions are a core asset to a state's economic development initiatives in the clean-energy sector in at least four different ways:

- Research and development of clean-energy technologies
- Clean-energy degrees, diplomas, certificates, and programs
- Adoption of institutional policies and commitments around clean energy
- Assisting in the commercialization of clean-energy technologies through incubators and/or sharing of business, management, and entrepreneurial expertise

Robust academic research and development programs in a state offer several attractive propositions for private-sector clean-energy companies. Universities' pure innovation and knowledge capital can be capitalized and leveraged into business opportunities, justifying financial investment around R&D clusters. And the campuses of universities and research institutions yield highly trained human resources. States with a large concentration of academic institutions offering degrees, diplomas, certificates, and programs in clean energy are naturally attractive to private businesses.

Nowhere is this more apparent than in Massachusetts. As we discussed in the Assets and Strengths section on pages 13-16, universities and other academic resources are arguably the state's No. 1 clean-energy asset, cited as a strength by virtually every expert that we interviewed. MIT and Harvard, with their world-class research and reputations, clearly lead the pack, but there are centers of clean-energy technical and business excellence across the Bay State at UMass-Lowell, Worcester Polytechnic Institute, UMass-Boston, Western New England College, UMass-Amherst, Babson, Boston University, and many other institutions. Not surprisingly, Massachusetts (along with only California and Oregon among the Top 15 states) earned marks in all four Knowledge Capital categories that we surveyed for this report. Successful clean-energy companies that have spun out from research advances at MIT and other universities, such as A123 Systems and Konarka, have become key mainstays of Massachusetts' clean-energy economy.

As large energy users themselves, academic institutions can also be significant demand drivers and market-opportunity creators for a state's clean-energy companies. States with a higher concentra-

tion of institutions that have made carbon-reduction commitments – reducing energy consumption and deploying clean-energy technologies – are a strong sign of a state's clean-energy leadership. Of the Top 15 states, only three – Florida, Pennsylvania, and Texas – failed to meet our benchmark of at least 20 percent of the state's higher-education institutions having joined the American College and University Presidents' Climate Commitment.

Another valuable academic asset for clean-energy businesses is the sharing of resources in management, business, and entrepreneurial skills – through incubators, executive education programs, or other vehicles. Major Danish wind company Vestas, for example, cited ties to MIT and other academic research centers in choosing Massachusetts for its first U.S. research office east of the Mississippi in 2009. But Texas won the plum Vestas prize – its main U.S. research center – in part because of a (perceived) even stronger academic asset in the Lone Star Wind Alliance, a university-wind industry consortium that includes leading universities in Texas and other western states. (Texas's status as by far the No. 1 market for wind energy in the U.S. clearly was another factor). Without question, MIT holds its own as a strong business asset. Beyond its world-class engineering and R&D resources, MIT and its Sloan School of Management deliver robust entrepreneurial training and policy expertise to the business sector, and MIT president Susan Hockfield is one of academia's leading voices on global energy challenges.

The emergence of business schools' Green MBA programs around the world also gives specific states and regions strong skill sets to draw from when building or growing clean-energy companies. All but three of the Top 15 states boast at least one Green MBA program listed in The Aspen Institute's Top 100 global rankings in 2009. Massachusetts is particularly strong with seven programs in the Top 100: Babson, Brandeis, BU, Bentley, Boston College, UMass-Boston, and MIT. California also hosts seven Top 100 Green MBA programs, while New York is home to five.

Massachusetts is clearly a leader in having strong academic institutions and is positioned to benefit from this in developing a robust clean-energy economy. The state should continue to promote and support the adoption of R&D initiatives and clean-energy degree programs from its universities. It should also consider fostering more business-academic partnerships. This will help place students directly after graduation while retaining businesses and lessening the transient student population base. Providing additional incentives for academic institutions to adopt even more ambitious carbon reduction strategies is an area where Massachusetts could place continuous emphasis in order to help build demand for clean-energy technologies and services.

| | CA | MA | OR | CO | NJ | CT | NY | MD | WA | MN | AZ | IL | FL | PA | TX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ECONOMIC/WORKFORCE DEVELOPMENT** | | | | | | | | | | | | | | | |
| Clean-Energy Jobs as a Percentage of Total Jobs (0.5% or More of State Total) | ● | ● | ● | ● | ● | | | | ● | ● | | | | ● | |
| Clean-Energy Patents Registered (3% or More of U.S. Total, 2002-09) | ● | ● | | | ● | ● | ● | | | | | ● | ● | | ● |
| Presence of a Clean Energy Alliance Business Incubator | ● | | | | ● | | ● | | | | | | ● | | ● |
| Presence of a Department of Energy National Lab | ● | | ● | ● | ● | | ● | | ● | | | ● | | ● | ● |

## ECONOMIC/WORKFORCE DEVELOPMENT

Beyond academic institutions, there are several other ways in which states can position themselves to become leaders in clean-energy human capital, business activity, and job creation.

One obvious asset to any regional clean-energy effort is the presence of a DOE National Laboratory. The DOE maintains 21 National Laboratories and Technology Centers, conducting cutting-edge energy research with more than 30,000 scientists and engineers. For our purposes, we included in our research only DOE labs that had clear involvement in clean-energy technologies. Nine of the Top 15 states have at least one such lab, but Massachusetts is not among them.

The most prominent example of the value provided by presence of a DOE lab can be seen at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL focuses entirely on renewable energy and energy efficiency, providing expert R&D designed to advance technologies from the lab to applied research, testing, scale-up, and demonstration. Ultimately, NREL's Commercialization & Technology Transfer Office supports efforts to bring these technologies to market, creating new businesses and new jobs. Partly due to NREL's proximity, the Denver metro area has become a hotbed for budding clean-energy companies.

Other DOE labs at the forefront of clean-tech research and development include the Pacific Northwest National Laboratory in Richland, Washington, a leader in smart grid testing, and the Lawrence Berkeley National Laboratory in Berkeley, California, the former home of U.S. Secretary of Energy Dr. Steven Chu.

Although Massachusetts is not home to a DOE-funded laboratory, the state can still reap the benefits of lab presence by focusing attention and resources on its many local university labs and technology centers that nurture the work of scientists, engineers, and entrepreneurs. MIT, for example, is an institutional partner of NREL's new Joint Institute for Strategic Energy Analysis, established in March 2010 to bring policy and technology expertise to help speed the transition to clean energy around the world. We do urge, however, that Massachusetts pursue the establishment of a DOE lab within the state, with a lab focused on energy-efficiency technologies being an obvious natural fit. We discuss this in more detail in the Stategy and Recommendations section on page 44.

Apart from laboratory availability, technology development can be significantly aided by business incubator programs. The Clean Energy Alliance was established by NREL and consists of incubators across the nation that aim to provide tailored business and financial services to the clean-energy community. Such incubators operate in six of the Top 15 states: California, Colorado, Florida, New

Jersey, New York, and Texas. A leading example is the Austin Technology Incubator (ATI) in Texas. Originally founded in 1989, ATI expanded into clean energy in 2002 and has helped grow 18 companies in solar, wind, LED lighting, and other clean technologies. Although Massachusetts lacks a Clean Energy Alliance member, it does have some notable clean-energy incubator efforts, including the Fraunhofer Center for Sustainable Energy Systems in Cambridge, the North Shore Cleantech InnoVenture Center in Lynn, and the Clean Energy Fusion Center in Waltham. In Worcester, the Institute for Energy and Sustainability is aiming to create a clean-energy incubator, partially funded with a $150,000 grant from MassCEC.

Another key metric for leadership in clean-energy innovation and development is the number of patent registrations recorded in each state. The Clean Energy Patent Growth Index, published quarterly by intellectual property law firm Heslin Rothenberg Farley & Mesiti P.C in Albany, New York, tracks patent activity in the clean-energy sector from 2002 to the present.

Interestingly, Michigan – a state that did not make our Top 15 ranking – leads all other states with 24 percent of clean-energy patents in that time period, largely due to car manufacturers' fuel-cell and hybrid-electric vehicle activities. California was second with 15 percent, followed by New York at 12 percent. Other states at or above a three percent share include Connecticut with seven percent, Texas with five percent, Illinois with five percent, and Massachusetts, New Jersey, and Florida all with three-percent shares of U.S.-owned clean-energy patents.

While patent registrations speak to innovation strength and can be used to help evaluate the success of research and development investments, jobs are a more direct metric for measuring the impact of a state's clean-energy economic development and industry growth. To track this key metric, we used the widely-cited Pew Charitable Trusts' June 2009 report, *The Clean Energy Economy*, which analyzed the emerging clean-energy industry in the U.S. and tracked clean-energy job growth, business presence, and investment in the national "clean-energy economy" between 1998 and 2007. Clean Edge also drew from this research in our October 2009 report, *Clean-Tech Job Trends 2009*.

One key point of analysis for the strength of a state's (and nation's) clean-energy economy was clean-energy jobs as a percentage of total jobs. According to Pew, clean-energy jobs in 2007 accounted for 0.49 percent of all national jobs, with 22 states exceeding that national average. Eight of the Top 15 states had clean-energy job percentages of 0.5 percent or more. Oregon's diverse set of clean-energy activities gave it the overall lead with 1.02 percent of all jobs belonging to the clean-energy economy. Massachusetts, with a 0.69 percent share for clean-energy jobs, landed in fourth place behind Oregon, Maine, and California.

We can expect clean-energy jobs to account for a growing percentage of total jobs as the growth of our national clean-energy economy expands. Massachusetts is already a leader in clean-energy jobs share, but the state should focus efforts on pushing this percentage higher. If the state is serious about cementing its position as a clean-energy hub, it needs to significantly expand the number of clean-energy jobs in the state. And there are several efforts underway to make that happen, with particularly encouraging emphasis on economically distressed areas of the state. MassCEC, for example, currently oversees a $1 million state Pathways out of Poverty grant for solar and energy-efficiency installation training in Brockton, Lowell, Pittsfield, Springfield/Holyoke, and Worcester.

# STRATEGY AND RECOMMENDATIONS:
## A Nine-Point Action Plan for Massachusetts

### Nine-Point Action Plan At-a-Glance

1. Establish an energy-efficiency innovation center and pursue a national DOE lab
2. Adopt aggressive financial incentives for clean energy
3. Establish a Massachusetts "Green Bank" to accelerate funding
4. Continue to increase commercialization of clean-energy research advances
5. Institute on-bill repayment system for energy-efficiency enhancements
6. Boost regulations for building efficiency
7. Streamline and hasten the local permitting process for clean-energy projects
8. Take carbon-reduction leadership to the next level: nationwide
9. Play to the state's strengths

Leaders of any kind stay ahead by continually examining and improving their activities. For leadership in a field as competitive and dynamic as clean energy, this is an absolute imperative. Our primary and secondary research has clearly shown that Massachusetts is a strong clean-energy leader among states in the U.S. In both the Barriers/Weaknesses and Leadership Scorecard sections of this report, however, we have detailed some areas where Massachusetts is behind other leading states in policy and other disciplines. This section of the report spells out 9 action items that we recommend the state pursue in its goal to advance its status as a national – and global – leader in clean-energy development, deployment, and both private and public-sector innovation. In some cases, the state has already taken initial steps on these recommendations.

### 1. Establish an energy-efficiency innovation center and pursue a national Department of Energy laboratory.

As previously noted, energy efficiency is one of the crown jewels of Massachusetts' clean-energy sector assets. The Fraunhofer Center for Sustainable Energy Systems, a collaboration between Fraunhofer and MIT for building efficiency systems and solar PV research, is a notable effort in this area. The presence of a high-profile, multiple-stakeholder center for research devoted specifically to a range of efficiency technologies would help attract targeted funding and cement the state's stature as a world hub in this sector.

The optimum scenario, a Massachusetts-based national DOE lab for efficiency technologies, would also address one of the state's clean-energy leadership weaknesses, the lack of such a lab. Although the state can't control DOE decisions, it is already taking action on this score, applying for the DOE's Energy Efficient Building Systems Design Energy Innovation Hub – one of three such new hubs announced in December 2009 by Secretary of Energy Dr. Steven Chu. MIT, UMass, Fraunhofer, and MassCEC are leading a coordinated effort to land this hub, which will focus on systems-based approaches to efficient design, construction, and operation of commercial and residential buildings. The hub will be the core of a $129.7 million federal Energy Regional Innovation Cluster – exactly what Massachusetts needs.

## 2. Adopt aggressive financial incentives for clean energy.

Massachusetts is already taking a number of key steps to finance clean energy in the state, most notably its SREC program, which took effect in 2010, to support the solar carve-out goals of the state RPS. This program should be closely measured and monitored to ensure that it is keeping the state on pace to meet its goal of 400 MW of solar PV. And the state should keep other alternative financial incentives in mind – for solar and other clean-energy technologies – including a FIT and tax credits. As outlined in the Financial Incentives and Drivers section on page 32, a FIT – direct government cash payments to generators of clean energy – can be a highly effective mechanism to spur clean-tech development. A number of our interviewees recommended this step for the state, and it should be considered for solar if the solar REC program fails to establish necessary market momentum.

To avoid FIT program excesses that have occurred elsewhere, however, state policymakers must carefully consider payment rates, calibrate those rates to move up and down as utility rates fluctuate, ensure that rates decline over time, and place caps on project eligibility and program duration. Other options for solar and other technologies are, production and/or investment tax credits for clean-energy projects. These could include so-called "pass throughs," allowing the tax credit to pass to a third-party tax equity investor in the event that a project host (such as a municipality or non-profit) is not a taxpaying entity – or if the project developer or owner does not currently have earnings and the tax liabilities that come with them.

## 3. Establish a Massachusetts "Green Bank" to accelerate funding for clean-energy and energy-efficiency startups and projects.

Clean-energy advocates in Washington, D.C. are currently pushing for the establishment of a federal Clean Energy Deployment Administration or Green Bank. The concept is an independent, government-sponsored enterprise that provides loan guarantees, debt instruments, and other financing tools to stimulate private-sector lending and investments in clean energy. The concept can work on the state level as well, and we recommend that Massachusetts become the first state to do this.

Policy analysts say a Green Bank can leverage public spending by 10x to 20x – a $10 million state outlay could attract $100 million to $200 million in private capital. This would be an excellent way to engage the state's large traditional financial players – investment and commercial banks, and the state pension funds – in the clean-energy space where they have not been active to date. It could address the issue of a shortage of seed-stage capital cited as a state weakness by several interviewees for this report and would help keep capital within the state for local projects, companies, and job creation. And it may already have a key supporter in Massachusetts: Congressman Ed Markey co-authored an article with Coalition for Green Capital founder and former FCC head Reed Hundt on the coalition's web site in March 2010.

### 4. Continue to increase commercialization of clean-energy research advances.

The gap from lab innovation to market commercialization in Massachusetts is a key clean-energy weakness cited by several interviewees who feel that the state needs to do a better job of mining its rich intellectual property and knowledge base to create commercial products. The state took a big step to address this in March 2010 with the launch of the Company Catalyst Program, which brings MassCEC funds to the Massachusetts Technology Transfer Center (MTTC) with the specific goal of commercializing clean-energy technologies. Researchers apply for grants of up to $40,000 to help them demonstrate the commercial viability of their projects.

MTTC has focused on helping bring in-state technology innovations to market since its founding in 2004, but the Company Catalyst Program is its first initiative that targets clean energy exclusively. It is a great step and we recommend that the state continue to focus additional resources in this area, and explore the possibility of a creating a fulltime clean-energy technology transfer position or small staff to oversee this critical area statewide.

### 5. Institute an on-bill repayment system for energy-efficiency enhancements.

In several leading clean-energy states, residents (and small businesses) can obviate the up-front capital cost of weatherization and other efficiency improvements by paying off the project over several years through a monthly charge on their utility bills. This financing mechanism is gaining popularity at the state and city level around the U.S. as an effective mechanism enabling energy-efficiency growth. Massachusetts is already actively exploring this possibility, with a Massachusetts Energy Efficiency Advisory Council working group studying the issue. We recommend that the state work with its utilities to implement such a system.

There is much enthusiasm in some quarters for PACE programs, a similar financing concept in which residents pay off their efficiency (or clean-energy installation) project costs via their city or county property tax bills. But from a statewide perspective, we recommend the on-bill repayment approach. The highly fragmented nature of local property tax collection, particularly in a state with a strong local governance model like Massachusetts, makes PACE a complex and daunting administrative challenge.

### 6. Boost regulations for building efficiency.

We recommend several regulatory enhancements related to building codes that will help advance Massachusetts' leadership in energy efficiency. First it should mandate energy performance scoring (EPS) – an energy-usage audit whenever a building is sold. A Massachusetts company, Conservation Services Group, already performs this service for voluntary EPS programs in six states. Second, Massachusetts should improve its contractor certification requirements for clean-energy and energy-efficiency installers, such as making the North American Board of Certified Energy Practitioners' solar PV installer certification mandatory rather than voluntary.

## 7. Streamline and hasten the local permitting process for clean-energy projects.

Although state officials have worked hard to get the long-stalled Cape Wind project moving forward and closer to final approvals, many large and small clean-energy developers continue to be frustrated by delays in permitting at the local level in Massachusetts. The Cape Wind experience "has given the world the impression that Massachusetts is a NIMBY place, dictated by rich people," said one interviewee. That's not a good image for a clean-energy leader. The state has made progress here with the Oceans Act of 2008 clearing some hurdles for offshore wind. The legislature should aid onshore wind by passing the pending Wind Energy Siting Reform Act, and the state should consider similar streamlining efforts for biomass and other technologies.

## 8. Take carbon-reduction leadership to the next level: nationwide.

Massachusetts' aggressive GHG reduction targets, its success to date, and its active participation in RGGI give the state a powerful platform. As the debate over cap-and-trade rages on Capitol Hill, Massachusetts officials can lead by continuing to step up and speak out about the economic payoffs of carbon reduction. We recommend this not just to help advance carbon emissions legislation, but to help keep it from moving backwards. In California, for example, a 2010 statewide ballot measure and Republican candidates for governor are calling for a delay in GHG reduction implementation until the economy improves. Massachusetts should continue to be prominent on the national stage with the message that GHG reduction enhances, not hinders, economic growth.

## 9. Play to the state's strengths.

Nationally and globally, clean energy is a highly diverse industry and no one state or region can lead in all of its sectors. The best strategy is to pick your strengths and focus policies and resources on those. From our research, we believe that Massachusetts' three key areas of focus should be energy efficiency, solar PV including thin-film, and advanced batteries/energy storage. Secondary areas, those with great long-term potential but not as large today, are offshore wind, wave and tidal power, solid-state lighting, and low-carbon materials.

In these areas and others, the state's greatest assets, as noted throughout this report, are its unparalleled research, innovation, and knowledge-capital resources. The state should certainly seek to attract and retain manufacturing where possible, but, we believe, should mainly focus on extending its leadership as a hub of research breakthroughs and innovation excellence in clean-energy technologies and business models. Pursuing a globally influential, innovation-centric approach will continue to create high-level scientific, technical, and business management jobs, as well as thousands of green collar jobs in installing, operating, and maintaining these technologies. It's an approach that can lift all boats as Massachusetts moves forward with its own aggressive clean-energy build out across the Bay State.

## CLEAN EDGE, INC.

**Clean Edge, Inc.,** founded in 2000, is the world's first research and publishing firm devoted to the clean-tech sector. The company, via its publications, events, and online services, helps companies, investors, and governments understand and profit from clean technologies. Clean Edge, with offices in the San Francisco Bay Area and Portland Oregon, offers unparalleled insight and intelligence on emerging clean-tech trends, opportunities, and challenges. Among its activities, the company publishes the annual *Clean Energy Trends* and *Clean Tech Job Trends* reports; produces the annual Clean-Tech Investor Summit (along with IBF) held each January in Palm Springs; maintains benchmark clean-tech stock indexes with NASDAQ that track U.S. clean-energy (CELS), global wind (QWND) and smart grid and grid infrastructure (QGRD) companies; and produces Clean Edge Jobs, the premier clean-tech jobs board serving companies, recruiters, and candidates. It also conducts custom research for a range of diverse stakeholders. For more information visit: *www.cleanedge.com*.

## AUTHORS

**Ron Pernick,** co-founder and managing director of Clean Edge, is an accomplished market research, publishing, and business development entrepreneur with more than two decades of high-tech experience. At Clean Edge, he manages the firm's major initiatives, including the annual Clean-Tech Investor Summit, industry reports, stock indexes, and consulting projects. He is the co-author of the highly acclaimed book *The Clean Tech Revolution* (Collins). Ron has coauthored more than two dozen reports at Clean Edge, is widely quoted in the media, and speaks regularly at industry events.

**Clint Wilder,** senior editor for Clean Edge, is an award-winning technology and business journalist. His book *The Clean Tech Revolution* (with co-author Ron Pernick), has been called "the best clean tech book" by *ClimateProgress.org* and has been translated into seven languages. He writes Clean Edge research reports and CE Views columns, and is also a blogger for the Green section of *The Huffington Post*. He presents and moderates at conferences in the U.S. and abroad.

**Trevor Winnie,** research and marketing associate, is involved in a range of activities at Clean Edge including working on the firm's stock index products and supporting Clean Edge staff in the preparation of reports and consulting projects.

**Aaron Berg,** principal and founder of Blue Tree Strategies, and **Grant Poujade,** consultant at Blue Tree Strategies, both have years of experience in clean-energy and energy-efficiency accounting and finance. They worked with Clean Edge on this project in a consulting capacity.

# APPENDIX: LEADERSHIP SCORECARD DEFINITIONS

*Below are our definitions and descriptions for each of the 59 categories on which we ranked the Top 15 states. The definitions and descriptions are listed in the same order in which they appeared in the matrix section of the report.*

## REGULATORY INCENTIVES AND DRIVERS

### STANDARDS

#### Appliance/Equipment Efficiency Standards Beyond Federal

The United States government requires appliances and equipment to meet certain federal efficiency standards, restricting retail sale of items that do not meet these requirements. When both the federal government and a state have adopted efficiency standards for the same type of appliance or equipment, the stricter standard applies. To earn a mark in this category, a state must have standards that are more stringent or apply to a larger number of products than are covered by federal standards.

#### Contractor Certification

Contractor certification requires those working in the renewable energy or energy efficiency space to acquire professional licensing to verify the ability to work with certain technologies and perform certain tasks. Certification requirements are designed as consumer protection measures to ensure that contractors have the necessary experience and knowledge to install systems properly.

#### Energy Efficiency Resource Standard

An energy efficiency (EERS) resource standard is a mechanism used to encourage more efficient generation, transmission, and use of electricity and natural gas. An EERS includes end-user energy saving improvements that are documented by utilities or other program operators. Distribution system efficiency improvements, combined heat and power (CHP) systems, and other high-efficiency distributed generation systems can be included as well. An EERS is typically implemented at the state level and either included as part of a state's RPS or as standalone legislation.

#### Procurement Mandates

State-level procurement mandates (usually overseen by finance departments) require all state agencies and anyone under contract with a state agency to use environmentally friendly materials and high efficiency equipment whenever possible. Requirements vary by state, but usually advocate for the use of recycled products, products made through carbon neutral manufacturing, or without use of hazardous chemicals.

#### Renewable Energy/Energy Efficiency Technology Certification

States can adopt policies that require renewable energy equipment to meet certain standards in order to protect consumers from buying inferior equipment. These requirements benefit consumers and protect the renewable energy industry by making it difficult for substandard products to reach the market.

### Statewide Renewable Fuel Standard

A state renewable fuel standard (RFS) establishes specific volume mandates for cellulosic biofuel, biomass-based diesel, advanced biofuel, and total renewable fuel that must be used in transportation fuel each year. Statutory requirements also include definitions and criteria for both renewable fuels and the feedstocks used to produce them, including new greenhouse gas emission (GHG) thresholds and carbon lifecycle analysis. To earn a mark in this category, states must have a statewide RFS in place, not just an RFS that applies to state vehicle fleets.

## BUILDING CODES

### Current Building Energy Codes Meet or Exceed Latest IECC and ASHRAE Standards

The International Energy Conservation Code (IECC) and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standards are two important sets of guidelines which states can model building energy codes after. To qualify for a mark in this section, states must have building code legislation in place which meets or exceeds 2009 IECC standards for residential buildings and 2007 ASHRAE standards for commercial buildings, as tracked by the Building Codes Assistance Project.

### LEED Green Building Requirements for State-Owned Buildings

Building energy codes adopted by many states require new construction and renovation of state-owned buildings to adhere to certain green building standards. Some states simply require efforts be made to exceed existing code requirements, but to earn a mark in this category a state must mandate a specific level of LEED as the minimum standard.

### Mandated Energy Performance Scoring Statewide for Residential or Commercial Buildings

In order to improve the transparency of buildings' energy use characteristics, states can implement legislation that mandates energy audits to assign energy scores to existing residential or commercial buildings. This mechanism empowers the buyer to be aware of a building's energy performance and provides valuable information for purchasing decisions. While some states have energy performance scoring systems available, California's Home Energy Rating System Program is the only plan in place that requires energy performance scoring statewide – in this case, for residential buildings.

### Mandated Energy Efficiency Improvements for State-Owned Buildings

Many states have mandated state-owned buildings to undergo energy efficiency improvements through energy efficiency retrofits, energy audits, or other energy-saving measures.

## UTILITY REGULATIONS

### Decoupling

Because utilities earn revenue from the sale of electricity, it makes no business sense for them to reduce overall electricity consumption by promoting energy efficiency measures. To incentivize utilities to pursue energy efficiency, some states have "decoupled" utility profits from the amount of

electricity sold. Methods of decoupling vary, but most commonly utilities are rewarded with a slight upward adjustment in rates if electricity sales are lower than forecasted.

### Public Benefit Fund

Public benefit funds are state-level programs typically developed to ensure continued support for renewable energy resources, energy efficiency initiatives, and low-income energy programs. These funds are most commonly supported through a very small surcharge on electricity consumption.

### Cost Recovery Other Than Public Benefit Fund

Some states allow utilities to use mechanisms such as tariffs, riders, or surcharges – not labeled as a public benefit charge – that help recover revenue lost through reduced energy consumption and premium renewable energy generation costs.

### Smart Meter Penetration Greater Than 5% of State's Electric Meters

Smart meters are an enabling smart grid technology and are often the first wave of utility smart grid projects. To track states with strong, widespread smart grid ambitions we created a threshold of five percent smart meter penetration. To earn a mark in this category, a state must have smart meters installed on at least five percent of all electric meters.

### Standardized Power Purchase Agreements

Power purchase agreements (PPAs) are used as contracts for the purchasing of energy created from power generating projects. Standardizing these PPAs allows for quicker negotiations with utilities and lower legal fees associated with project development.

### Strong Net-Metering Law/Policy

Net metering allows electric customers with on-site energy projects to sell surplus electricity back to the utility during times when electricity production exceeds consumption. These customers – mostly owners of PV systems – are paid a pre-determined price for the electricity sold back to the grid. Net metering is required by law in most U.S. states, but some of these laws only apply to investor-owned utilities and exclude municipal utilities or electric cooperatives. States earning a mark in this category received a grade of B or better according to the 2009 *Freeing the Grid* report published by the Network for New Energy Choices.

### Strong Interconnection Law/Policy

Interconnection standards govern the technical and procedural process by which an electric customer connects an electric-generating system to the grid. Interconnection standards specify the technical, contractual, metering, and rate rules that system owners and utilities must abide by. Standards for systems interconnected at the distribution level are typically adopted by state public utility commission, while the Federal Energy Regulatory Commission (FERC) has adopted standards for systems interconnected at the transmission level. Not all states have adopted interconnection standards, and some states' standards apply only to investor-owned utilities – not to municipal utilities and electric cooperatives. States earning a mark in this category receive a grade of B or better according to the 2009 *Freeing the Grid* report published by the Network for New Energy Choices.

## RENEWABLE PORTFOLIO STANDARDS

### 20% or Higher by 2020 or Earlier; or 25% by 2025

A renewable portfolio standard (RPS) is a regulatory policy that requires utilities to produce a specific portion of their electricity from renewable energy sources by a specific date. State RPS targets vary widely, both in terms of the percent targeted and the target date. To separate stronger RPS legislation from the pack, a threshold of 20 percent by 2020 or earlier, or 25 percent by 2025 was created. For RPS mandates with target dates in years other than 2020 or 2025, the target percent was required to be equal to or larger than the last two digits of the target year up until 2025 (e.g., 21 percent by 2021 and 23 percent by 2023 would both qualify).

### Enforceable

Although most state RPS mandates are legally enforceable, some states have announced renewable targets that are merely goals and not based on actual legislation. To receive a mark in this category, and qualify for a mark in any of the other RPS categories, a state must have an RPS mandate that is enforceable by law.

### Incentives

Although rare, an RPS mandate can also incentivize utilities to reach a certain renewable target. States with incentives embedded into RPS legislation receive marks in this category.

### Inclusion of Set-Asides

The term "set-aside" refers to a provision within a state's RPS that requires utilities to acquire a certain amount of electricity from a specific type of energy generation. Examples of set-asides include states creating targets for one or more specific technology; states requiring a certain percentage from customer-sited distributed generation (regardless of technology used); and states creating multiple tier categories with different percentage requirements for each tier.

### No Clean Coal or Nuclear Power

RPS details vary by state and each allows a unique set of technologies to count towards a utility's renewable portfolio. Some states allow clean coal and nuclear power to qualify as renewable energy generation, consequently weakening the overall RPS mandate. This category grants marks only to states that explicitly exclude clean coal and nuclear power.

### No Large Scale Hydro (30 MW or Greater)

Hydropower, while a carbon-free and renewable source of energy, can cause significant environmental harm when implemented at a large scale. In an attempt to create a more sustainable RPS, some states choose to restrict the type of hydropower that can be counted towards a utility's renewable portfolio. To earn a mark in this category, state RPS legislation must restrict any hydro project that has a capacity of 30 MW or greater.

### Penalties

States issuing penalties to utilities that fail to meet defined RPS targets receive a mark in this category.

## CARBON REDUCTION COMMITMENT

### Climate Action Plan

Cities and states committed to reducing carbon, promoting clean technology and energy efficiency, will often outline a detailed "climate action plan" describing how clean-energy and carbon reduction goals will be met. Those states with completed climate action plans earn marks for this category.

### GHG Reduction Target Using 1990 Levels or Better by 2020 or Earlier

GHG reduction targets are commonly expressed in either parts per million of carbon dioxide equivalent, or parts per million of carbon dioxide equivalent concentration, as a percentage reduction from a specified baseline or nominated year. States receiving marks in this category must have a legislative GHG reduction goal targeting 1990 levels of GHG emissions or better by the year 2020.

### GHG Reduction Targets Mandated by Law

Greenhouse gas (GHG) reduction targets are a popular way for states to indicate carbon reduction goals. Several states have GHG reduction targets in-place, but many are recommendations by a commission rather than actual legislation. Given that without legislation these targets are unenforceable, states must have actual GHG law in place to receive a mark in this category.

### Membership in Regional Climate Initiative

Regional climate initiatives aim to develop uniform regulatory environments across multi-state geographies. Major regional initiatives in the United States include the Midwest Greenhouse Gas Reduction Accord (MGGRA), the Western Climate Initiative (WCI), and the Regional Greenhouse Gas Initiative (RGGI). Some of these initiatives include member states as well as observer states. To qualify for a mark in this category, states must have member status in a major regional climate initiative.

## SOLAR AND WIND EASEMENT AND ACCESS LAWS

### Solar - Easement and Access Laws

Solar and wind access laws, which may be implemented at both the state and local levels, are designed to protect a consumer's right to install and operate a solar or wind energy system at a home or business. Some solar access laws also ensure a system owner's access to sunlight. In some states, access rights prohibit homeowners associations, neighborhood covenants or local ordinances from restricting a homeowner's right to use solar energy. Easements, the most common form of solar access law, allow for the rights to existing access to a renewable resource on the part of one property owner to be secured from an owner whose property could be developed in such a way as to restrict that resource. An easement is usually transferred with the property title. At the local level, communities use several policies to protect solar access, including solar access ordinances, development guidelines requiring proper street orientation, zoning ordinances that contain building height restrictions, and solar permits.

### Wind - Easement and Access Laws

*See: Solar – Easement and Access Laws*

# FINANCIAL INCENTIVES AND DRIVERS

## COMMERCIAL TAX INCENTIVES

### Investment Tax Credit

Investment tax credits (ITCs) are offered as a function of the total eligible costs of installing a renewable energy or efficiency project. ITCs exist at the federal and state level and are available to the owners of the project, whether a corporation, LLC, partnership, or individual. States receiving a mark in this category had an ITC program in place.

### Production Tax Credit

Production tax credits (PTCs) are based on the number of energy units a renewable energy system generates. To ensure project quality, payments based on a system's actual performance are generally more effective than incentive payments based on a system's rated capacity. PTCs exist at the federal and state level and are available to the owners of the project, whether a corporation, LLC, partnership, or individual. States receiving a mark in this category had a PTC program in place.

## RESIDENTIAL AND INDIVIDUAL TAX INCENTIVES

### Income Tax Exemption or Reduction

Many states offer income tax incentives to reduce the expense of purchasing and installing renewable energy or energy efficiency systems and equipment. Eligible technologies and credit/deduction structure varies by state, and in most cases there is a maximum limit on the dollar amount of the credit or deduction.

### Property Tax Exemption or Reduction

Some states offer state property tax exemptions or reductions if homeowners install renewable energy systems or implement energy efficiency upgrades. Because property taxes are collected locally, some states grant local taxing authorities the option of allowing a property tax incentive for renewable energy systems.

### Sales Tax Exemption or Reduction

Sales tax incentives typically involve an exemption from the state sales tax (or sales and use tax) for the purchase of a renewable energy system, an energy-efficient appliance, or other energy efficiency measures.

## INVESTMENT ACTIVITY

### State Equity Fund

Several states have established clean-energy funds which provide equity to projects and/or companies to accelerate the development of energy efficiency and clean energy. These funds are often executed in partnership with a private financial firm or as an extension of an existing public benefit energy fund. While several states offer direct equity financing for private businesses innovating clean-energy technologies, some have laws that prohibit any state agency from having a direct ownership interest in any private enterprise.

### Venture Capital and Other Private Investment ($400M+, 2007-09)

Data provider Bloomberg New Energy Finance tracks global investment deals in the clean-energy sector including deal date, deal size, type of funding, etc. Using this database, investment deals were tallied from January 2007 through December 2009 for recipient companies headquartered in each of the Top 15 states. To highlight state leaders in this category, a threshold dollar amount was created. States that accumulated a sum of at least $400 million in disclosed deal values during this time period received marks for this category. Deal types included venture capital financing rounds, private equity expansion capital, and private equity buyouts.

### Venture Capital and Other Private Investment (30+ Deals, 2007-09)

Using the same Bloomberg New Energy Finance database for investment dollar amount, deals were tallied from January 2007 through December 2009 by companies headquartered in each of the Top 15 states. To highlight state leaders in this category, a threshold deal total was created. States that completed at least 30 investment deals during this time period received marks for this category. Deal types included venture capital financing rounds, private equity expansion capital, and private equity buyouts.

## UTILITY INCENTIVES

### Energy Efficiency Loans Offered by More than 5% of Utilities

In many states, utility loan programs provide customers with financing for the completion of energy efficiency projects or the purchase of energy efficient equipment. For a state to earn a mark in this category, at least five percent of its utilities must offer energy efficiency loans.

### Renewable Energy Loans Offered by More than 5% of Utilities

In many states, utility loan programs provide customers with financing for the purchase of renewable energy systems. These programs commonly provide funding for solar water heaters, PV systems, and geothermal heat pumps, among other things. For a state to earn a mark in this category, at least five percent of its utilities must offer renewable energy loans.

### Energy Efficiency Rebates Offered by More than 20% of Utilities

Utilities often offer rebates for customers that complete energy efficiency measures. For a state to earn a mark in this category, at least 20 percent of its utilities must offer energy efficiency rebates.

### Renewable Energy Rebates Offered by More than 20% of Utilities

Utilities sometimes offer customer rebates to promote the installation of renewable energy systems. Rebate amounts vary widely based on technology and program administrator. For a state to qualify for a mark in this category, at least 20 percent of its utilities must offer renewable energy rebates.

### State Performance Incentives for Utilities

The use of performance incentives (also known as utility incentives or shareholder incentives) is a commonly used approach by states that have any mechanisms in place beyond program cost recovery. States with performance incentives reward utilities for successfully reaching or exceeding clean-energy program goals.

## LOAN/CASH INCENTIVES

### Direct Loan Programs

Loan programs provide financing for the purchase of renewable energy or energy efficiency systems or equipment. Some state governments offer low-interest loans for a broad range of renewable energy and energy efficiency measures. Other states provide funds for the capitalization of a loan fund. These programs are commonly available to the residential, commercial, industrial, transportation, public, and nonprofit sectors.

### Grant Programs

States offer a variety of grant programs to encourage the use and development of renewable energy technologies and energy efficiency measures. Most programs offer support for a broad range of technologies, while a few programs focus on promoting one particular technology. Grants are available primarily to the commercial, industrial, utility, education, and government sectors. Most grant programs are designed to pay down the cost of eligible systems or equipment. Others focus on research and development, or support project commercialization.

### Loan Guarantees

Some states allow for funds to be used to support clean-technology projects in the form of loan guarantees. These guarantees incentivize private financial institutions to lend to clean-technology projects by limiting their risk of financial loss. In the event the project is unable to support its debt service and defaults on the loan, the state government services the debt or pays the financial institution a pre-designated amount of the loan principal.

### PACE Financing Program and/or Legislation

Property accessed clean energy (PACE) legislation allows for the use of municipal bonding authority to capitalize financing programs for property owners. In a PACE program, homeowners are given a loan which finances installation of renewable energy systems or implementation of energy efficiency measures. PACE homeowners then payback this loan over a period of time through property tax payments.

### On-Bill Repayment Mandate

On-bill repayment mandates require that utilities have billing systems capable of serving as a repayment conduit for the financing of renewable and energy-efficiency projects. With an on-bill repayment mandate, home and building owners can pay back energy-efficiency and renewable-energy loans through payments on their regular utility bill.

### Renewable Energy Certificate Incentives

Renewable energy certificates (RECs) are issued by clean power producers and certified by independent auditing bodies. RECs represent the “environmental attributes” associated with the production of renewable energy. RECs help state governments, corporations, and utilities fulfill requirements to support clean technology, like those required by state RPS mandates.

### Statewide Feed-In Tariff Program or Legislation

A feed-in tariff is a type of production incentive that provides cash payments based on the number

of kilowatt-hours (kWh) a renewable energy system generates. Utilities operating under a feed-in tariff are required to buy energy from renewable energy systems for a pre-determined price that is subsidized by the state. In the United States, feed-in tariff programs are emerging at both at the state and city levels. For a state to qualify for a mark in this section, a statewide feed-in tariff must exist.

# KNOWLEDGE CAPITAL AND ECONOMIC/ WORKFORCE DEVELOPMENT

## KNOWLEDGE CAPITAL

### At Least One Global Top-Ranked Green MBA Program

One way in which universities are supporting state efforts to develop a clean-energy economy is by providing focused business and management training in the clean-technology field. The Aspen Institute, an international nonprofit group, issues a yearly ranking of the Top-100 Green MBA programs. States earning a mark in this category have at least one of these programs located in-state.

### Campus Climate Commitment Member (At least 20%)

The American College & University Presidents' Climate Commitment guides institutions in implementing sustainable practices that impact a wide range of issues, such as green building, recycling and waste management, water and energy use, food systems, procurement policies, and transportations. To date, 677 higher education institutions around the United States have joined this initiative to make campuses "climate neutral" by establishing policies to limit greenhouse gas emissions and reduce energy usage. States receiving marks in this category have more than 20 percent of all 2-4 year institutions in the state as members of the ACUPCC.

### Innovative Clean Energy Academic Programs (At least 5%)

A number of post-secondary schools are implementing innovative clean-energy academic programs in response to the growing opportunities available in the economy to appropriately trained graduates. Three databases tracking the nation's clean-energy education programs include the Interstate Renewable Energy Council, the United States Department of Energy, and the National Council for Workforce Education. To qualify for a mark in this category, at least five percent of a state's 2-4 year higher education institutions had to be recognized for their clean-energy education programs by one of the three aforementioned agencies.

### Top-Ranked Overall Green Universities (At least 10%)

To earn a mark in this category, a state must have at least 10 percent of its 2-4 year higher education institutions recognized in one of several sets of rankings sources. Ranking sources include Top 10 Clean-Tech Colleges 2010 (Cleantech Group); 2010 Green Rating Honor Roll (Princeton Review); Cool Schools 2009 (Sierra Club); College Sustainability Report Card 2010 (Sustainable Endowments Institute); Top 20 Green Power Purchasers (U.S. Environmental Protection Agency).

## ECONOMIC/WORKFORCE DEVELOPMENT

### Clean-Energy Jobs as a Percentage of Total Jobs (0.5% or More of State Total)

In June 2009, The Pew Charitable Trusts published a report examining the growth of America's clean-energy economy from 1998 to 2007. One way in which states can be compared against each other is by estimating clean-energy jobs as a share of the state's overall economy. Pew reported that nationally, clean-energy jobs accounted for 0.49 percent of all jobs in 2007. For states to earn a mark, at least a 0.50 percent share for clean-energy jobs must have been achieved.

### Clean-Energy Patents Registered (3% or More of U.S. Total, 2002-09)

Heslin Rothenberg Farley & Mesiti P.C., an Albany, New York-based intellectual property law firm, has tracked clean-energy patents since 2002 through its Clean Energy Patent Growth Index. Percent share of patents issued by state is one of the many ways in which this index breaks down the historical dispersion of patent registrations in the United States. To qualify for a mark in this category, a state must be home to at least three percent of all clean-energy patents issued in the U.S. from 2002 through 2009.

### Presence of a Clean Energy Alliance Business Incubator

Availability of incubators providing business and financial services to startup companies is an important economic development tool. The National Renewable Energy Laboratory (NREL), one of DOE's National Labs, has formed a network of incubators across the country that focuses exclusively on the clean-energy community. This network, called the Clean Energy Alliance, consists of 11 incubators in 11 different states. Although other important incubators exist outside of this network, affiliation with NREL gives incubators a greater ability to impact the clean-energy economy. States earned marks in this category only if they were home to a Clean Energy Alliance incubator.

### Presence of a Department of Energy National Lab

The U.S. Department of Energy funds and maintains 21 National Laboratories and Technology Centers around the country. Being home to a DOE lab can be a great advantage to state hoping to be a leader in the national clean-energy economy. States housing a DOE lab that has a clear involvement in clean-energy technologies earned a mark in this category.