CLEANENERGYRESULTS

Annual Report to the Massachusetts Department of Energy Resources

Covering January 1, 2016 – December 31, 2016

Commissioner Suuberg at the Stop & Shop Anaerobic Digester Ribbon Cutting

2016

Massachusetts Department of Environmental Protection

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EXECUTIVE SUMMARY

The Clean Energy Results Program (CERP), which was launched in November 2011, is a first-of-its-kind partnership between the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Department of Energy Resources (DOER). This innovative program builds on MassDEP's regulatory expertise and authority to support DOER in advancing the permitting and development of renewable energy and energy efficiency projects throughout Massachusetts. MassDEP also works closely with the Massachusetts Clean Energy Center (MassCEC) and DOER on CERP program activities.

This Annual Report covers MassDEP activities performed from January 1 – December 31, 2016. It is being provided pursuant to the Memorandum of Agreement (MOA) executed between MassDEP and DOER, which also funds the Clean Energy Results Program.

In 2016, the Clean Energy Results Program continued to initiate and implement clean energy projects across Massachusetts. MassDEP, working with its CERP partners, continued to make significant progress permitting innovative projects, providing technical assistance, and collaborating on policy and regulatory initiatives that promote clean and renewable energy and energy efficiency projects. For example, MassDEP reviewed permits for several anaerobic digester projects during the year that will manage source-separated organics, furthering MassDEP's goal of diverting organics from disposal. In addition, MassDEP was part of a team of several Commonwealth agencies, including UMass Lowell and UMass Amherst, along with the United States Environmental Protection Agency (US EPA) that organized two workshops with the Food and Beverage Industry, focusing on not only increasing energy efficiency, but also reducing chemical use and use of safer cleaning materials, all with an eye toward reducing energy use and promoting improved operations and ultimately saving costs for the businesses. This work will continue through 2017.

Work done by MassDEP staff directly advanced numerous clean energy and energy efficiency projects including installation of solar PV systems on contaminated sites and landfills, construction of anaerobic digestion facilities, promotion of techniques for greener cleanups of contaminated sites, and promotion of energy efficiency projects at numerous facilities including wastewater and drinking water treatment facilities and industrial facilities.

Below are highlights from each key program area. More information on each of these can be found under the Detailed Program Progress section of this report.

Organics Diversion and Anaerobic Digestion

MassDEP has focused on development of anaerobic digesters (AD) as a way to manage organics since the establishment an AD task force in 2012 that investigated regulatory changes that would be needed, incentives the state might offer and whether a disposal ban on organics would be beneficial. Since then MassDEP has continued to work with several private and public partners on anaerobic digestion projects, providing technical and financial assistance as well as permitting. Several AD projects continue to move forward or have been constructed, including installation of second engines at Jordan Farm and Barstow Farm, new farm digesters at Barway Farm in Deerfield and Crescent Farm in Haverhill, and Quantum Biopower's co-digestion project at the Holyoke wastewater treatment plant. These facilities, should they all be constructed, will provide significant additional capacity for management of source separated organics. MassDEP, DOER and MassCEC will continue to provide financial incentives for the diversion of organics and support of anaerobic digestion technology development.

Grants for Organics Processing Equipment

In 2016, MassDEP, through the Sustainable Materials Recycling Program (SMRP), provided grants to four companies to assist with installation of de-packaging equipment that will process food waste, including packaged food waste, to provide organic waste feedstock for use by anaerobic digesters and composting facilities.

Renewable Energy at Contaminated Sites

MassDEP continued to work with developers of contaminated sites looking to install solar projects. Ten sites submitted pre-determination letters to DOER which, if all are constructed, will result in an additional 39.8 MW of solar. In addition, MassDEP worked with proponents of many more potential projects.

The Bureau of Waste Site Cleanup continued to encourage "Greener Cleanups" at contaminated sites, speaking at several conferences and workshops on the subject. In addition, a new program of recognizing leaders in greener cleanups was started in conjunction with the Licensed Site Professionals Association (LSPA) with recognition awards presented in September, 2016.

Food and Beverage Industry Initiative

Based on the successful model used with the water and wastewater utilities, a new initiative to hold workshops for the food and beverage industry began in 2016. This initiative was developed with a number of partners including UMass Lowell, UMass Amherst, USEPA, DOER, DAR, OTA and TURI. Two interactive workshops were held in Westboro and in Springfield designed to assist the industry with reducing their costs by providing information and assistance on energy efficiency, renewable energy, waste diversion and reduction and safer cleaning/sanitizing materials.

Water and Wastewater Utilities

MassDEP continued to focus its CERP partnership efforts to increase energy efficiency and expand clean generation projects at municipal drinking water and wastewater facilities across the Commonwealth. MassDEP's energy-saving efforts in the water sector began in 2007, with the launch of the Massachusetts Energy Management Pilot for Drinking Water and Wastewater Facilities. In 2007, the baseline year, 15,975 kilowatts (kW) of clean energy were in place and operating at municipal treatment and District facilities statewide. By the end of 2016, over 32,908 kW of new clean energy power were added-- bringing the statewide total of installed clean energy capacity operating at municipal water and wastewater facilities to over 48,883 kW. An additional 4,600 kW of clean energy generation projects were "in-process" and once completed will bring the total statewide clean energy capacity at water and wastewater facilities to 53,483 kW.

In 2016, MassDEP worked in partnership with the Harvard Kennedy School Ash Center for Democratic Governance and Innovation to engage an Ash Center Summer Fellow on a Clean Energy Results Analysis Project. The details of that Analysis Project are discussed in further detail later in this report.

Partnerships have been critical to the Commonwealth's success. One of the leading case study examples that embody this theme of partnership and results is the Greater Lawrence Sanitary District (GLSD). GLSD was part of the state-run Massachusetts energy pilot and the first 21 energy leader facilities in 2007. GLSD is the Commonwealth's third largest regional wastewater district- treating more than 33 million gallons of municipal and industrial wastewater from Andover, North Andover, Lawrence, Methuen, and Salem, NH. After a 20 year commitment to environmental and energy management, the GLSD operation is now on track to become a "zero-net energy" facility by 2018. Once completed, this facility will produce enough energy on-site to meet its own power needs – producing more than 27 million megawatt hours of electricity every year by harvesting biogas from the breakdown of organics and wastewater sludge. This will allow GLSD to be "energy resilient" and continue to operate off-the-grid as an island in the event of an emergency such as a major storm event.

Additionally, MassDEP continued to make progress on implementing a new statewide Pumping System Optimization (PSO) Pilot for drinking water and wastewater facilities with National Grid and Eversource. Pumping systems represent a major electrical load and therefore an opportunity for plants across Massachusetts to increase efficiency and reduce costs (pumping represents approximately 90% of electric usage for drinking water facilities and 20-30% at wastewater facilities). As a result of the implementation of this PSO Pilot in 2016, fourteen Massachusetts drinking water and wastewater facilities received "no-cost" pumping optimization evaluations. Based on PSO evaluations conducted at these facilities, approximately $400,000 of annual cost savings were identified and 3,200,000 kWhs could be reduced at an estimated total project costs of $2.0 million. Based on 2015 energy usage data from MA DOER's MA Energy Insight (MEI), MassDEP has analyzed the potential electricity and cost savings that could be achieved from a 10% sector-wide reduction in water pumping. As highlighted below, the economic and environmental benefits from these statewide reductions are significant. In 2017 MassDEP will continue to work on implementation of these efforts.

Potential Sector-Wide Electricity and Cost Savings at 10% Reduction Target

Facility Type	Electricity Usage (MWh) *	Potential 10% Pumping Reduction Electricity (MWh)	Potential Annual Cost Savings ($)
Wastewater Treatment & Collection Stations	260,674	5,213	$938,427
Drinking Water Treatment & Distribution Stations	169,358	15,242	$2,743,597
Totals	**430,032**	**20,456**	**$3,682,025**

*Energy data from DOER's – MA Energy Insight (2015)

The Massachusetts Clean Energy Partnership for Drinking Water and Wastewater Facilities expanded its national outreach through the publication of two articles in the Journal of American Water Works Association in 2016. The American Water Works Journal is the oldest and largest nonprofit, scientific and educational organization that reaches over 41,000 water industry leaders every month. The first article was published in the July, 2016 issue– titled "Innovation in the Water Sector: Pathway to Zero-Net Energy", and the second article appeared in the October, 2016 edition – titled "Massachusetts' Return-On-Investment: A 'Gap Funding' Model for Success." Links to these articles can be found in the Related Information section.

Detailed Program Updates

Food and Beverage Industry

MassDEP has also been looking to build on the success of the Clean Energy at Water and Wastewater Facilities program with another industry sector. This industry sector is somewhat different than water and wastewater facilities in that it is a very broad sector with very large, multi-national companies and very small companies. Therefore, the resources available to focus on addressing such topics as energy efficiency or use of safer cleaning materials vary substantially.

A team consisting of MassDEP; UMass Lowell, Center for Sustainable Production; UMass Amherst, Center for Energy Efficiency& Renewable Energy; UMass Clean Energy Extension; USEPA, Region I; the Department of Agricultural Resources; the Department of Energy Resources; the Department of Public Health; the Office of Technical Assistance; and the Toxics Use Reduction Institute; organized two workshops with the Food and Beverage Industry focusing on reducing costs for the industry by improving energy efficiency and use of renewable energy, reducing chemical use, using safer cleaning materials, and promoting improved operations.

Workshops were held in Westboro and Springfield and were organized to help companies learn about the opportunities that are available to them to reduce energy use, water use or toxic chemicals use and thereby save money. Two or three companies highlighted the types of sustainability practices they had considered and put into place with the idea that many of the practices are transferable to other businesses. The workshops provided opportunities for companies to learn about no cost energy audits than can be provided by the energy suppliers and UMass. In addition, companies could discuss other sustainability topics such as using less toxic cleaning agents, opportunities to divert waste from disposal to composting or anaerobic digestion, etc. Some of the “take away” points that attendees commented on include:

- There are many opportunities
- There are many experiences to draw from
- Other companies have similar challenges
- Schedule an audit
- Talk to your energy utility first!
- There are free resources available
- Seek assistance on energy, waste, usage issues from experts

As a direct result of the workshops, several companies scheduled energy audits with their energy provider or UMass and have started to put the resulting recommendations into effect. In addition, via contacts made at the workshops companies have contracted to divert organics from going to disposal and sought further information about less toxic cleaning agents.

Additional workshops will be held in 2017 to reach food and beverage companies in other parts of the Commonwealth.

The workshops were made possible by a grant from EPA Region I to the University of Massachusetts, Lowell.

Anaerobic Digestion/Organics Diversion

MassDEP continues to prioritize development of anaerobic digesters and diversion of source separated organics (SSO), working closely with its state partners through the Massachusetts Organics Subcommittee and other forums to promote and support diversion of source-separated organics and siting anaerobic digestion projects. During 2016 several projects made significant strides forward. In support of AD projects, MassDEP expanded its efforts to develop an organics collection infrastructure to provide the necessary feedstock for energy production through anaerobic digestion. MassDEP also updated its Organics Action Plan to reflect progress in February, 2017. Strong emphasis over the last 12 months has been on educating generators that may fall under the ban on how to comply and successfully divert their organics. The updated Organics Action Plan may be viewed on the MassDEP web site at: http://www.mass.gov/eea/docs/dep/public/committee-3/orgplanf.pdf

Organics Waste Ban

The Organics Waste Ban went into effect October 1, 2014. During 2015 and 2016, much of MassDEP's efforts to implement the ban were focused on providing technical assistance to commercial generators of greater than one ton per week of organics on how to comply with the ban and divert their organics.

Creation of Framework/Infrastructure for Increased Organics Diversion

MassDEP, through RecyclingWorks in Massachusetts, provided technical assistance to dozens of commercial generators of organics on how to establish a successful organics diversion program. Several case studies have been published on the RecyclingWorks website, RecyclingWorks, to serve as model programs for other businesses. RecyclingWorks, with input from the Massachusetts Health Officers Association and solid waste haulers, has issued guidance on best management practices for storing and collecting organics. This guidance will provide health officials with information on how best to establish storage and collection requirements in their communities to reduce any impacts. RecyclingWorks has published information on on-site processing technologies of organics that may be utilized by larger organics generators. MassDEP Municipal Assistance Coordinators have provided technical assistance to several communities looking to pilot organics collection for residents, including Newton, Ipswich, Manchester, Cambridge, Salem and Hamilton.

Financial Incentive Programs

During 2016, MassDEP's Recycling Business Development Grant program targeted expansion of processing capacity for source separated organic materials to help ensure there will be sufficient feedstock to serve anaerobic digesters being permitted and constructed. Four facilities received grants in 2016 to install processing equipment that is capable of processing organics and/or de-packaging out-of-date pre-packaged food.

The grant recipients included:

> **Recycleworks , Inc., East Weymouth – Up to $200,000**
> Recycleworks, Inc. looked to funding to purchase a specialized baler that de-packages food and beverage products, allowing for the recovery of containers and liquids. Packaging material will be marketed, and outlets will be found for liquids (e.g., animal feed, anaerobic digestion, composting, gray water and natural detergent ingredients.)

CRMC Bioenergy, LLC - Up to $200,000
CRMC Bioenergy, LLC of Mansfield, a wholly-owned subsidiary of CommonWealth Resource Management Corporation (CMRC), owns and operates the existing CRMC Bioenergy Facility at the Crapo Hill Sanitary Landfill in Dartmouth. CRMC sought funding to add the ability to source and accept bulk materials in the quantities required to support the planned expansion of their operating pilot-scale anaerobic digestion project. The grant will be used, in part, to purchase de-packaging equipment that will enable the facility to accept and process bulk organics that are packaged or have some level of contamination into a pump-able, slurried form for anaerobic digestion.

EL Harvey and Sons, Inc. - Up to $100,000
EL Harvey and Sons, Inc. of Westborough is a family-owned and -operated waste and recycling corporation. EL Harvey sought funding to purchase a tank to be used with de-packaging equipment. The grant will be used, in part, to purchase a vertical silo tank to be used with de-packaging equipment that will store processed organics in slurry form, which will feed anaerobic digestion. This comprehensive process will divert an estimated 10,000 tons per year of organics that is currently landfilled or incinerated.

Troiano Trucking, Inc. - Up to $200,000
Troiano Trucking Inc. of North Grafton has a history of recycling food. Troiano currently takes in about 25 tons of wasted food per day and transfers it to animal feed operations. Troiano sought grant funding to expand their business from trucking to manufacturing. The grant will be used, in part, to fund a Scott Turbo Separator that will enable the facility to accept and process bulk organics that are packaged or have some level of contamination and convert it into high-quality animal feed.

Siting of Anaerobic Digestion Facilities

The siting of new anaerobic digestion facilities proceeded on several fronts in 2016. The Stop & Shop digester, located at the Stop & Shop distribution warehouse in Freetown, Mass. completed construction of its AD facility in early 2016 and started operations. The digester handles organic waste from Stop & Shop's New England stores and it supplies about 40% of the warehouse's needs for power.

Following the evaluation of state properties for the potential for siting anaerobic digestion, MassDEP and the Division of Capital Asset Management and Maintenance (DCAMM) narrowed the list to three candidate properties that were evaluated further through feasibility studies conducted during 2013 at MCI-Shirley, MCI-Norfolk and the Amherst Wastewater Treatment Plant (on the UMass-Amherst campus). Ultimately it was determined to move forward with two sites - MCI-Shirley and the Amherst Wastewater Treatment Plant. Upon approval of an exemption by DCAMM's Asset Management Board in 2015 that would allow the MCI-Shirley project to enter into a long-term power purchase agreement (PPA), DCAMM proceeded with procurement to implement a long-term PPA with a selected vendor. DCAMM developed an RFQ that was issued in August 2016. Unfortunately, no bids were received for the project and further evaluation of the project is required.

Permitting and Construction of Anaerobic Digestion Facilities

The Greater Lawrence Sanitary District (GLSD) facility AD expansion project was permitted in 2016, with the final air permit issued on April 12, 2016. Construction of the expansion of the facility continued through the remainder of 2016 and should allow the facility to start up the operation of its pilot phase during winter and spring, 2017. During the pilot phase the facility will slowly ramp up introduction of organics into the existing digesters to co-digest the organics with the sludge generated by the facility. Full-scale operations with organics is expected to commence in 2018 upon completion of construction of the fourth digester and installation of the two combined heat and power (CHP) units.

Air permits were also issued in 2016 for the installation of a second engine at both Jordan Farm in Rutland and Barstow's Farm in South Hadley. A new digester to be located at Barway Farm in Deerfield was also permitted, allowing the facility to construct and become operational by the end of 2016. There are currently four farm facilities operating digesters in the Commonwealth. It is expected that in the future Crescent Farm in Haverhill, which submitted permit applications at the end of 2016, will begin construction early in 2017. When these five facilities have completed construction and are operating at full capacity they will generate approximately 4.75 MW of power.

Pre-permit meetings have been held with three other farms on proposals to add AD facilities, including Hunt's Farm in Orange, Luther Belden Farm in Hatfield, and Rockwood Farm in Granville. Pre-permit meetings were also held by MassDEP with Quantum BioPower regarding a proposed co-digestion AD facility to be located at the Holyoke wastewater treatment facility.

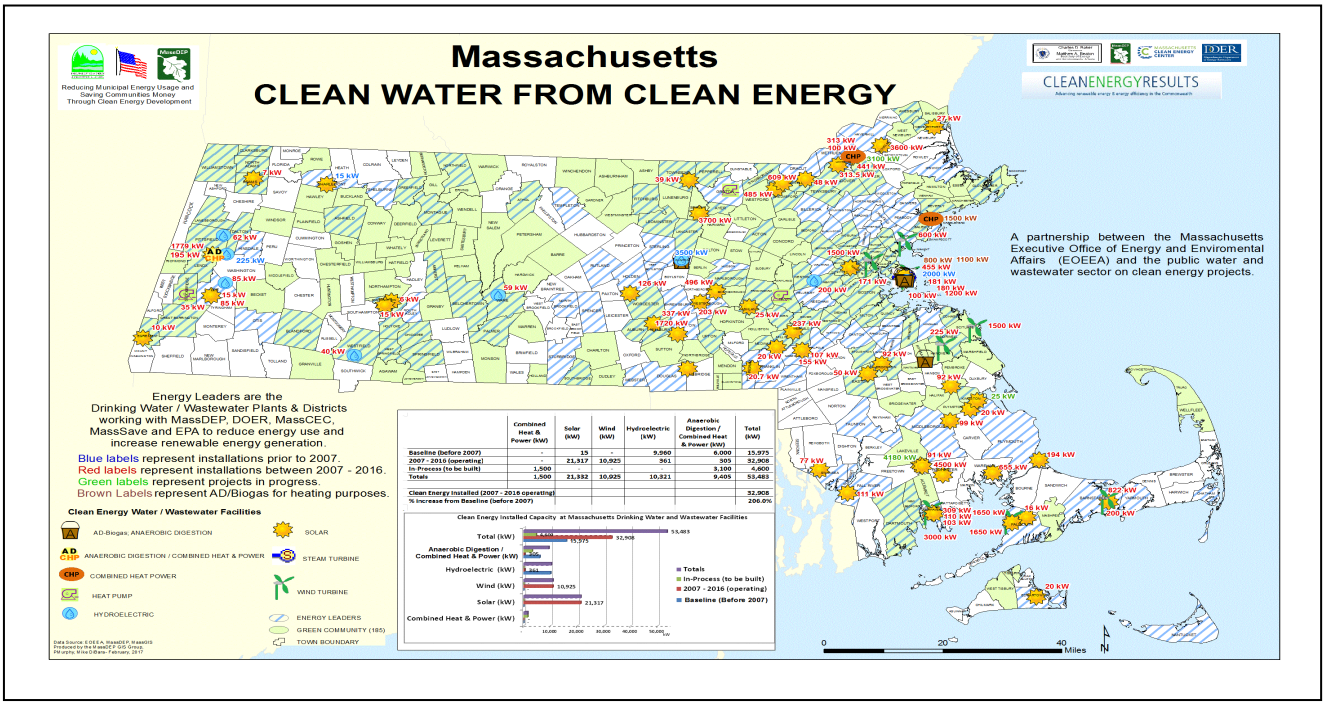
Clean Energy at Drinking Water and Wastewater Utilities

MassDEP continued to educate, engage and leverage technical and financial assistance resources for the benefit of drinking water and wastewater facilities. Programmatic efforts involved connecting and leveraging organizational resources from MassDEP, Mass Save®, MA DOER, Mass CEC, USDA – Rural Development, US EPA, and the University of Massachusetts.

Over 32 Megawatts of New Clean Energy Generation Added – Doubling Statewide Capacity Since 2007

Clean energy generation capacity at municipal drinking water and wastewater facilities rose by an additional 32 megawatts since 2007. Overall, this represents an annual average increase of over 20% growth of clean energy per year. Solar photovoltaic (PV) installation projects represented nearly 65% (21.3 megawatts) and wind projects accounted for 33% (10.9 megawatts) of the new generation. By the end of 2016, over 48.8 megawatts of clean power generation were operating. Once several projects that are currently "in-process" are completed, there will be over 53.4 megawatts of clean generation capacity statewide.

Figure 1. Clean energy installed capacity at Massachusetts drinking water and wastewater facilities

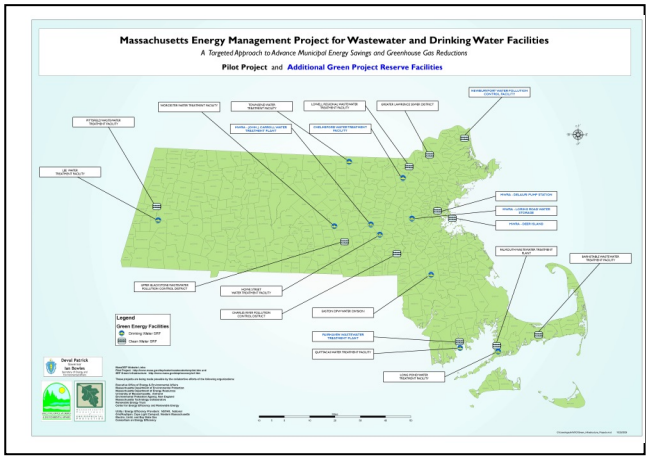


	Combined Heat & Power (kW)	Solar (kW)	Wind (kW)	Hydroelectric (kW)	Anaerobic Digestion / Combined Heat & Power (kW)	Total (kW)
Baseline (before 2007)	-	15	-	9,960	6,000	15,975
2007 - 2016 (operating)		21,317	10,925	361	505	32,908
In Process (to be built)	1,500				3,100	4,600
Totals	1,500	21,332	10,925	10,321	9,405	53,483
Clean Energy Installed (2007 - 2016 operating)						32,908
% Increase from Baseline (before 2007)						206.0%

Verifying Clean Energy Results: Actual Revenue and Energy Savings Calculated for 21 Facilities

With the number of highly successful clean energy projects completed by the Massachusetts water sector, it is important to track and accurately measure the results. MassDEP worked with a Summer Fellow from the Harvard Kennedy School's Ash Center to analyze the actual economic and environmental results for the first 21 "energy leader" drinking water and wastewater treatment facilities (14 Pilot sites and 7 Green Project Reserve sites) funded under the American Recovery and Reinvestment Act of 2009 (ARRA)). These facilities voluntarily joined our Clean Energy Partnership in 2007 and using audits and renewable energy assessments projected their estimated energy savings and clean energy generation. (The facilities are identified below in Figures 2 & 3).

Figures 2 & 3. First 21 "Energy Leaders" – MA Clean Energy Partnership; and EPA Case Study



Since the initial projections were done for the launch of the 2007 project, all of the projects have been constructed and installed, but the energy savings and generation amounts were not verified, as they were not required to be reported to MassDEP. This project, which sought to verify energy results, involved the collection and compilation of large amounts of facility energy usage and clean energy generation data voluntarily provided by the facilities – spanning 10 years (2007 – 2016). Working in partnership with MA DOER and the 21 participating treatment facilities, the Summer Fellow compiled and analyzed actual energy usage data from utility bills, the amount of on-site renewable energy generated, and any Renewable Energy Credit (REC) revenues received. Total "revenue" (in dollars) included: the savings resulting from energy efficiency; the value of energy generated on-site; and the revenue from Renewable Energy Credits. The data were compiled for the period of 2013-2016, chosen for this detailed analysis because by then all the projects were operational. (See figure 4 below.)

Table 1. Total Actual Revenues and Greenhouse Gas Reductions (21 Sites)

	Usage Savings	Energy Generation	Rec Revenue	Total Revenue	GHG (tons)
Wastewater Pilot (7 Sites)	$3.34M	$4.81M	$1.59M	$9.76M	9,790
Drinking Water Pilot (7 Sites)	$1.19M	$0.48M	$0.27M	$1.94M	1,283
Subtotal				**$11.70M**	**11,074**
Additional Wastewater (4 Sites)	$0.29M	$1.72M	$0.40M	$2.42M	4,061.06
Additional Drinking Water (3 Sites)	$0.83M	$1.65M	$0.50M	$2.97M	4,789.29
Subtotal				**$5.39M**	**8,850**
Totals (21 Sites)				**$17.09M**	**19,924**

Total Greenhouse Gas Reductions

19,924 tons

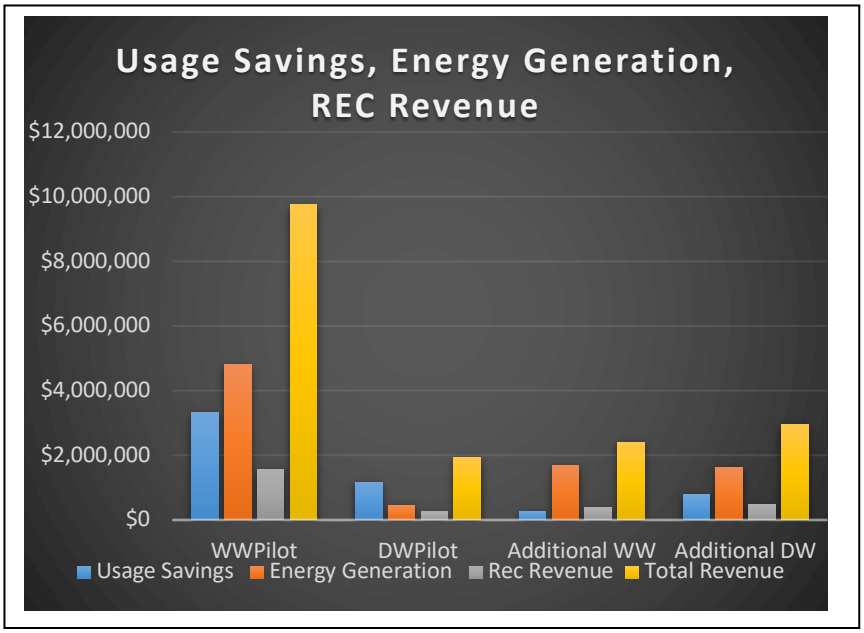
The results (see Tables 1 and 2) indicated that the total energy savings from the 21 sites was 90.24 million kilowatt hours (kWh) from 2013 to 2016, which is 22.64% less than the 2007 projected estimate. The total avoided costs and revenues was $17.09 million (15.88% lower than the 2007 estimate, based on the total energy savings and actual energy generation. The smaller actual savings and revenue may have been a result of several factors, including increased wastewater flow through the wastewater treatment facility, more energy intensive treatment required to meet effluent limits, and higher energy costs than originally projected.

Table 2. Actual vs. Estimates: Revenue and kWh Saving Results (FY13 - FY16)

Actual	Total KWh Savings (KWh)	Total Revenue ($)	Estimates	Total KWh Savings (KWh)	Total Revenue ($)
14 Pilot sites	58.02M	11.70M	14 Pilot sites	81.92M	14.86M
7 sites	32.22M	5.39M	7 sites	34.74M	5.45M
Grand Totals	90.24M	17.09M	Grand Totals	116.65M	20.31M

Despite the lower projected total savings and revenue from these projects, the results are still impressive. The chart below shows the total savings broken down by wastewater and drinking water, and compares the first 14 pilot facilities with the second set of 7 sites. It is worth noting that the total energy savings and revenue generated were higher in the wastewater sector than in the drinking water sector, although significant clean energy generation was documented in the drinking water sector.

Figure 4. Actual Financial Results: First 21 "Energy Leader" Facilities (FY13 - FY16)

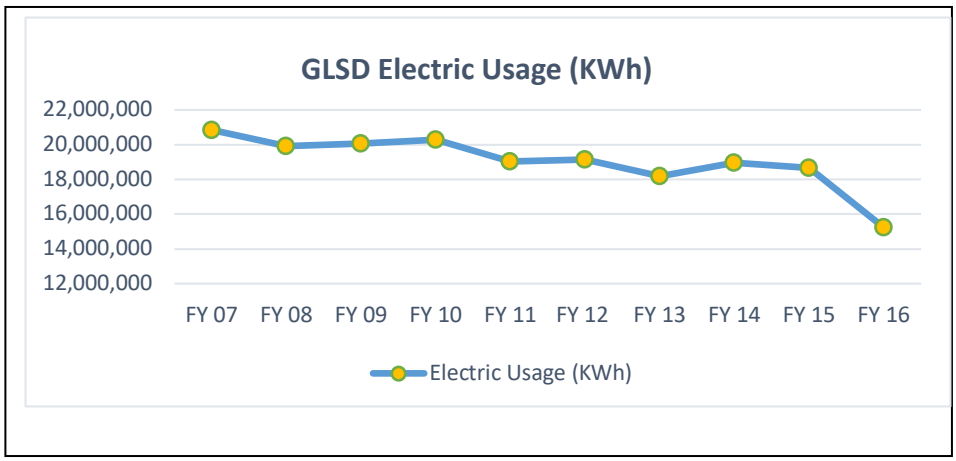


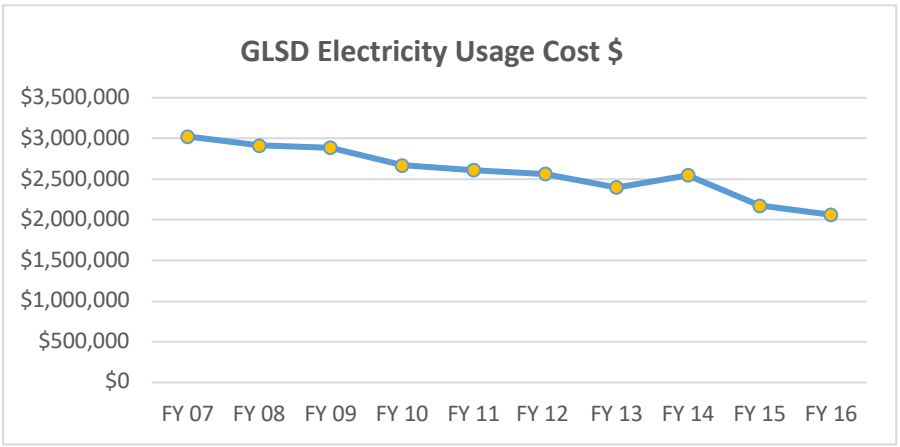
Greater Lawrence Sanitary District (GLSD) on a Pathway to "Zero-Net" Energy Status

Beginning in 1995, in response to concerns about its energy consumption, the Greater Lawrence Sanitary District (GLSD) facility began to look at ways to reduce its operational costs. Over the next 10 years, the facility conducted several targeted energy audits that enabled facility managers to understand energy consumption, identify opportunities for energy efficiency improvements, and identify and prioritize projects to reduce costs and GHG emissions.

Building on these earlier efforts, the GLSD wastewater facility joined six other Massachusetts wastewater treatment plants and seven drinking water facilities in late 2007 to participate in the first phase of the Massachusetts Energy Management Pilot for Drinking Water and Wastewater Treatment Facilities. Led by the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Executive Office of Energy and Environmental Affairs, this pilot program assisted drinking water and wastewater facilities in saving money while reducing their energy consumption and GHG emissions. In order to achieve these goals, the program created a new public/ private partnership that brought together state and federal agencies, electric and gas utilities, and other partners to share resources and knowledge.

During the last decade, through collaboration with the MassDEP, MA DOER, MA Clean Energy Center, US EPA, University of Massachusetts – Lowell and the energy utilities, GLSD has successfully implemented energy efficiency and clean energy generation projects that has produced annual energy cost savings of more than $1 million, reduced its annual electricity demand by more than 5.7 million kilowatt hours - a 30% reduction- and cut the plant's carbon footprint by more than 3,000 tons.





GLSD is now implementing an "Organics-to-Energy" program where it will combine up to 140,000 tons per year of source-separated organics with its sewer sludge in the plant's anaerobic digesters to produce heat and electricity to help power its operations. Upon completion of their organics-to-energy project, GLSD will be producing more than 27 million megawatt hours of electricity on-site, every year by harvesting biogas from the breakdown of organics and sludge. And this will also allow GLSD to be "energy-resilient" and continue to operate off-the-grid as an island in the event of an emergency such as a major storm event.

Massachusetts Pumping System Optimization Pilot Moves into Evaluation Phase

MassDEP made significant progress in advancing a new statewide pumping system optimization (PSO) pilot for drinking water and wastewater facilities with National Grid and Eversource. Pumping systems represent a major electrical load and therefore an opportunity for plants across Massachusetts to

increase efficiency and reduce costs, (pumping represents approximately 90% of electric usage for water facilities and 20-30% at wastewater facilities). Identifying and implementing energy efficiency improvements at water and wastewater plants has been a major focus of our energy management efforts. In 2016, this pilot entered the assessment and implementation phases. As highlighted in the table below, Twelve Massachusetts facilities received "no-cost" pumping system optimization evaluations from National Grid and Eversource; and two evaluations were conducted at Municipal Light Plant facilities. Overall, these evaluations focused on the following:

- Evaluation of the base case scenario (existing operation)and determination of the baseline energy usage;
- Estimation of the energy usage of a more efficient pumping operation to provide reduced energy usage; and
- Calculation of energy use and savings.

The following municipal drinking water and wastewater facilities received pumping system optimization evaluations in 2016:

National Grid	Eversource	Municipal Light Plants
Greater Lawrence Sanitary District	Walpole Water	Hull Wastewater
Gardner Water Plant		Lynnfield Water
Fall River Water Plant		
Hoosac Water Quality District		
Lynn Water and Sewer Commission		
South Essex Sewer District		
MWRA – Quincy Pumping Station		
MWRA – Weymouth Pumping Station		
Southbridge Water Treatment Facility		
Upper Blackstone Water Pollution Abatement District		
Webster Wastewater Treatment Plant		

Based on PSO evaluations conducted on fourteen facilities, approximately $400,000 of annual cost savings were identified and 3,200,000 kWhs could be reduced. MassDEP will work with the project partners, in 2017, to develop a coordinated plan to cost-effectively jump start these energy saving opportunities. In addition to the energy and cost savings, these implementation projects could result in improved pump system performance and reliability, and reduced maintenance and labor costs.

Pumping optimization projects have been implemented at three facilities -- MWRA Deer Island Wastewater Treatment Plant, Wareham Fire District, and the West Springfield Wastewater. Overall, at a total project cost of $216,711, these energy efficiency improvements are anticipated to save $57,116 and 589,285 kWh annually.

Drinking Water Program Advances Solar Energy Generation on Public Water Supply Lands

MassDEP's drinking water program continued to provide technical assistance to water suppliers interested in developing solar photovoltaic projects on public water supply lands.

MassDEP streamlined the review process for solar and wind projects on public water supply lands in 2011. Under this program, a solar power purchase agreement is made between the energy developer and the water supplier to provide solar electricity at guaranteed long-term rates or generate income from leasing the land. The energy developer provides design, financing, maintenance and support for all the elements of the solar electricity system.

In 2016, MassDEP granted approval to two new solar development projects at public water systems on Cape Cod.

> **North Sagamore Water District** - A 195 kW ground-mounted solar system was approved by MassDEP on February 26, 2016 and became operational in August 2016. The North Sagamore Water District will generate approximately $450,000 in revenues by leasing the land with a net metering agreement over a 20 year period. This project will reduce their annual electricity bill by approximately 30%. The District plans to use these energy savings from this project to make upgrades to their water infrastructure.
>
> **Oak Bluffs Water District** – A 1.46 MW ground mounted solar system was approved by MassDEP on August 4, 2016.

Since 2011, MassDEP has approved 15 solar PV projects on public water supply lands that are generating nearly 22 megawatts of electricity statewide.

MassDEP coordinated with US EPA in developing a national EPA brochure titled '*Reducing Operating Costs and Energy Consumption at Water Utilities – with Water-Source heat Pump Systems.*' The Town of Stockbridge's drinking water plant, water source heat pump project, was featured along with the Freeport Wastewater Treatment Plant in Maine. Stockbridge received a $39,000 grant from the Massachusetts 2014 Gap Funding Program. The brochure is posted on US EPA's website: https://www.epa.gov/sites/production/files/2017-04/documents/water_utility_heat_pump_brochure_508.pdf

Renewable Energy on Closed Landfills

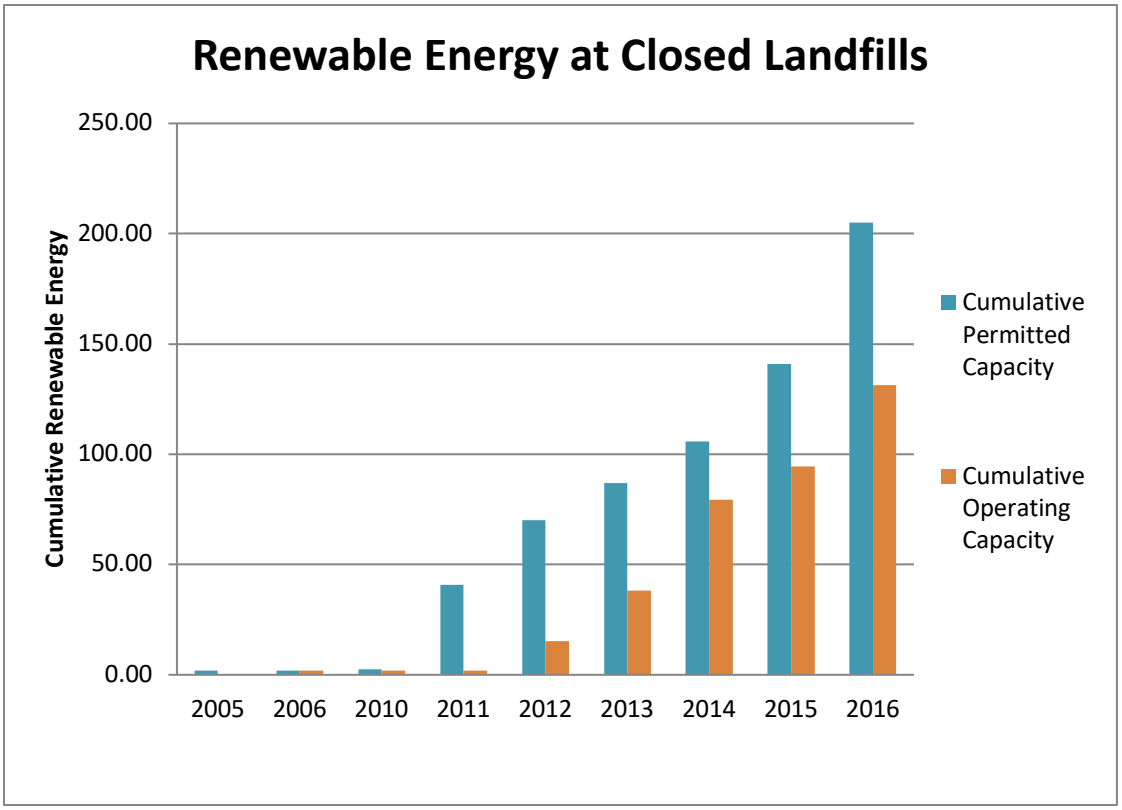
During 2016, MassDEP continued to review and approve solar PV projects at closed landfills while several previously approved projects completed construction and came online. Through the end of 2016, 89 landfills had received post-closure use permits for a total of 204.9 MW of solar and wind and 58 projects generating 131.2 MW had come on line and are now operating. Operating landfill renewable energy projects represent over 8% of operating renewables in Massachusetts. The following lists summarize the activities that occurred with solar-on-landfill projects during 2016:

> **22 New, Modified or Revised Post-Closure Use Permits for Solar-on-Landfill Installations Rated at a Total of 64.8 megawatts (MW):**
>
> - Ashland Landfill 0.907 MW
> - Berkley Landfill 3.66 MW
> - Bird Inc. Landfill (Walpole, revised approval) 2.4 MW
> - Boxford Landfill 0.912 MW
> - Brockton Sanitary Landfill 4.6 MW
> - Cape Resources C&D Landfill (Barnstable) 3.7 MW

- Cedar Street Landfill (Cohasset) 0.56 MW
- Dover Landfill 1.6 MW
- Emery Street Landfill (Palmer, revised approval) 5.0 MW
- Falmouth Landfill 4.5 MW
- Greenwood Street Landfill (Worcester) 5.6 MW
- Groton Landfill (revised approval) 2.93 MW
- Lenox Landfill (modified approval) 0.7488 MW
- Main Street Landfill (Saugus) 1.66 MW
- North Carver Landfill (Carver) 1.7 MW
- Northampton Landfill 3.12 MW
- Plainville Landfill 6.0 MW
- Republic Services BFI Landfill (Randolph) 4.5 MW
- Republic Services Landfill (East Bridgewater) 6.0 MW
- Stockbridge Landfill 0.9 MW
- Titcomb Pit Landfill (Amesbury) 2.8 MW
- Wilbraham Landfill 0.927 MW

Eight MassDEP-Approved Solar-on-Landfill Projects Began Operations in 2016, Generating a Total of 22.8 MW:

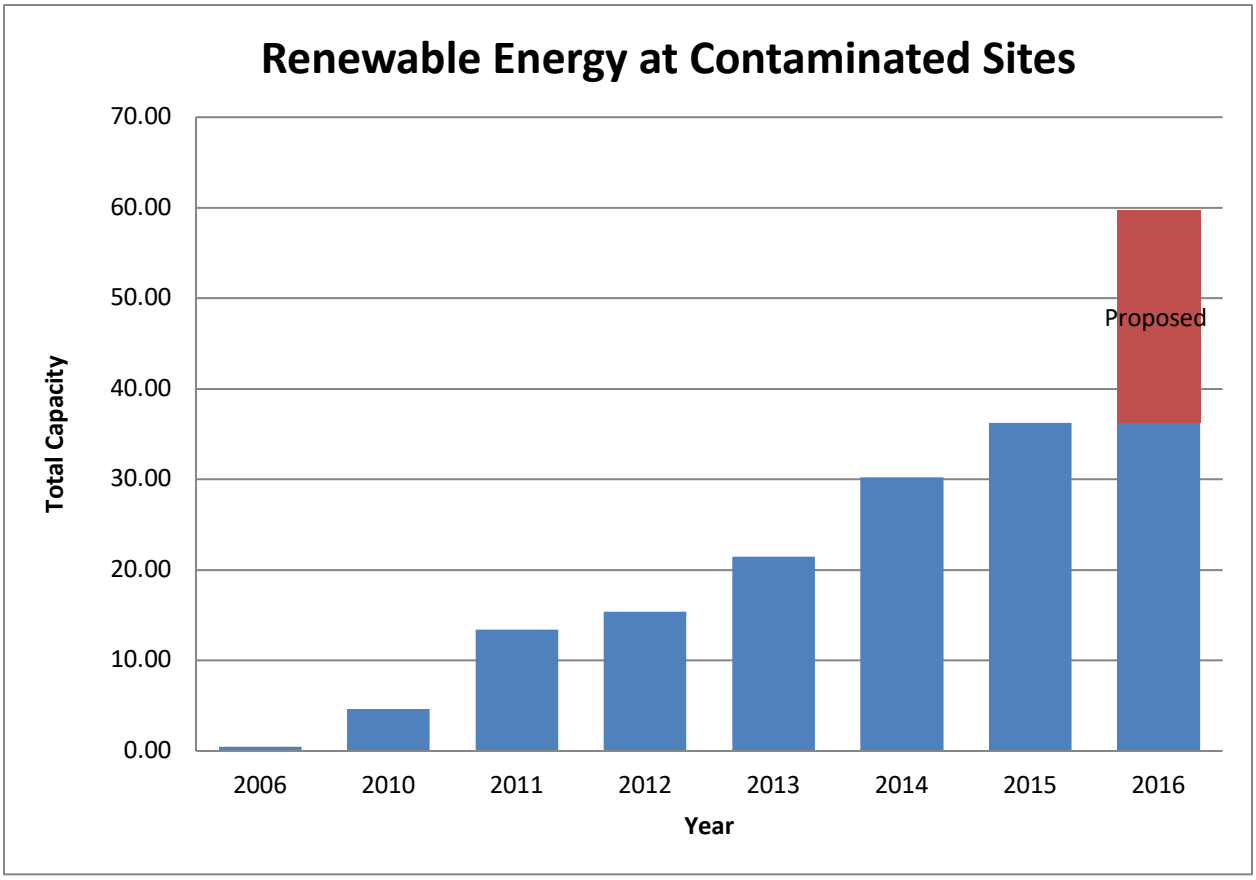
- Bellingham Landfill 4.29 MW
- Groton Landfill 2.93 MW
- Needham Landfill 3.7 MW
- Norton Landfill 1.9 MW
- Palmer Landfill 5.0 MW
- Webster Landfill 1.8 MW
- Weston Landfill 2.27 MW
- Wilbraham Landfill 0.927 MW



Renewable Energy on Contaminated Sites

MassDEP continued to work with property owners and developers interested in developing new solar projects on contaminated sites/brownfields. 10 pre-determination letters were filed with DOER in 2016, which will represent an additional 40 MW of power if all are constructed, adding to the 36.22 MW already operating on contaminated sites. Those that have received pre-determination letters include:

- Former Cowles Gravel Site, Westfield, RTN 1-19856, 2.6 MW's
- FMR Berkshire Truck Plaza, West Stockbridge, RTN 1-11099, 2 MW's
- Former Lucent Technologies, North Andover, RTN 3-0174, 6 MW's
- Former Lucent Technologies II, North Andover, RTN 3-0174, 6 MW's
- W.R. Grace, Concord, RTN 2-0000010, ~ 4.5 MW
- Lexington Landfill, Lexington, RTN 3-21522, ~ 2.2 MW (no PCUP, closed via 21E w/AUL)
- General Latex/DOW Property, IHP Superfund, Billerica, RTN 3-0000237, 4.0 MWs *(No PD)*
- IHP Asbestos landfill, IHP Superfund, Billerica, RTN 3-0000240, 6.0 MWs *(No PD)*
- MBTA, Dedham, RTN 3-0002856, 3.0 MWs *(No PD)*
- Bird Machine & Company, Walpole, RTN 4-3002469, 4.1 MWs *(No PD)*



Greener Cleanups Awards

MassDEP honored four members of the Licensed Site Professionals Association (LSPA) with Greener Cleanups Awards at the LSPA's September Membership Meeting in Newton, MA.

The Greener Cleanups Awards were presented to the following Licensed Site Professionals (LSPs) and their clients for demonstrating professional stewardship in promoting Greener Cleanup principles and practices to reduce the overall net environmental footprint of hazardous waste site cleanup response actions implemented under the Massachusetts Contingency Plan:

- Donald Podsen, LSP, Managing Hydrogeologist at Brown & Caldwell in Andover, Massachusetts and his project team received the Greener Cleanup Leadership Recognition Award for their work with the City of Medford at the 448 High Street Site in Medford, Massachusetts.
- J. Andrew Irwin, PE, LSP, *President of* IRWIN Engineers in Natick, Massachusetts received a Greener Cleanup Leadership Award, Honorable Mention for his work with Brownfields Real Estate Development LLC at the 129 Concord Road Site in Billerica, Massachusetts.
- David Austin, LSP, Senior Project Manager at AECOM in Chelmsford, Massachusetts received a Greener Cleanup Leadership Award, Honorable Mention for his work with Pentair at the Former Tyco Valves & Controls Site in Wrentham, Massachusetts.
- Matthew Hackman, LSP, President at Matthew Hackman, PE, CHMM, Inc. in Warwick, Rhode Island received an award for Greener Cleanups Stewardship.

Greener Cleanups are promoted by MassDEP in an effort to eliminate or reduce total energy use, air pollutant emissions, greenhouse gases, water use, materials consumption, and ecosystem and water resources impacts related to the assessment and cleanup of property where oil or hazardous materials have been released into the environment.

Related Information

- **Innovation in the Water Sector: Pathway to Zero-Net Energy**

http://www.mass.gov/eea/docs/dep/energy/jaw201607snow-npr.pdf

- **Massachusetts Return-On-Investment: A 'Gap Funding' Model for Success**

http://www.mass.gov/eea/docs/dep/energy/jaw201610dibara-npr.pdf

Summary of Goals for 2017

MassDEP will continue to work with DOER and MassCEC to pursue energy efficiency and renewable energy projects at facilities across the Commonwealth in 2017 as well as look for opportunities, such as with the food and beverage industry, to continue to expand our work to new categories of facilities.

• Implement "Gap" Grant II – Conduct outreach and issue program for a second round of "Gap" grants
• Continue to issue post-closure use permits for utility scale solar projects on old capped and closed landfills
• Continue to work with developers to install utility scale solar projects at contaminated land/brownfield sites and bring such sites back into productive use
• Continue to promote green and sustainable remediation practices including the deployment of energy efficiency measures and renewable energy technologies in site cleanup applications
• Continue to promote the application and installation of renewable thermal technologies/Ground-Source Heat Pumps for building heating and cooling and remedial process water qualifying under the Alternative Portfolio Standard (APS)
• Explore opportunities for deployment of climate change adaptation and resiliency measures inclusive of energy storage and standby power applications for remedial systems supported by the Energy Diversity Act and Governor Baker's Executive Order 569.
• Hold workshops, modeled on the highly successful Clean Energy Partnership for Water and Wastewater Facilities, with the food and beverage industry to promote energy efficiency, waste reduction, toxics reduction and greener cleaning
• Continue to work on developing anaerobic digester projects to provide infrastructure for managing diverted waste organics
• Use every opportunity to work with partners DOER and MassCEC, to encourage businesses and facilities that MassDEP regulates to conduct assessments and implement energy efficiency measures and/or renewable power