DATA DIGEST

STATISTICAL PROFILE OF THE PIONEER VALLEY REGION

Clean & Renewable Energy

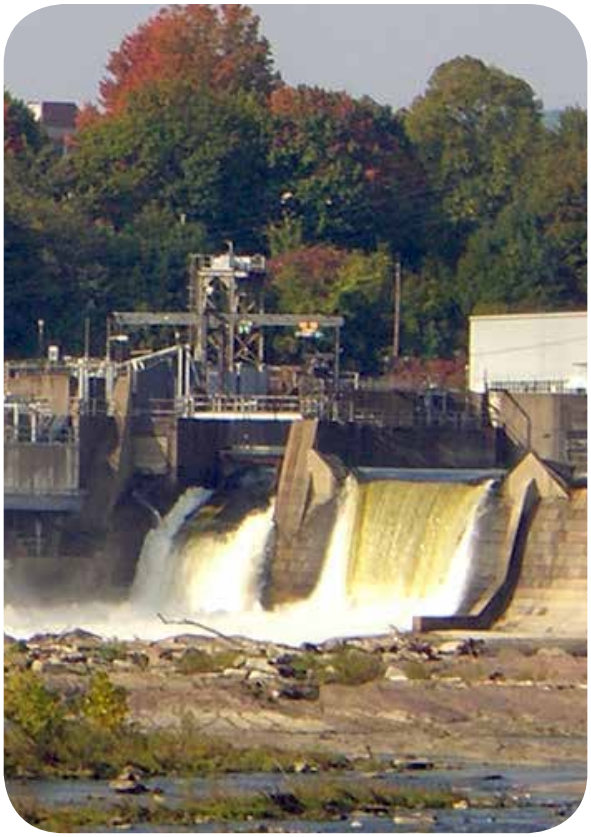
Fueling the Pioneer Valley Economy

Massachusetts Green High Performance Computing Center, Holyoke, MA
Image courtesy of the Daily Hampshire Gazette

Background

With four more green jobs per capita than the state average, the abundant hydro-power of the Connecticut River and its tributaries, above average photovoltaic capacity accounting for 18.6% of the state's capacity, and 43 percent of the region's communities committed to taking steps to becoming greener; the Pioneer Valley is leveraging its many assets to insure it continues to be one of the Commonwealth's most successful green regions. As the desire to be less reliant on fossil fuels gains strength nationally and world-wide due to limited supplies, cost, and environmental impacts, clean and renewable energy production, "green" jobs, and renewable energy research are cornerstones of a successful 21st century economy. Clean and renewable energy production in the Pioneer Valley can power nearly double the occupied housing stock of the entire region. Projects such as the Massachusetts Green High Performance Computing Center in Holyoke, a Technology Park in Springfield outfitted with photovoltaic (solar) rooftop panels, the energy net-zero, multi-modal John W. Olver Transportation center in Greenfield, and millions of dollars of renewable energy research funding at the Five Colleges are all examples of how the Pioneer Valley (Franklin, Hampden, and Hampshire Counties) is a leading region in clean and renewable energy.

Background (continued)



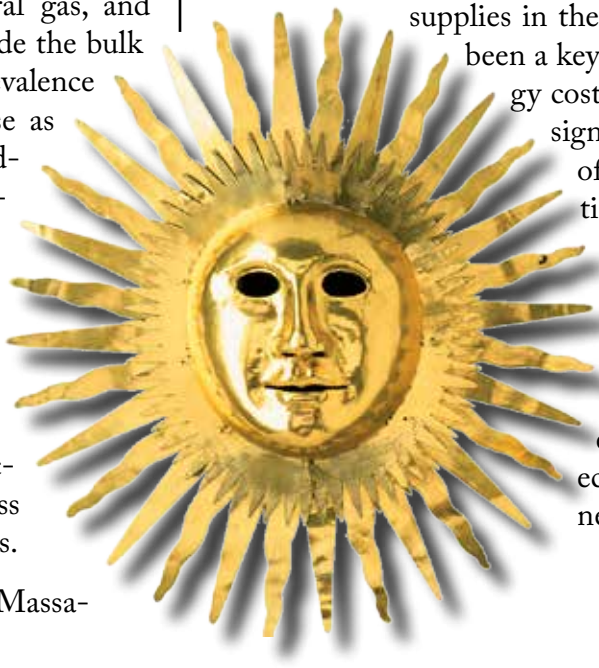
While renewable energy options have been gaining support in the United States, the Commonwealth of Massachusetts in particular has seen gains since support of the clean energy sector became a priority for the Patrick-Murray administration. Making the shift to renewable and clean energy improves air quality, lowers greenhouse gas emissions, and stimulates the economy creating jobs that tend to be well-paying and "clean," while simultaneously stabilizing the cost of energy to Massachusetts residents and businesses.

The Commonwealth's support of clean energy is apparent through an array of state laws and initiatives, many of which the Pioneer Valley has been a leader in implementing. Some examples include the Renewable and Alternative Energy Portfolio Standards for which the Pioneer Valley received one of the first program grant awards in 2003, the Green Communities Act of which 30 of the 69 Pioneer Valley communities have become designated members, and an expanding list of grants and tax incentives to promote the installation of renewable energy generation units. Among other benefits, these programs and previously existing facilities allow the Pioneer Valley to power the equivalent of 580,000 homes purely from renewable and alternative energy sources.

This data digest examines the impact clean energy jobs, renewable energy production, energy efficiency, and renewable energy research have on the region, providing some examples of how the Pioneer Valley is a leader in becoming a green energy region.

Energy in Massachusetts

Within the Pioneer Valley there are different types of renewable and non-renewable energy production. Traditional methods such as coal, natural gas, and petroleum power plants continue to provide the bulk of the power to the region. However, prevalence of renewable sources continue to increase as various renewable energy projects including wind turbines, solar farms, and hydroelectric generators have increasingly come online over the past five years, nearly doubling the renewable energy production since 2008. These renewable sources allow for a higher level of consistency in energy prices as compared to relying solely on traditional carbon based energy sources since renewable sources tend to be less susceptible to world-wide market demands.



Energy prices in the Commonwealth of Massachusetts increased relatively steadily from the 1970s to 2000s. In the late 1990s, and more recently from 2008 to 2010, electricity costs per kilowatt hour have seen declines. This is in part due to the recession as energy prices tend to decline due to economic slumps, although the decrease in cost of natural gas due to increasing supplies in the United States has also been a key factor. However, energy costs for the region remain significant due to a variety of factors including location, climate, and natural resources. Reducing energy costs to the average home or business owner must not be underestimated in ensuring the region's economic competitiveness and future growth.

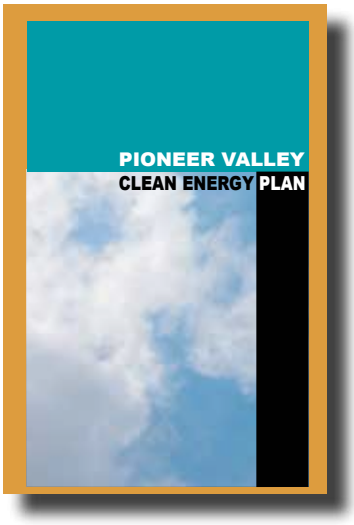
Massachusetts Retail Electricity Price

Source: U.S. Department of Energy, Energy Information Administration

The retail price of a kilowatt of electricity in Massachusetts dropped to approximately fourteen and a quarter cents in 2010 after peaking in 2008 at sixteen and a quarter cents. Compared to the national average and the New England region, Massachusetts has the highest industrial energy costs at nearly one cent per kilowatt hour more than the next most costly state which is neighboring Connecticut. However, Massachusetts has relatively low residential energy costs compared to the rest of the New England region, with only Rhode Island being a fraction of a cent cheaper. Continuing the shift to renewable energy sources will likely reduce both the actual cost of energy and the variability in prices.

Pioneer Valley Clean Energy Plan

In January 2008, the Pioneer Valley Planning Commission and the Franklin Regional Council of Governments published the Commonwealth's first regional Clean Energy Plan. The Pioneer Valley plan previewed goals and recommendations that would eventually be reflected in the Commonwealth's Green Communities Act and Programs as well as in the state's Clean Energy Climate Action Plan. These goals and recommendations included four clean energy goals for the Pioneer Valley, tools for implementation, and how to identify challenges that stand in the way of achieving greener standard.



The four goals established for the Pioneer Valley Clean Energy Plan included:

1. Reduce the region's energy consumption to 2000 levels by the end of 2009 and reduce consumption by another 15 percent from 2010-2020.
2. Site sufficient new capacity to generate 214 million kilowatt hours of clean energy annually in the Pioneer Valley by the end of 2009 and another 440 million kilowatt hour per year by 2020.
3. Reduce the region's greenhouse gas emissions by 80 percent below year 2000 levels by 2050.
4. Create local jobs in the clean energy sector.

Clean Energy Jobs Per Capita

Source: Massachusetts Clean Energy Center - 2011 & 2012 Clean Energy Industry Report

Since the initial publication of the clean energy plan four years ago, there have been many successful advances in the ongoing quest to a greener region. Major efforts by municipalities and residents are continuing to improve energy efficiency and conservation through projects that are often funded by the state through Green Communities grant funds. Many of these projects target municipal buildings that are "energy hogs" and provide funding to retrofit these with energy efficient heating and lighting units, improved insulation, or renewable energy production units such as the photovoltaic units installed on the Smith Vocational and Agricultural high school in Northampton.

The explosion of residential and commercial photovoltaic energy installations continues to help ease the demand on the New England electric grid for fossil fuels by providing cheap, efficient, and clean energy at an attractive, affordable price to an increasing number of Pioneer Valley residents. The increase of commercial and residential photovoltaic installations has also spurred job growth in the clean energy sector due to a need for technical professionals trained in installation and maintenance of renewable energy units such as photovoltaic panels and hydroelectric generators. According to Massachusetts Clean Energy Center's 2012 Clean Energy Industry report, the four counties of Western Massachusetts (including Berkshire County) saw a 6.2% growth in the clean energy employment between 2011-2012, thereby adding nearly 600 jobs to reach a total of 10,252 jobs region-wide. In turn, these 10,252 jobs comprise 2.5% of the four counties' labor force, a half a percent higher than the state's proportion of clean energy employment. While Western Massachusetts' rate of growth in clean energy jobs between 2011 and 2012 was lower than the statewide average, the number of clean energy jobs per capita in Western Massachusetts exceeds that of the state as a whole. For every thousand people in the Western Massachusetts labor force, twenty-four are employed in a job related to clean energy compared to the state's rate of twenty for every thousand.

Pioneer Valley Energy Use

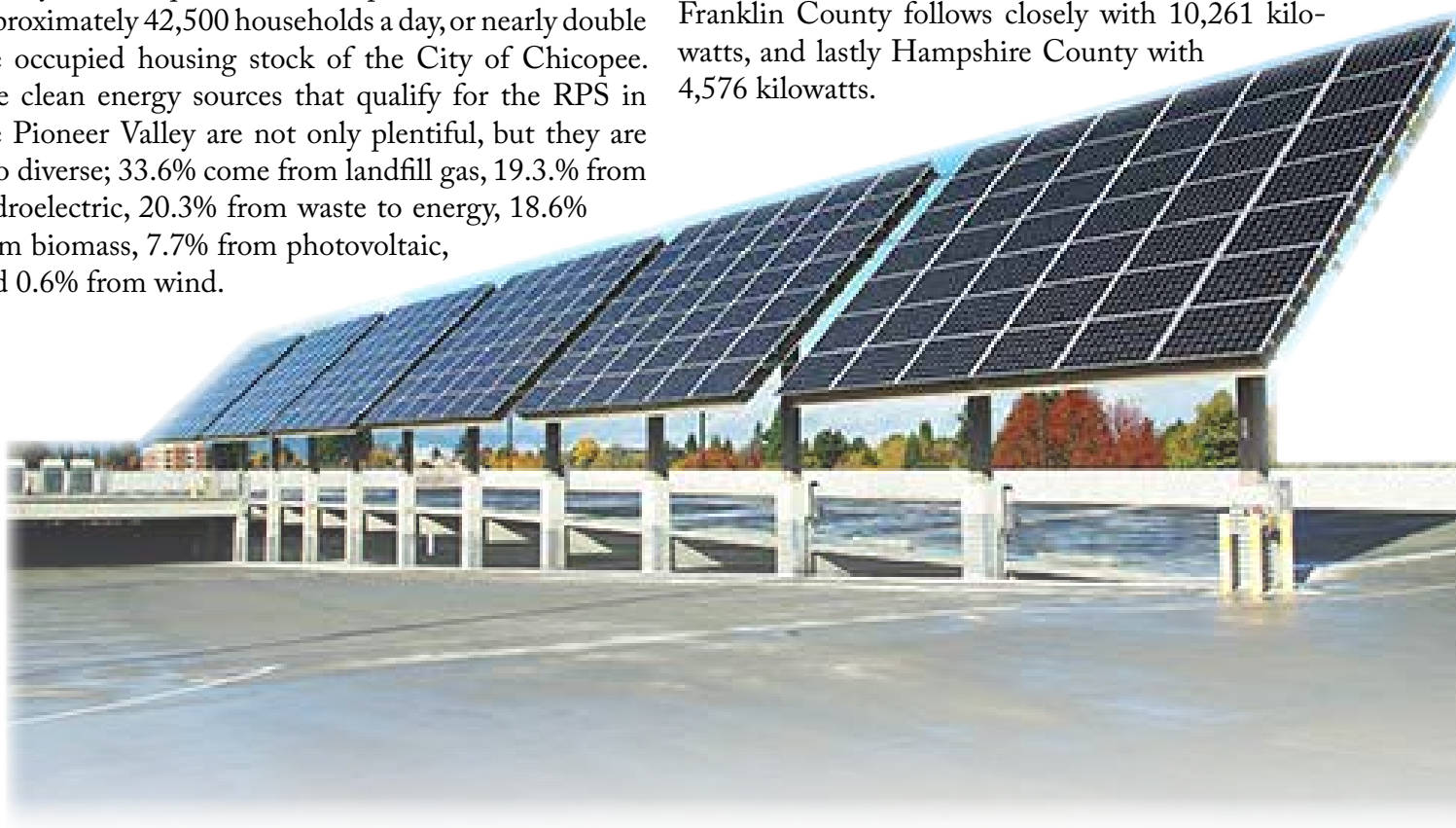
Renewable Energy Portfolio Standards

One of the most prevalent statewide clean energy initiatives is the Renewable Portfolio Standard (RPS). Adopted by the Massachusetts legislature in 1997 and fully implemented beginning in 2003, the RPS is a statutory obligation placed upon investor-owned utilities that requires one percent of the energy derived from the Massachusetts electric grid to come from a renewable energy source and then increases at a half percent annually until 2009 and thereafter at one percent annually with no expiration date (hence requirement in 2020 is for fifteen percent of sales to have coverage from renewable).

Relying on the state's Renewable Portfolio Standard and a companion Solar Carve-out program, the Pioneer Valley has the capacity to produce 39,381 kilowatts of energy[1]. Based on the average Massachusetts household electricity use of 22.23 kilowatt hours of energy per day, this is equivalent to the power needed to serve approximately 42,500 households a day, or nearly double the occupied housing stock of the City of Chicopee. The clean energy sources that qualify for the RPS in the Pioneer Valley are not only plentiful, but they are also diverse; 33.6% come from landfill gas, 19.3.% from hydroelectric, 20.3% from waste to energy, 18.6% from biomass, 7.7% from photovoltaic, and 0.6% from wind.

Solar Carve-out Program

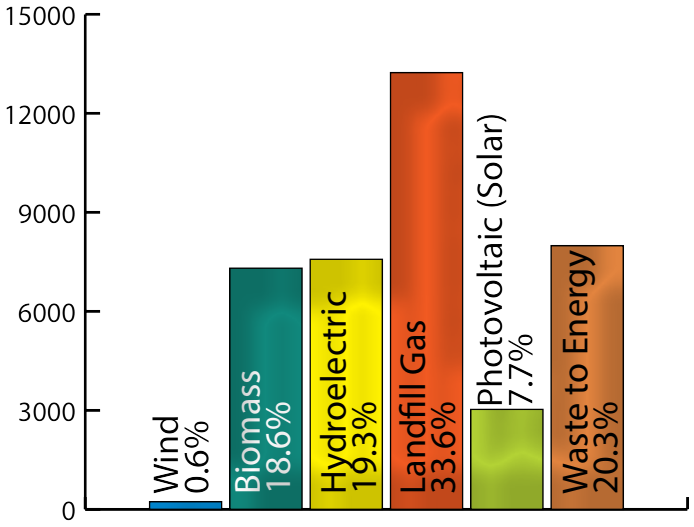
The creation of the Massachusetts Department of Energy Resources' Solar Carve-out program has facilitated the installation of photovoltaic panels being installed on residential, commercial, public, and non-profit properties through market based incentives. In the past three years, for example, there have been significant increases in photovoltaic power implementation in the Pioneer Valley and throughout Massachusetts. With a state goal of 400,000 kilowatts in nameplate capacity to qualify for the Solar Carve-out program, the Pioneer Valley is, once again, one of the leading regions in the state. The Pioneer Valley currently (as of December 2012)possesses 29,268 kilowatts of the 157,740 kilowatts of nameplate capacity within Massachusetts.[2] In basic terms, 18.6% of the state's Solar Carve-out program's energy capacity is installed in the Pioneer Valley while the region accounts for only 10.6% of Massachusetts' population. While the largest portion of the region's photovoltaic capacity is situated within Hampden County, comprising some 14,430 kilowatts, Franklin County follows closely with 10,261 kilowatts, and lastly Hampshire County with 4,576 kilowatts.



1 For methodology see Appendix: Aggregating Renewable Portfolio Standards

2 Nameplate capacity: pertains to the maximum amount of power a generation unit can provide. This value is multiplied by the capacity factor to establish the average amount of power a unit generates.

Pioneer Valley RPS and Solar Carve-out Energy Generation by Type, 2012

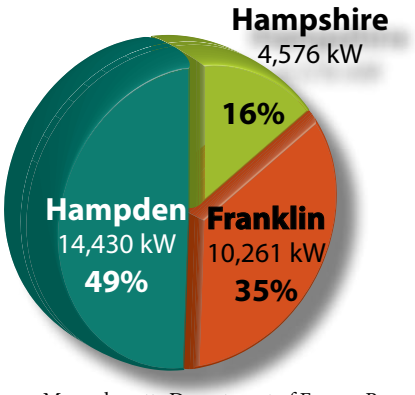


Source: Massachusetts Department of Energy Resources

Solar Carve-out Program (continued)

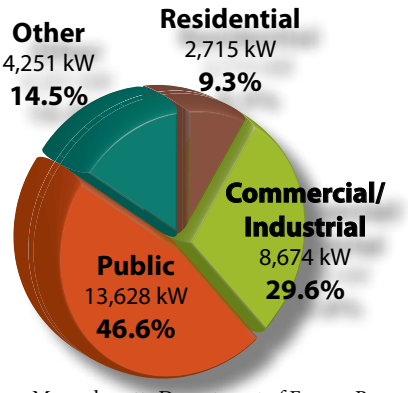
Public facilities make up the largest percentage, 46.6%, of photovoltaic units installed which can qualify for the Solar Carve-out program with a total of 13,628 kilowatts. The next largest category is commercial and industrial and includes systems built on agricultural, commercial/office, industrial, and mixed-use sites. Commercial and industrial systems make up 8,674 kilowatts or 29.6% of Solar Carve-out capacity installed in the region. Residential systems, including units built on residential and multi-family residential buildings, make up 2,715 kilowatts or 9.3%. Finally, the remaining 14.5% of photovoltaic units (producing about 4,251 kilowatts) fall into the "other" category and include mostly large solar farms designed for the commercial sale of renewable energy.

Pioneer Valley RPS and Solar Carve-out Energy Generation by Type, 2012[2]



Source: Massachusetts Department of Energy Resources

Solar Carve-out Program by Building Type, 2012[2]



Source: Massachusetts Department of Energy Resources

Additional Clean Energy Projects

The Pioneer Valley's industrial history of river-powered mills is reflected into the 21st century through the vast amount of hydroelectric energy production the region produces. Beyond the 4% RPS and Solar Carve-out program, additional clean energy production projects including a recent hydroelectric plant in Russell, a wind turbine in Blandford, and data from older and larger hydroelectric plants identified by the Federal Energy Regulatory Commission brings the total clean energy production in the Pioneer Valley to at least 537,638 kilowatts, with the bulk coming from hydroelectric power. This has the potential to power nearly double the occupied housing stock of the entire Pioneer Valley, or approximately 580,000 homes.

The Green Communities Act

One of the most important environmental initiatives introduced by the Commonwealth of Massachusetts is the Green Communities Act. One element of the Act was the creation of the Green Communities Program. The program encourages municipal investment in renewable energy and energy efficiency and provides grant funding for municipal projects related to reducing energy use in municipal buildings; transitioning to renewable forms of energy production; and supporting the adoption of energy efficient policies. A Massachusetts city or town must apply to the Massachusetts Department of Energy Resources and meet five rigorous criteria in order to be officially designated as a "Green Community" and eligible to receive state funding assistance.

Green Communities Criteria

1. Provide as-of-right siting in designated locations for renewable/alternative energy generation, research and development, or manufacturing facilities.
2. Adopt an expedited application and permit process for as-of-right energy facilities.
3. Establish an energy use baseline and develop a plan to reduce energy use by twenty percent within five years.
4. Purchase only fuel-efficient vehicles.
5. Set requirements to minimize life-cycle energy costs for new construction; one way to meet these requirements is to adopt the new Board of Building Regulations and Standards (BBRS) Stretch Code.

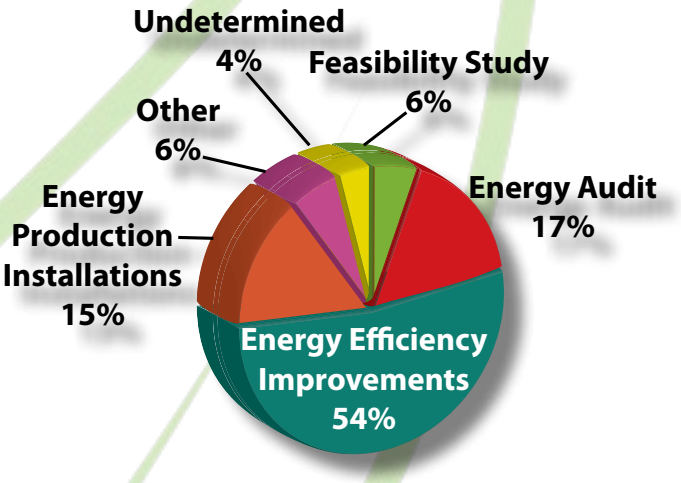
Impacts within the Pioneer Valley

Within the sixty-nine communities comprising the Pioneer Valley, thirty have thus far successfully earned their "Green Communities" designation. This is equivalent to 47% of eligible communities in the region since six of the communities in the Pioneer Valley have municipally owned power companies and thus are only eligible for the designation if they pass an exemption. These communities have committed to the five criteria outlined above as they work together to achieve the ambitious goals of the Pioneer Valley Clean Energy Plan. Each certified Green Community receives funding based on population, socio-economic status of residents, and their Green Communities Action Plan. In the three years of grant funding totaling over $6 million in the region, there have been a variety of clean energy projects that the Green Communities have undertaken.

Of the fifty-four projects funded with Green Communities Act dollars, more than half (29) were for the implementation of energy efficiency projects. The remaining projects were split between three feasibility studies, six energy audits, eight energy generation installations, three miscellaneous projects, and two communities still have undetermined projects from the most recent round of funding.[3]

In total, just over $6 million has gone into the Pioneer Valley's state-designated Green Communities to facilitate implementation of municipalities' energy efficiency goals. The amount of state dollars varies among eligible communities with the City of Springfield receiving $1,149,684 and the Town of Hatfield receiving $130,725.

Pioneer Valley RPS and Solar Carve-out Energy Generation by Type, 2012



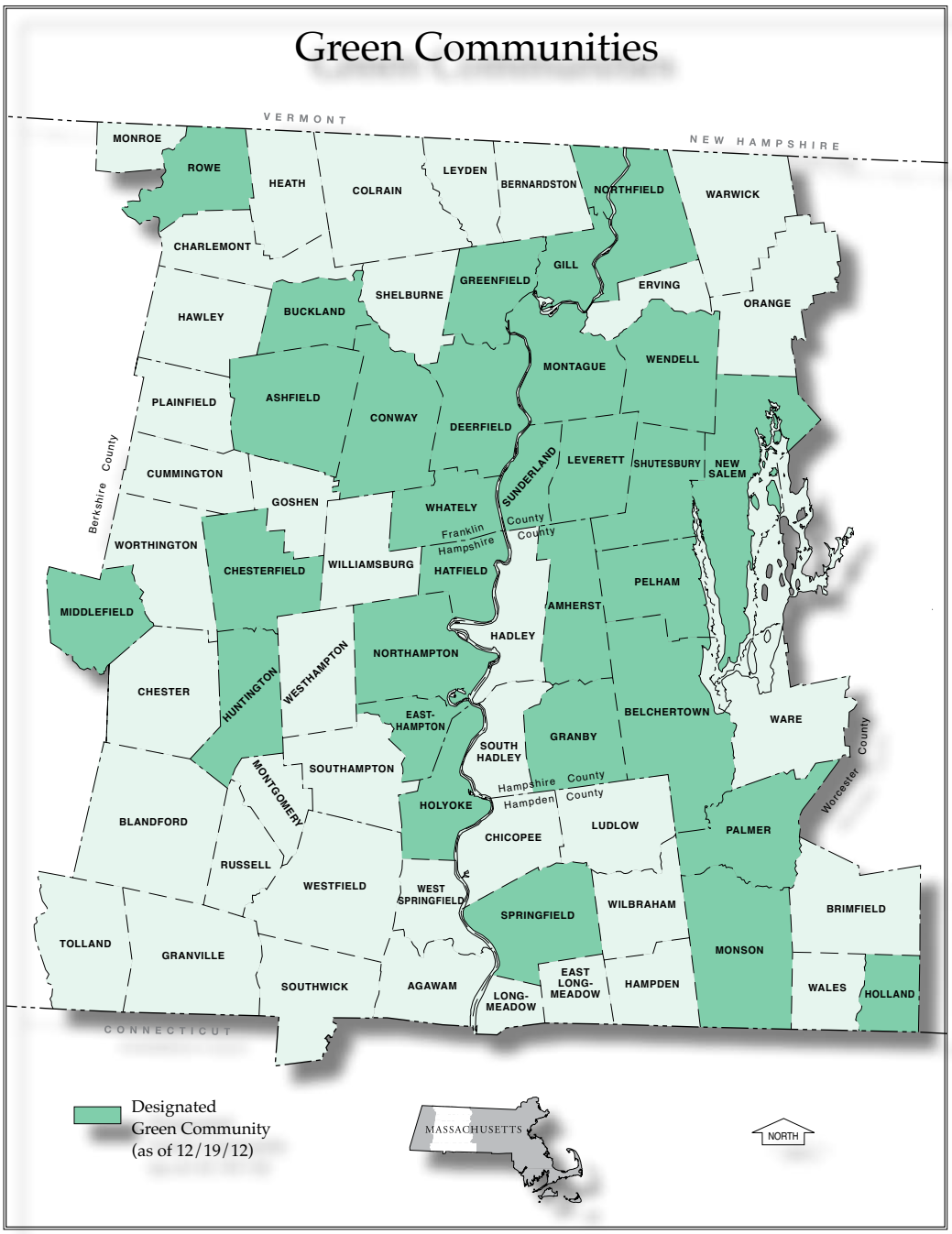
Source: Massachusetts Department of Energy Resources

Local Highlights

Funding for the Green Communities Program must be geared towards energy efficiency and reduction projects. The Town of Belchertown and Cities of Greenfield, Northampton, Holyoke, and Springfield were chosen as highlighted in this report because of their successful efforts to reduce municipal energy consumption. Belchertown, for example, has decreased municipal energy use 4.2% between 2009-2011 (2,582 MMBtus)[4].

3 While not officially designated by the municipalities or the state, the projects were categorized into seven different groups for the purposes of this report, including feasibility studies, energy audits, energy efficiency improvements, energy production installations, other, and undetermined.

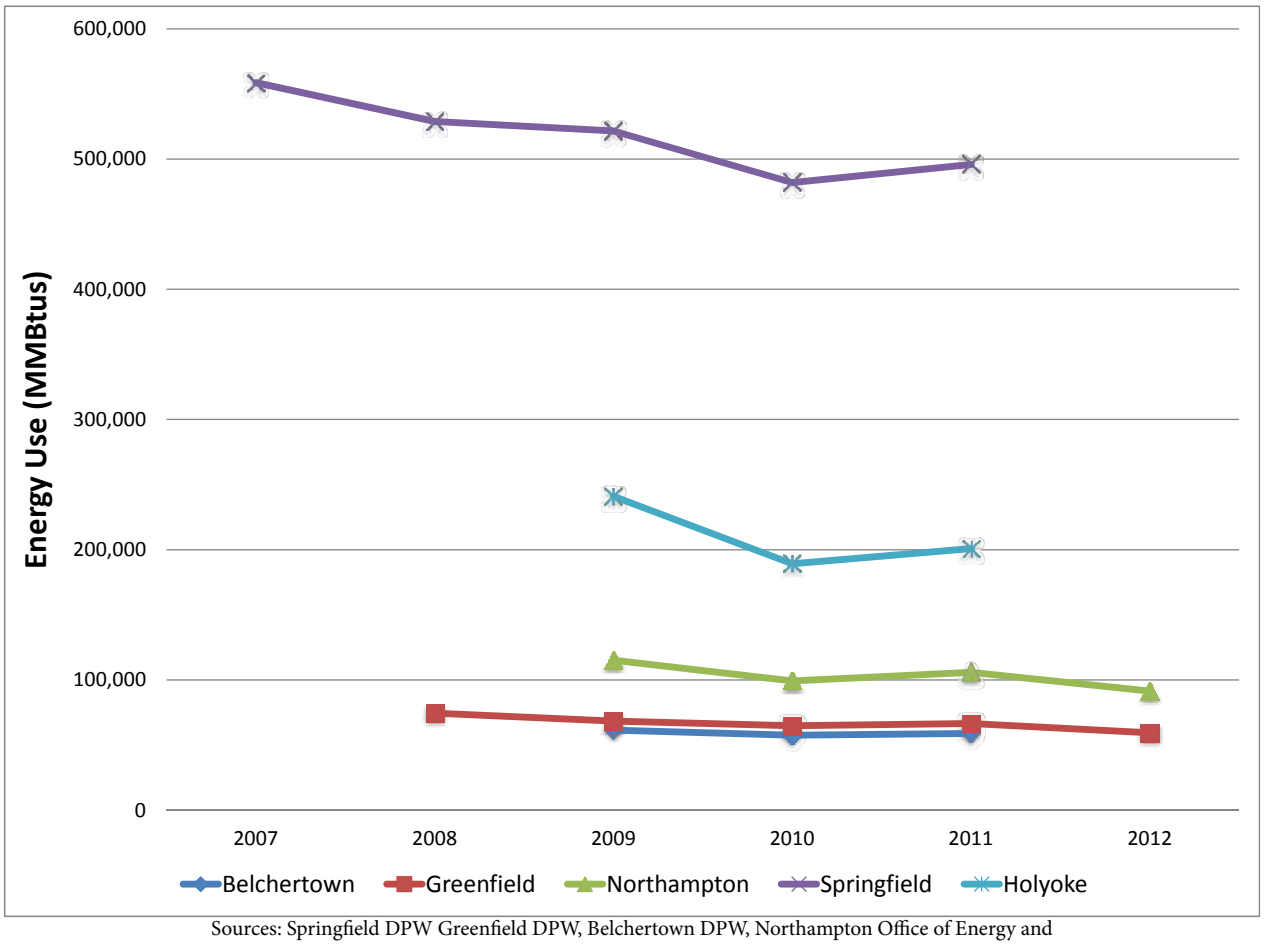
4 For context, 1 Btu is equal to the amount of heat needed to raise the temperature of one pound of water by one degree. It takes approximately 341 BTUs to power a 100 watt light bulb for 1 hour. 1 MMBtu = 1 million Btus.



Local Highlights (continued)

Greenfield has seen great success as the City's energy use has been reduced by an impressive 20.4% (15,226 MMBtus). The City of Northampton has seen similar progress to Greenfield as its energy use has been reduced by 20.6% (23,799 MMBtus) since 2009. The City of Holyoke has also made great progress and between 2009-2011 achieved a nearly 17% reduction of municipal energy use (totaling 40,086 MMBtus). Finally, as the largest municipality in the region, Springfield has seen a reduction of energy use totaling at 62,708 MMBtus since 2007, which translates to an 11.2% reduction in the City's municipal energy use. When extrapolating to the entire Pioneer Valley, it is evident that steps municipalities take to reduce their energy use can make a large impact on the environment as well as having long-term cost saving benefits to cities and towns, which in turn allow municipalities to spend public funds on other well-deserving projects and initiatives. While many other variables affect municipal energy use such as the year-to-year changes in weather and yearly building use, energy efficiency measures clearly generate significant and positive impacts at the local level.

Municipal Energy Use Trends 2007-2012



Sources: Springfield DPW Greenfield DPW, Belchertown DPW, Northampton Office of Energy and Sustainability, Holyoke Office of Planning and Development

Global Research Occurring Locally

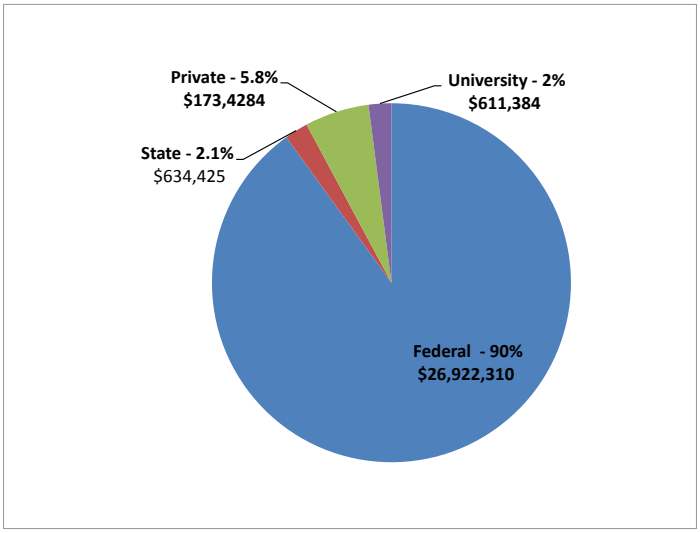
Clean energy technology is constantly evolving introducing a steady stream of more efficient, affordable, and renewable sources of energy. Research is an integral component which can be built based on past and current successes as well as a driver of clean energy innovation and entrepreneurship for the region. As a part of the interstate Knowledge Corridor, the Pioneer Valley boasts a large concentration of public and private higher education institutions as well as a wide array of research institutions pursuing clean and renewable energy alternatives. While much of this research is concentrated at the University of Massachusetts Amherst, there are a variety of partners at the regional, national, and international scales. Research centers associated with the University of Massachusetts Amherst include:

- The Wind Energy Center
- The Institute for Massachusetts Biofuels Research
- Polymer-Based Materials for Harvesting Solar Energy (PHaSE) Energy Frontier Research Center
- The Center for Renewable Energy Science and Technology

Among these research entities, nearly every aspect and topic for improving future renewable and clean energy is covered including, but not limited to, fuel cells, wind power, photovoltaic panels, and biofuels. These research centers are frequently at the cutting edge of developing and improving clean and alternative energy technology.

The University of Massachusetts Amherst receives the bulk of the research dollars flowing into the Pioneer Valley, totaling nearly $28 million in 2012. At the same time, there is research going on at other higher education institutions in the Pioneer Valley, including Mount Holyoke College and Smith College which secured $1,558,879 and $396,819, respectively towards their research efforts.

$30 Million in Clean Energy Research Funding by Source, FY 2012



Sources: Mount Holyoke College Faculty Grants Coordinator, Smith College Grants and Contracts Specialist, UMass Amherst Director of Research Development

In sum, the Pioneer Valley higher education institutions captured $29,902,403 in 2012 for clean energy related research.[5]

At 90%, or $26,922,310, Federal grants make up the large majority of the clean energy research grant funding coming to the Pioneer Valley, from agencies such as the U.S. Department of Energy and the National Science Foundation. The remainder of the clean energy research funding comes from a mix of funding sources including state, private sector, and college and university grants. Private funding accounts for the second largest source, totaling at $1,734,284 or 5.8% of all of the region's clean energy research funding. Last, state and college and university sources account for $634,425 and $611,384, respectively, or approximately 2% each, of total clean energy research funding coming into the Pioneer Valley in Fiscal Year 2012.

Conclusion

The Pioneer Valley has a strong profile in terms of clean and renewable energy projects, jobs, and research. There are few of the sixty-nine communities comprising the region that haven't been affected in some manner by "green" energy initiatives or technology either in the form of research, job creation, or new energy production installations. Incentives at the state level have encouraged thirty Pioneer Valley communities (47% of those eligible) thus far to achieve the Green Community designation and thereby helped to stimulated the region's economy with approximately $6 million worth of public sector clean energy investment. Energy efficiency improvements at the municipal level have saved hundreds of thousands of kilowatts of energy use throughout the region while cutting energy and fuel costs at the municipal level. As more communities meet Green Communities criteria, regional energy can be expected to steadily decrease while energy cost savings increase. In this way, municipalities are acting as leaders in increasing the region's renewable energy use and moving toward less reliance on fossil fuels. Given the concentration of higher education institutions throughout the interstate Knowledge Corridor, the Pioneer Valley captures significant grant funding for research. A majority of the $30 million total come from federal sources, with the largest portion going to the University of Massachusetts Amherst. As higher education institutions continue to partner with municipalities and businesses throughout the region as in the case of the Massachusetts Green High Performance Computing Center in Holyoke, research dollars have significant effects on the region's economy, creating and attracting businesses with higher paying jobs. The Western Massachusetts region (including Berkshire County) clearly stands as a leader in the state in regards to clean energy jobs per capita, with approximately twenty-four jobs per one-thousand workers.

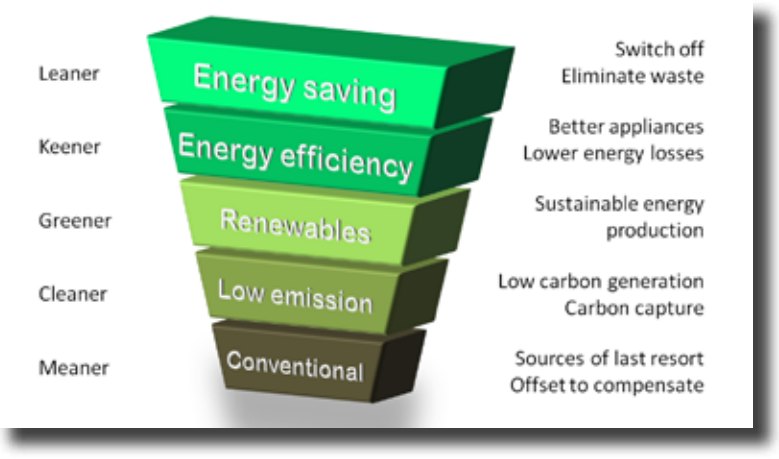
The Pioneer Valley produces more than 537,000 kilowatts of clean and alternative energy from a diverse array of sources including hydroelectric, landfill gas, photovoltaic, waste-to-energy, wind, and biomass. While non-renewable energy continues to provide the bulk of power to residents, businesses, and industries; efforts to increase the portion of energy produced from renewable and clean sources helps the region's economy and environment by encouraging lower energy costs and reduced levels of pollution. By continuing to invest in renewable clean energy projects while fostering high levels of energy efficiency and clean energy research, the Pioneer Valley can continue to retain its lead role in fostering a sustainable and dynamic economy.

5 Amherst College and Hampshire College did not have any significant funding grants related to clean energy research during the 2012 Fiscal Year.

Appendix – Aggregating Renewable Portfolio Standards

For the sake of simplicity, this report aggregated Massachusetts' two classes of Renewable Portfolio Standard and the Solar Carve-out program in an attempt to quantify the amount and types of clean and alternative energy in the Pioneer Valley. To calculate the true amount of clean and renewable energy produced in the region a "capacity factor" was used which can be defined as the ratio between the actual outputs of power plants over time to the potential output if the plant operated at full capacity. For example, when there is no sun for photovoltaic units or no wind for wind turbines, they cannot produce energy, despite their nameplate capacity. These capacity factors were established primarily from information and conversations with officials of Massachusetts Department of Energy Resources (DOER) and the Massachusetts Clean Energy Center (MassCEC).

Facility Type	Capacity Factor	Notes
Hydroelectric	**0.4**	Although the capacity factor for hydropower installations varies considerably by facility, 0.4 was established as a reasonable estimate based on discussions with DOER.
Landfill Gas	**0.86**	For new installations. A capacity factor of 0.85 was used for installations built before 2008 based on conversations with one owner of multiple landfill gas facilities in the region.
Photovoltaic (Solar)	**0.13**	Based on guidance from Mass DOER and Massachusetts Clean Energy Center
Waste to Energy	**0.85**	Although the capacity factor for waste to energy installations varies considerably by facility 0.85 was established as a reasonable estimate based on discussions with clean energy facility owners.
Wind	**0.26**	This estimate was provided by DOER for on-shore wind facilities.
Biomass	**0.85**	This estimate is for facilities that do not recover thermal energy. For this report only electrical generation was estimated.



Catalyst for Regional Progress

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