

Leading by Example: Reducing Energy Use in State Facilities

PREPARED BY

The Connecticut Department of Energy
and Environmental Protection



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Energy and Technology Committee

Table of Contents

EXECUTIVE SUMMARY AND SNAPSHOT OF ACCOMPLISHMENTS	2
PUBLIC COMMENTS ON DRAFT REPORT	2
FOUNDATIONAL WORK COMPLETED; ADVANCEMENTS ONGOING	2
INCREASED SAVINGS – EACH YEAR	2
NEXT STEPS.....	3
2016 SNAPSHOT OF ACCOMPLISHMENTS	4
STATUTORY REQUIREMENTS	5
OVERVIEW OF “LEAD BY EXAMPLE” PROGRAM: IMPROVING ENERGY MANAGEMENT IN STATE FACILITIES	5
STATE ENERGY USE REDUCTION PLAN.....	8
INVENTORYING FACILITIES, COLLECTING DATA, AND CORRELATING ENERGY DATA WITH BUILDINGS	8
ESTIMATING A BASELINE.....	8
CURRENT STATUS.....	9
BENCHMARKING BUILDINGS.....	10
PROCUREMENT - ENERGY MANAGEMENT SERVICES AND ENERGY SUPPLY	10
FINANCING MECHANISMS	11
SCREENING, ASSESSING, PRIORITIZING.....	11
RESULTS: SUMMARY OF LEAD BY EXAMPLE ENERGY USE REDUCTION ACHIEVEMENTS THROUGH CALENDAR YEAR 2016.....	11
SMALL-SCALE PROJECTS [USE OF UTILITY ADMINISTERED PROGRAMS TO SIMPLIFY ENERGY-EFFICIENT UPGRADES]	11
MEDIUM-SCALE PROJECTS [BOND FUND INVESTMENTS]	12
LARGE-SCALE PROJECTS [GUARANTEED ENERGY SAVINGS PERFORMANCE CONTRACTING]	13
TRAINING AND WORKFORCE DEVELOPMENT.....	14
PLANNING FOR RENEWABLE ENERGY GENERATION AT STATE FACILITIES.....	15
STATE PARK RENEWABLES	16
RECOMMENDATIONS.....	16
Appendix A: State Facilities Energy Efficiency Bond Funded Projects	17

EXECUTIVE SUMMARY AND SNAPSHOT OF ACCOMPLISHMENTS

Connecticut's "Lead by Example" (LBE) program has come a long way toward reducing energy use in Connecticut state facilities. Reducing energy use in state facilities is an important way to save energy statewide, as government sector buildings account for approximately 15% of electricity and natural gas consumption by commercial and industrial energy consumers. LBE program components, including data-driven decision making, benchmarking of buildings, and collaboration with state agencies, have led to important energy efficiency upgrades and other clean energy installations that will help to save the state money and reduce harmful environmental impacts. Developed in 2012 pursuant to Public Act 11-80 by the Department of Energy and Environmental Protection (DEEP) and the Department of Administrative Services (DAS), the program provides a variety of pathways for state agencies and municipalities to utilize in their efforts to maximize energy efficiency in their facilities. This multi-faceted approach includes a utility administered incentive program, a bond-funded program, and an energy saving performance contracting program. The success to date of these evolving programs is detailed on the following pages.

PUBLIC COMMENTS ON DRAFT REPORT

A draft of this report was made available to the public on January 24, 2017 and a public information meeting was held on February 15, 2017 which included an [overview presentation](#) of the draft report, which is posted on DEEP's LBE webpage, www.ct.gov/deep/LeadByExample. We received comments during a public comment period held between January 24, 2017 and February 28, 2017. The comments received related to the following topics: documenting energy savings of projects; identifying a pipeline for future projects; reporting on jobs and economic benefits; electronic energy data management; and better building inventory information. DEEP has incorporated some of those recommendations into plans for future data gathering, and to the extent possible will report in the future on these topics. DEEP also received comments on fuel cells and virtual net metering. [Written comments](#) may be found at DEEP's Energy Filing webpage www.ct.gov/deep/energyfilings.

FOUNDATIONAL WORK COMPLETED; ADVANCEMENTS ONGOING

- Web-based data analysis platform has been procured and customized to reflect state energy invoice data and account-to-buildings-to-meters correlations; electronic data feeds have been established for major utility data; benchmarking in EPA's Energy Star Portfolio Manager has been completed for almost 300 state buildings. Further enhancements are in progress.
- DEEP continued facilitation of inter-agency collaboration on many levels to ensure the program's success including Commissioner level policy decision making, staff level for informed collaboration, and between agencies' finance and facilities staff.
- Planning is ongoing for installations of renewable energy generation sources and aggregated energy procurement through feasibility analyses and development of financing mechanisms.

INCREASED SAVINGS – EACH YEAR

- Utility Administered Incentive Program: Since 2014, 134 projects planned or completed statewide to result in energy savings of over \$800,000 annually.
- Bond Funded Program: Since 2012, 72 projects funded that will result in almost \$3 million energy savings annually.
- Energy Savings Performance Contracting: one project executed in 2016 & two projects in development, with an anticipated annual energy savings of \$6 million for the initial three projects.

NEXT STEPS

- Continue to invest in energy data management improvements, and work to increase electronic state energy use data transfer between the major utility companies and the state's data analysis platform.
- Continue DEEP's partnership with the state agencies to increase the investment in energy efficiency in state facilities so as to reduce energy consumption in state facilities.
- Continue to support the Connecticut Green Bank in its efforts to develop financing mechanisms for future small, medium, and large-scale comprehensive energy saving projects and renewable energy generation installations. Additionally, request general obligation bond funds to support the development of energy savings investments at state facilities.

2016 SNAPSHOT OF ACCOMPLISHMENTS

- ✓ Negotiated and executed Connecticut's first Energy Saving Performance Contract (ESPC), at CT Valley Hospital for DMHAS, with \$31.9M in **guaranteed** energy and maintenance savings and 35% reduction in energy use
- ✓ Completed or have scheduled 72 medium-sized energy efficiency projects that result in approximately \$2.9 million in **annual** savings
- ✓ Leveraged utility incentive programs for small-scale projects for use by state agencies, achieving more than \$800,000 in **annual** savings from the 134 projects completed or underway since 2014
- ✓ Operationalized EPA Portfolio Manager benchmarking analysis capabilities for state buildings
- ✓ Benchmarked approximately 27 million square feet across 276 state buildings and facilities
- ✓ Established monthly electronic data flow for state's major utility companies to feed consumption and cost data into DEEP systems
- ✓ Procured, set up and continue to populate Web-based platform for tracking energy data (Relies on state agencies to feed monthly scans of non-electronic data)
- ✓ Completed preliminary feasibility analysis for installation of solar panels at DEEP facilities using ARCGIS
- ✓ Convened inter-agency task forces on the Commissioner and Staff levels to establish financing mechanisms without barriers, for future projects
- ✓ Convened inter-agency task forces on the Commissioner and Staff levels to develop ongoing structure for assessing and prioritizing projects
- ✓ Published list of approved Qualified Energy Services Providers which is in place until 2018
- ✓ Issued an RFP in Dec. 2014, in partnership with DAS, to procure less expensive electricity for state facilities. No contracts were awarded due to the lack of satisfactory responses at that time
- ✓ Issued RFPs in 2015 and 2016 for Class 1 renewable energy sources, both for larger scale (20 MW or more), and for 2-20 MW, to procure grid scale electricity supply from renewable energy generation sources for all of the state's electricity consumers. Selections were made.
- ✓ DAS revised Connecticut state building code in 2016 to incorporate the 2012 International Energy Conservation Code (IECC)

STATUTORY REQUIREMENTS

The Connecticut Department of Energy and Environmental Protection (DEEP) submits this report pursuant to Connecticut General Statutes (C.G.S.) Section 16a-37u(d), specifically:

On or before January 1, 2013, and annually thereafter, the commissioner (of the Department of Energy and Environmental Protection) shall report, in accordance with the provisions of section 11-4a, on the status of its implementation of the plan (required by C.G.S. §16a-37u(a)(1)) and provide recommendations regarding energy use in state buildings to the joint standing committee of the General Assembly having cognizance of matters relating to energy. Any such report may be submitted electronically.

The Department of Energy and Environmental Protection and the Department of Administrative Services developed the “Lead by Example” program to maximize energy efficiency in state and local government buildings. The goal of this program will assist Connecticut state agencies in reducing their energy use in state buildings, in accordance with the targets established in Connecticut General Statutes Section 16a-37u.

While DEEP routinely updates information about implementation of the plan on DEEP’s webpages, this report meets the reporting requirement for 2016. Reports for 2012 through 2015 have previously been provided and can be found on the [Lead by Example](#) page on DEEPs Energy website.

OVERVIEW OF “LEAD BY EXAMPLE” PROGRAM: IMPROVING ENERGY MANAGEMENT IN STATE FACILITIES

Challenge: Energy efficiency and renewable initiatives can help lower energy bills, however, many state agencies lack the technical and financial resources to identify and implement sustainable investments in efficiency upgrades.

Initiative: Since 2013, the inter-agency team of DEEP, the Department of Administrative Services, the Attorney General’s Office, the Office of the Treasurer, the Office of Policy and Management, the CT Green Bank, and others, have advanced the “Lead by Example” program, including the following initiatives and financing mechanisms to reduce energy use in state buildings:

1. Established master agreements with Connecticut’s utilities to unlock the ability of state agencies to use utility administered programs to complete small-scale energy efficiency investments in facilities;
2. Continued to install medium-scale energy equipment retrofits in state facilities using general obligation bond funded allocations;
3. Initiated a standardized guaranteed Energy Savings Performance Contracting Program to plan for and implement large-scale, comprehensive projects with multiple energy savings measures at state facilities.

Results: Results of the “Lead by Example” approach from work completed through calendar year 2016 is summarized in the “Results” section below.

For more information: please refer to the [Lead by Example](#) state agencies page on DEEPs website.

Table 1: GOALS, ACCOMPLISHMENTS, AND FUTURE STEPS

= Work in Progress-on track	= Work in Progress – issues need resolution	= Completed	= Future actions
Goals	Accomplishments	Future Steps	
Reduce energy consumption by 10% by January 1, 2013 and an additional 10% by 2018	No reliable baseline was developed in 2012, therefore we are developing a more reliable baseline for comparison.	Refine the baseline as more accurate information becomes available.	
Assess current energy consumption of all fuels used in state-owned facilities	Procured, set up, and continue to populate web-based data analyses platform, EnergyCAP, for analyzing energy data (Relies on state agencies to feed scans of some of the non-electronic data monthly.)	Encourage more state agencies to take advantage of the program and to comply with DEEP’s request for their help to fully populate the data. Work with agencies to refine building/meter/account correlations.	
	Established monthly electronic data flow for state’s major utility companies to feed consumption and cost data into DEEP systems.	Continue to work with the utility companies to feed data electronically into EnergyCAP platform.	
Identify the top one hundred energy consuming buildings in state facilities	Operationalized EPA Energy Star Portfolio Manager benchmarking analysis capabilities for state buildings.	Continue work with major utility companies & EnergyCAP to populate State and Municipal EPA Energy Star Portfolio Manager accounts.	
	Benchmarked approximately 27 million square feet across 276 state buildings and facilities.		
Establish targets for conducting energy audits in state buildings	Planning is ongoing.	Coordinate with utility companies and state agencies.	
Determine which energy efficiency measures are most cost-effective in state facilities	Planning is ongoing.	Next steps are dependent on outcomes of energy data analyses.	
Establish programs that use performance contracting, bonding, or other means to make improvements or upgrades that save money by reducing energy use in state facilities	Leveraged utility incentive programs for small-scale projects for use by state agencies, achieving more than \$800,000 in annual savings from the 134 projects completed or underway since 2014.	Standardize the use of utility incentive dollars to help finance projects of a larger range of sizes. Unlock the potential to complete more projects and more comprehensive projects.	
	Led inter-agency process to allocate over \$20 million in bond funds for the 72 completed or scheduled energy efficiency projects that result in approximately \$2.9 million in annual savings. Fifty seven projects have been completed of the 72 projects approved since 2012.	Phase out the bond-funding approach in favor of a sustainable mechanism for financing mid-sized projects, or request more bond funds.	
	Negotiated and executed the first Energy Saving Performance Contract (ESPC) – at CT Valley Hospital for DMHAS.	Expand the LBE & C&LM programs to prevent rationing of projects based on competition for financing. Unlock the potential to complete more projects and more comprehensive projects.	

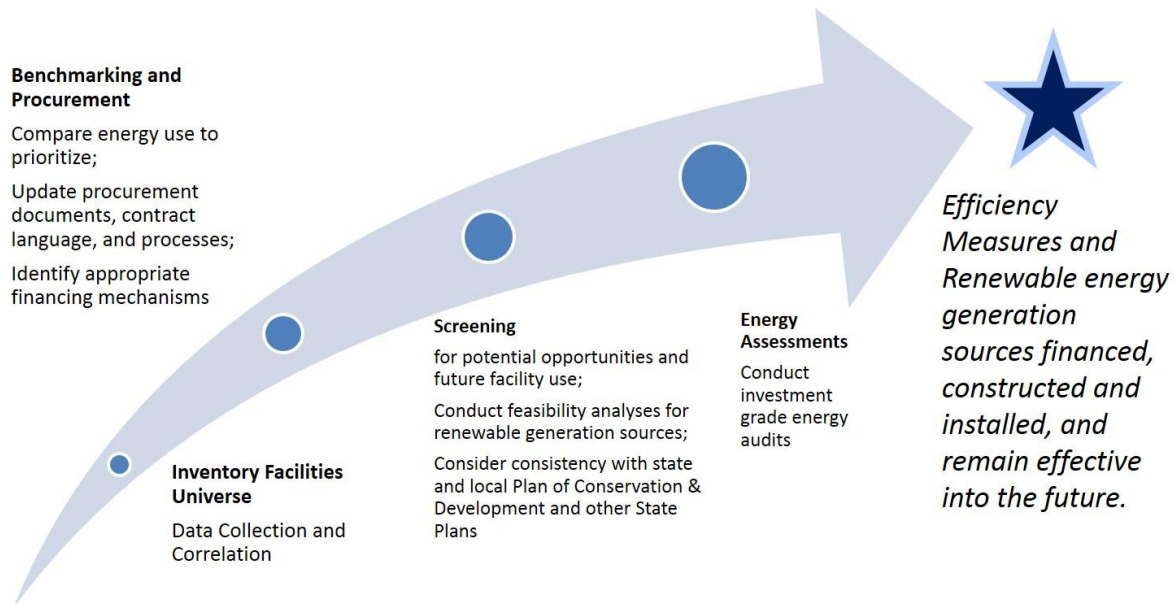
Goals	Accomplishments	Future Steps
Review the status of state-owned buildings that may have the potential to connect to a district heating and cooling system, where such heating and cooling system currently exists or where one is proposed.	Consulted with Department of Administrative Services (DAS) to assess the current status of plans for connections to the capitol area system	Update information and conduct periodic outreach to other agencies regarding the potential for state-owned buildings to connect to district heating and cooling system, the cost of such connection and any projected energy savings achieved through any such connections.
Prioritize opportunities at state facilities for renewable energy installations (solar, anaerobic digestion, other)	Completed preliminary feasibility analysis for installation of solar panels at DEEP facilities.	Work with CT Green Bank to establish Power Purchase Agreement mechanism and work with utilities and Attorney General's Office to develop interconnection agreements that meet state requirements to enable use by state agencies.
Institutionalize sustainable financing mechanisms without barriers, for all energy efficiency projects in state facilities	Convened inter-agency task forces on the Commissioner and Staff levels to work out the details of standardized financing mechanisms.	Eliminate barriers for projects that will pay for themselves in energy savings, and create a process whereby all such projects can move forward without competing for limited dollars.
Generate and prioritize a pipeline of viable energy efficiency projects in state facilities	Convened inter-agency task forces on the Commissioner and Staff levels to develop ongoing structure for assessing and prioritizing projects.	Continue to collaborate with Department of Administrative Services, Office of Policy and Management, CT Green Bank, Office of the Treasurer, and Attorney General's Office to establish a sustainable semi-autonomous structure for assessing and prioritizing projects.
Request qualifications and select Qualified Energy Services Providers (QESPs)	Published list of approved providers. Signed contracts recently were extended until 2018.	Continue to receive updated contracts from approved QESPs.
Procure less expensive electricity for state facilities, starting with the executive branch buildings	Issued a Request for Proposals (RFP) in Dec. 2014, in partnership with DAS. No contracts were awarded due to the lack of satisfactory responses at that time.	DEEP will re-issue an RFP in the first half of 2017 and will proceed accordingly.
Procure grid scale electricity from renewable energy generation sources for all of the state's electricity consumers	RFPs were issued in 2015 and 2016 for Class 1 renewable energy sources, both for larger scale (20 MW or more), and for 2-20 MW. Selections were made.	Contract negotiations are underway to finalize the acquisition of these resources by Connecticut's major electricity suppliers.
Update state building codes as needed to ensure energy efficiency standards are met	DAS updated state building codes to include the 2012 International Energy Conservation Code (IECC).	2015 IECC will be incorporated in next update of the state building code.

STATE ENERGY USE REDUCTION PLAN

DEEP has made substantial progress in assessing energy use at state facilities as part of the implementation plan to reduce energy use in state buildings. As shown in Figure 1, the process begins with the development of a comprehensive inventory of all state facilities. This is done by contacting each state agency to get a list of all their owned buildings and comparing their list with the Office of Policy and Management state building inventory database to see which buildings still exist, what new buildings there are, what buildings no longer exist, and what is no longer state property.

Along with inventorying state facilities, all energy accounts for all utilities for all state agencies need to be identified and then must be correlated to the correct buildings. This allows us to identify the energy consumption and cost for a specific state building. All of the elements of the plan actually occur both sequentially and concurrently. That is, while DEEP systematically works to put a comprehensive statewide approach in place, individual agencies and projects may advance to implementation concurrent with the systematic prioritized plan implementation. The steps in Figure 1 are described in more detail in the following sections.

Figure 1: Implementation of State Facilities Energy Use Reduction Plan



INVENTORYING FACILITIES, COLLECTING DATA, AND CORRELATING ENERGY DATA WITH BUILDINGS

ESTIMATING A BASELINE

We are making good progress toward the goal of reducing energy consumption by 20% by 2018, and are on track to significantly reduce energy consumption in state buildings. With the implementation of the Energy Savings Performance Contract project at the Department of Mental Health and Addiction Services Connecticut Valley Hospital campus, and given the expected savings of similar comprehensive projects planned in the next two years, we believe the state is on track to meet our 2018 goal.

Public Act 11-80, codified at Connecticut General Statutes 16a-37u(b), identified a goal to reduce energy use from “current [2011] consumption” levels by a total of 20% by January 1, 2018 in buildings owned or leased by the state. However, there was never an accurate baseline developed in 2012 to compare the percentage against. Due to a lack of reliable data, there were previously incomplete estimates of statewide usage used as proxies in estimating a baseline for statewide consumption. Therefore we are developing a more reliable baseline to compare 2018 data against. How far back this can be estimated depends on resources and data availability.

One consideration in identifying baselines, is that the state’s building inventory is dynamic and has been incomplete in the past, so comparing total usage is limited in its usefulness to measure energy consumption and progress toward reducing that use. Therefore, the important work underway is to correlate energy usage data with individual buildings and systematically analyze the state’s energy consumption. This equips us with the ability to strategically prioritize buildings for energy reduction investments and possible applications of renewable energy generation.

More meaningful metrics will be based on the data collection efforts currently underway, enabling analyses to guide the state’s energy reduction plan. DEEP will continue to refine the baseline calculations and analyze energy consumption as the state inventory of buildings and facilities continues to change and energy accounts are continually added and removed. As part of this process DEEP will evaluate potential modifications of energy reduction targets.

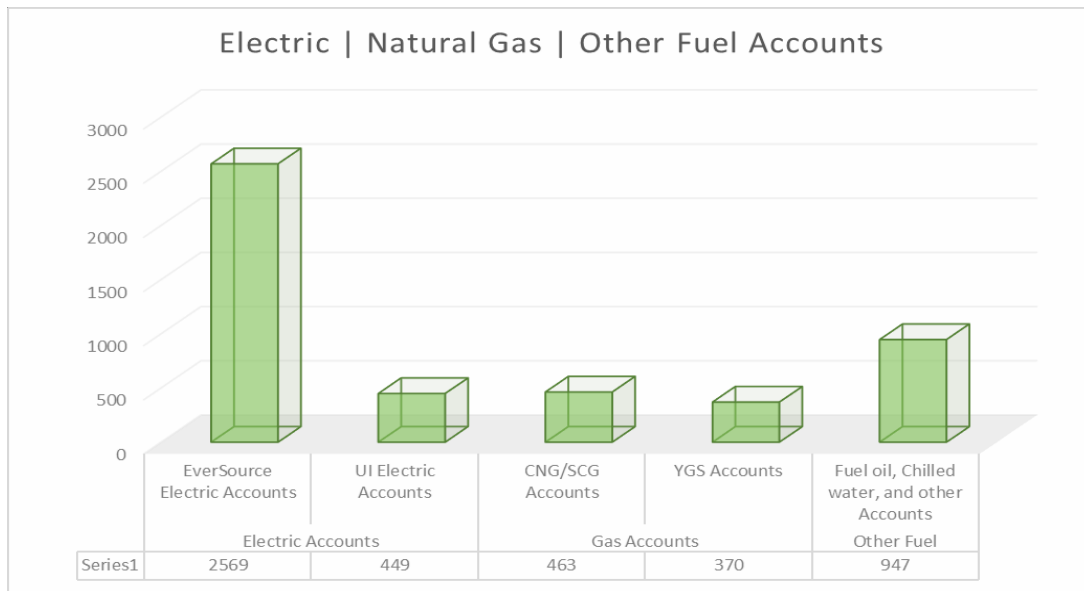
CURRENT STATUS

DEEP has collected energy data for each utility or delivered fuel account (electricity, natural gas, water, fuel oil and other energy sources including propane, steam, chilled water) for almost every state account, and is working to correlate the data to state buildings to determine which utility account numbers and meter numbers are associated with each state building. Some state agencies have completed this for their own accounts while many have not. DEEP has encouraged and assisted all state agencies to undertake this process, but has no authority to require it from those who don’t comply.

DEEP is currently in the process of instituting a system for managing energy invoice data on a web-based platform called EnergyCAP, to collect energy consumption data in a consolidated format. This will allow energy information to be understood for individual buildings, each agency, and for the state as a whole. When analyses of data are available at both specific and summary levels the analytics can be used to prioritize actions and investments from both the finances and facilities perspectives. EnergyCAP will be accessible to all state agencies once all the data and information has been collected and fed into the platform. This statewide energy management tool will allow DEEP and trained finance and facility staff from all other agencies to see, compare, and potentially implement adjustments to energy consumption, and identify potential energy efficiency measures to undertake. DEEP anticipates completing the process of matching energy consumption for most fuels to individual buildings and agencies as well as establishing electronic data feeds of this information on an ongoing basis for most electricity and natural gas accounts by the end of calendar year 2017.

In addition to electricity and natural gas, many agencies also consume deliverable fuels (fuel oil, propane) for heating and other processes at their facilities as shown in Figure 2. The current annual estimate for energy consumption by the state is approximately 611 million kWh in electricity and 2.5 million DTh of natural gas.

Figure 2: Currently Identified State Energy Accounts



Source: CT DEEP records, 2016

BENCHMARKING BUILDINGS

As energy usage for each state building is correlated with its energy accounts, DEEP is benchmarking the largest buildings in order to compare energy usage on a square foot basis to better prioritize the buildings that will yield significant savings from energy efficiency measures. This process includes electronically and/or manually entering data into the U.S. Environmental Protection Agency (EPA) Energy Star Portfolio Manager. This nationally used tool compares buildings of similar characteristics across the country that are benchmarked, and assigns an individual building an Energy Usage Index score or Energy Star rated score. In order to “lead by example,” DEEP has benchmarked all DEEP-owned buildings that are over 4,000 square feet. DEEP is working with other state agencies to benchmark the largest buildings and facilities over the next two to three years. DEEP is working with Eversource and United Illuminating to ensure state buildings’ energy use and costs can electronically feed directly into Portfolio Manager and EnergyCAP. This joint effort will be fully functional in 2017. Once a new building is added in Portfolio Manager, each agency has the option to allow Eversource or United Illuminating to have full access to their Portfolio Manager accounts to upload utility information electronically.

BENCHMARKING HIGHLIGHTS

- 27 million square feet of state property entered into US EPA Energy Star Portfolio Manager
- 276 state buildings and facilities have been benchmarked
- All DEEP-owned buildings over 4,000 square feet

PROCUREMENT - ENERGY MANAGEMENT SERVICES AND ENERGY SUPPLY

Since 2012, DEEP has procured services through both competitive and federal general services administration processes to put in place [energy management services](#) such as Qualified Energy Services Providers, interim owners’ representatives, and technical service providers.

Also, in an effort to reduce energy costs, DEEP, in partnership with the Department of Administrative Services (DAS), has engaged in a competitive electricity supply procurement process for all Executive Branch Agency

accounts. By aggregating the load demand, DEEP and DAS aim to reduce electricity supply costs for participating agencies. DEEP is currently working to update the data analysis on electricity accounts for all executive branch state agencies and expects to re-issue a Request for Proposals for energy supply for state operations in the first half of 2017. Additional information about DEEP's electricity procurement for state agencies can be found at DEEP's [Affordable and Reliable Electricity Procurement](#) page.

FINANCING MECHANISMS

Concurrently, DEEP is working with its Lead By Example partners to update services procurement documents, finalize contract language, and establish streamlined processes to make the program even more accessible to state agencies. Developing and institutionalizing the various financing mechanisms is also key to the success of these programs. To this end, DEEP has convened inter-agency task forces at the commissioner level and at the staff level, which will continue to meet regularly to iron out the details. Because these projects may include multiple streams of financing, it is essential to have input and consensus in advance from all the key agencies involved in sponsoring the programs. The goal is to eliminate barriers for projects that will pay for themselves in energy savings, and to create a process whereby all such projects can move forward without the need to compete for limited funding.

SCREENING, ASSESSING, PRIORITIZING

DEEP will continue to screen, assess and prioritize potential projects. At the portfolio level, DEEP will screen the benchmarked facilities that have poor rating scores in Portfolio Manager. In consultation with other key agencies, DEEP will prioritize which state buildings represent the greatest opportunity for potential retrofit opportunities and also will assess the feasibility for installation of renewable energy generation sources. In addition to this proactive Portfolio Manager approach, DEEP and other key agencies continue to confer with agencies whose capital or operating plans call for investment in energy management and therefore prompt those agencies to pursue energy management improvements. Energy audits on various levels will assist in the assessments and prioritizing of projects to reduce energy use at state buildings.

RESULTS: SUMMARY OF LEAD BY EXAMPLE ENERGY USE REDUCTION ACHIEVEMENTS THROUGH CALENDAR YEAR 2016

SMALL-SCALE PROJECTS [USE OF UTILITY ADMINISTERED PROGRAMS TO SIMPLIFY ENERGY-EFFICIENT UPGRADES]



Figure 3: Fort Trumbull State Park, New London

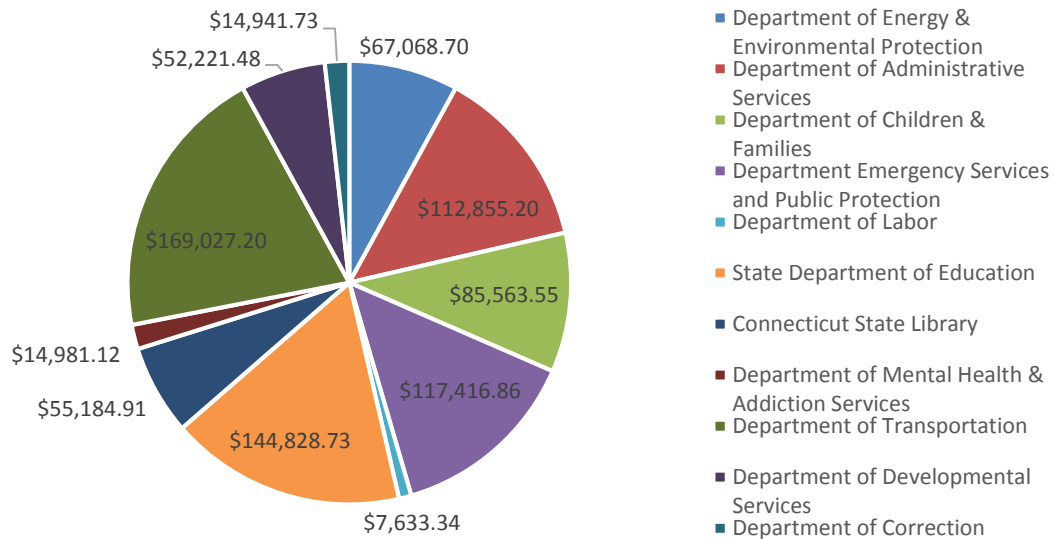
The Utility administered Incentive program is designed to provide cost effective, turnkey energy-saving services to utility customer accounts, also known as the Small Business Energy Advantage program (SBEA). The program offers utility administered funding incentives and on-bill financing for the balance of project cost, eliminating the need for up front capital investment. The reduction in energy usage and costs, in conjunction with the ability to utilize on-bill financing, ideally results in net-positive cash flow from day one. Once the on-bill financing period has ended (2 to 4 years), the reduction in energy use will result in decreased operational energy costs over the remaining life of the installed measures. Under this program, proposed measures are focused primarily on quick payback energy efficient lighting. Under a Master Agreement

between both Eversource and United Illuminating and the Department of Administrative Services (on behalf of all

state agencies) the SBEA program was rolled out to state agencies in 2014. The Fort Trumbull lighting upgrade is one of the successful SBEA projects at a state facility (See Figure 3).

To date, **134** of these projects at state facilities have been approved with an estimated annual cost reduction of **\$841,722** and electricity use reduction of **6.1 million kilowatt-hours** (See Figure 4).

Figure 4: \$841,722 Estimated Annual Cost Savings from Small-Scale Projects 2014-2016



MEDIUM-SCALE PROJECTS [BOND FUND INVESTMENTS]

LBE BOND PROJECTS EXAMPLES

- LED Lighting upgrades
- HVAC upgrades
- Boiler System Replacements
- Electronic Monitoring System installations
- Retro-Commissioning upgrades

Beginning in 2011, the State Bond Commission allocated \$15 million in previously authorized bond funds to implement projects to reduce energy consumption in state buildings. Given the success of these investments, in 2015 the State Bond Commission released an additional \$5 million of previously authorized bond funds. These funds are supplemented by energy efficiency investments made through the major electricity and natural gas distribution companies in the state: Connecticut Light and Power and Yankee Gas (doing business as Eversource Energy) and United Illuminating, Southern Connecticut Gas, and Connecticut Natural Gas, a part of AVANGRID. The utility investments leveraged the bond funding resulting in additional energy savings.

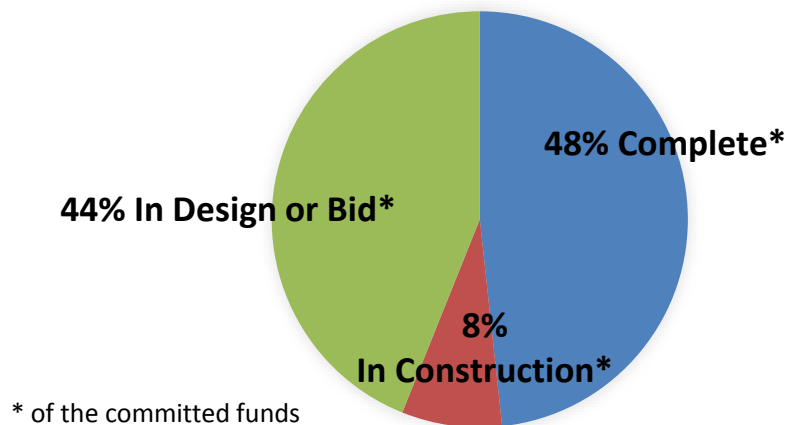
As of December 2016, the DEEP-led inter-agency process has approved 72 projects to implement energy efficiency in state buildings. Of these, 57 projects have been completed. The cost for all completed projects is \$9.8 million. The estimated cost for the balance of approved projects that are either in construction, the bid process, or design is \$10.5 million. Energy Efficiency Fund incentives received are nearly \$842,000. The estimated annual energy consumption savings (electricity, natural gas, and fuel oils) exceed 89.3 billion British Thermal Units (BTU), resulting in an **annual cost avoidance of approximately \$2.91 million** (in 2015 dollars). **The estimated simple return on investment for these projects is 5.9 years** (See Figure 5).

All previously authorized and allocated bond funds have been fully committed as of December 2016. The future of the LBE Bond program is dependent upon receipt of additional bond authorizations. DEEP will allow state agencies

to submit energy efficiency projects for consideration in case additional bond funds are authorized and allocated. For information on the list of approved projects, please see the [Lead By Example for State Agencies](#) webpage on DEEPs website or refer to Appendix A in this report.

Figure 5: LBE Bond Funds Invested 2012-Present

\$2.91 Million in Annual Savings, with Average 5.9 Year Payback



LARGE-SCALE PROJECTS [GUARANTEED ENERGY SAVINGS PERFORMANCE CONTRACTING]

Energy Savings Performance Contracting (ESPC) is a mechanism whereby the Qualified Energy Service Provider (QESP) contractually guarantees a pre-determined amount of cost savings over the performance period, based on agreed-upon measures and retrofitting upgrades they will do at that location.

Initial projections for the Energy Savings Performance Contracting projects being planned, facilitated and implemented at the Department of Correction, Connecticut Valley Hospital, and the Department of Motor Vehicles estimate an **investment of approximately \$80 million in energy savings measures across these three agencies, all of which will be paid back within 15 to 20 years, largely through guaranteed future energy savings.** These projects and those that follow will include rigorous measurement and verification to ensure the energy performance and cost savings match the guarantees provided by the contractors. Ongoing monitoring and verification will also allow facility managers to continuously improve building energy use. Construction and installation of these large-scale investments will support green jobs in Connecticut. The total estimated cost reduction or avoidance is currently estimated at \$6.0 million annually for the initial three projects. In consultation with other key agencies, a pipeline of additional large-scale projects for

CONNECTICUT VALLEY HOSPITAL, MIDDLETOWN. CT

- \$31.9M in guaranteed energy and maintenance savings
- 35% reduction in energy use
- Reduced GHG emissions of estimated 10,000 metric tons of CO2
- 2 miles of new steam and condensate pipes
- 1.5 megawatt Cogen System
- Solar-Powered electric vehicle carport charging station

different agencies is in development, contingent upon a sustainable financing mechanism being established. In December 2016, the Department of Mental Health and Addiction Services became the first state executive branch agency to break ground on a Guaranteed Energy Savings Performance Contract project. The project, at the Connecticut Valley Hospital in Middletown, is a comprehensive campus-wide project that will be completed over a three year construction period and will result in guaranteed energy and maintenance savings of \$31.9 million over the 15-year performance period. It is the first of several planned comprehensive energy upgrades at state facilities using an Energy Savings Performance Contract.



Figure 6: Connecticut Valley Hospital

The upgrades at Connecticut Valley Hospital will include 2 miles of new insulated steam pipe and condensate pipe installation, a 1.5 megawatt Cogeneration System for the Power Plant, a solar-powered electric vehicle carport charging station, and interior, exterior, and street lighting upgrades to LED with new lighting controls. These are just a few of the several energy efficiency upgrades that will take place at Connecticut Valley Hospital. These installed measures will reduce the energy use at the facility by 35%, increase patient and hospital staff comfort and safety, address the deferred maintenance on the outdated failing equipment which will help reduce operating costs, while reducing greenhouse gas emissions through energy savings (See Table 2).

Table 2: CT Valley Hospital Energy Savings and Carbon Dioxide Emissions Reductions

	Electric		Natural Gas		#2 fuel oil		Total
	kWh	MMBtu	Ccf	MMBtu	Gal	MMBtu	MMBtu
Baseline	12,284,606	41,927	2,067,638	211,726	28,892	4,074	257,727
Guaranteed savings	9,527,303	32,517	540,646	55,362	10,448	1,473	89,352
Total savings	78% (24% efficiency; 54% co-generation savings)		26%		36%		35%
Metric tons of CO2 reduced	6,698		2,958		107		9,763

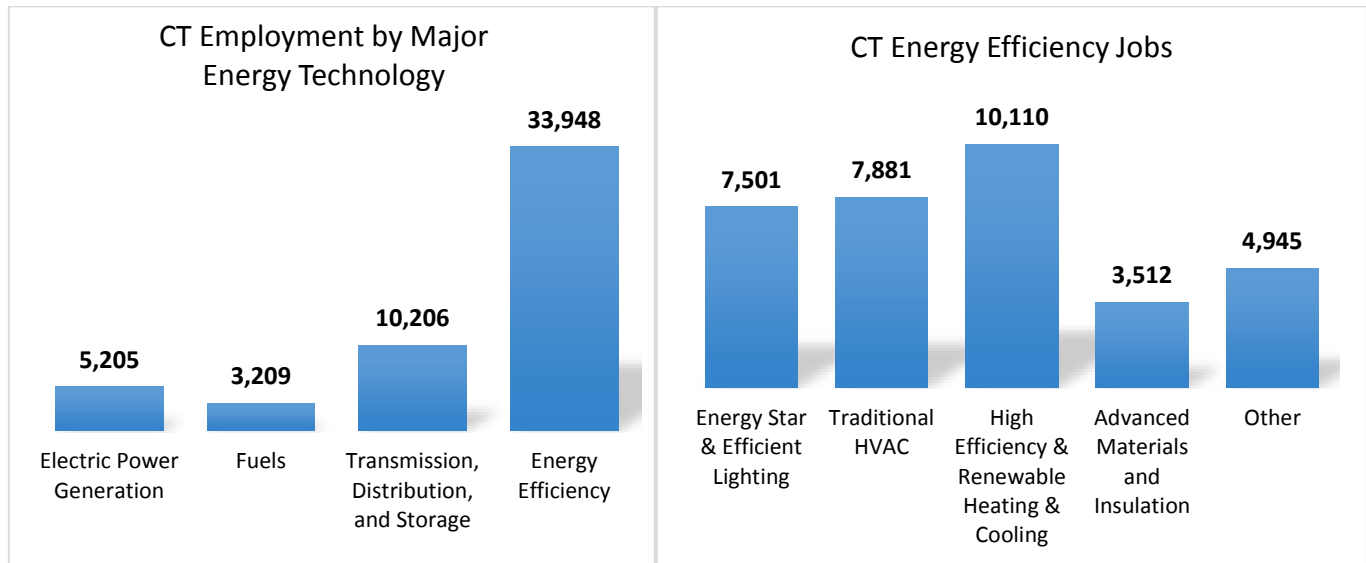
TRAINING AND WORKFORCE DEVELOPMENT

DEEP continued to facilitate training of professionals on code compliance and efficient building design and construction by promoting and encouraging professionals to complete training in energy efficient building operation and receive their Building Operator Certificates (BOC). DEEP also facilitated the participation of state facility managers in the Green Professional (G-PRO) Building Skills Training. Program graduates are taught strategies to make their buildings more comfortable, energy-efficient and environmentally friendly by applying system maintenance and optimization skills learned throughout the course. G-PRO is a comprehensive national training and certificate program developed to teach the people who build, renovate and maintain buildings the principles of sustainability combined with trade-specific green construction knowledge.

DEEP also participated in the CT Energy Workforce Development Consortium and provided support for ongoing analysis of certification and training opportunities throughout the state, as well as updates to the webpage, www.GetIntoEnergyCT.com. According to the US Dept. of Energy, *U.S. Energy and Employment Report*, January 2017, Connecticut has nearly 34,000 employed in energy efficiency work, which represents 1.6% of all energy efficiency jobs nationally. The largest number of these employees work for high efficiency HVAC and renewable

heating and cooling firms. A majority of the energy efficiency employment is found in the construction sector (See Figure 7).

Figure 7: Connecticut Employment for Energy Technology and Efficient Jobs

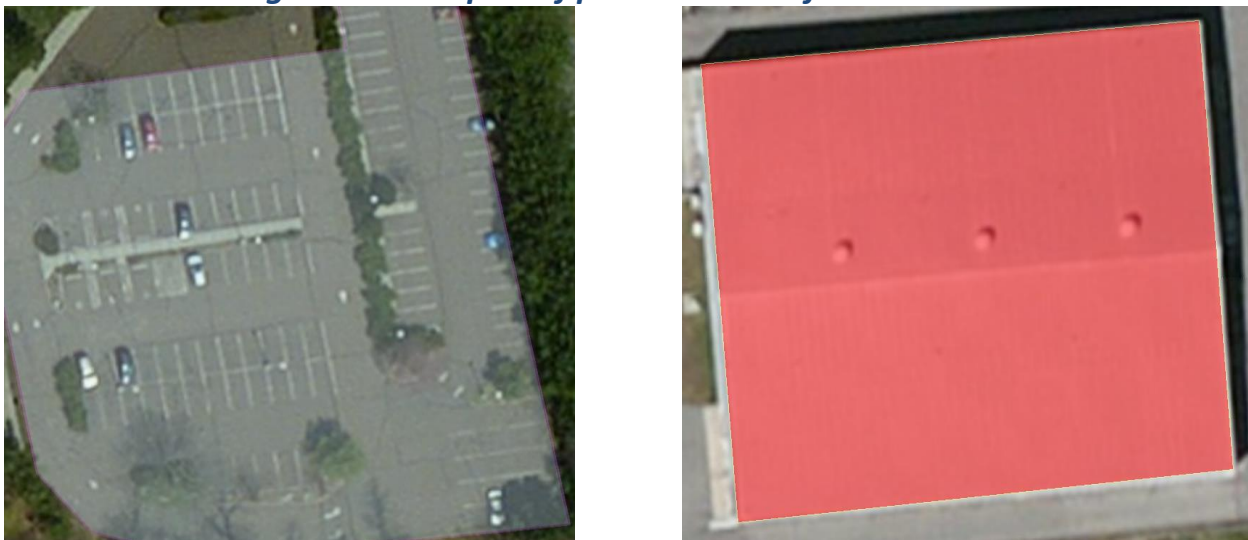


Source: US Dept. of Energy, *Energy and Employment Report*, January 2017

PLANNING FOR RENEWABLE ENERGY GENERATION AT STATE FACILITIES

In 2016, DEEP’s strategic planning for installation of renewable energy generation at state facilities on a comprehensive statewide basis included the development of financing mechanisms and preliminary feasibility screening. State agencies have a great opportunity to demonstrate how to harmonize renewable development and siting considerations. Many of these facilities are located in town centers, close to existing infrastructure. With current budget constraints, the state has limited financial resources for implementing both energy efficiency and renewable energy sources. It is important to prioritize energy efficiency while concurrently securing financing for renewable energy deployment. The CT Green Bank began developing a power purchase agreement template that can be replicated at multiple properties. Next steps include finalizing the financing agreements for use by state agencies, and working with the CT Green Bank to procure service providers.

Figure 8: Examples of potential sites for solar installation



STATE PARK RENEWABLES

As part of the Lead by Example approach, the Department of Energy and Environmental Protection is implementing a State Parks Renewable Energy Technology Initiative. This initiative is funded with \$1.0 million in dedicated funding and includes the installation of geothermal heating and cooling, solar photovoltaic, solar thermal hot water, solar lighting, and other renewable technologies. This initiative will:

- ✓ Increase state government's use of clean energy alternatives;
- ✓ Increase the reliability of the state's energy infrastructure by reducing strain on the electric grid, particularly during peak usage periods;
- ✓ Increase energy surety by reducing dependence on fossil fuel sources and utilizing distributed onsite generation technologies; and
- ✓ Demonstrate alternative energy technologies in high visibility venues to educate the public.



Figure 9: Hammonasset Nature Center

To date, the following projects have been implemented or are in construction under this initiative:

- ✓ Solar photovoltaic and solar thermal hot water at the Sherwood Island State Park pavilion;
- ✓ Geothermal heating and cooling and solar photovoltaic electricity generation at the new Hammonasset State Park Nature Center;
- ✓ Solar photovoltaic electricity generation at the new West Beach bath house, Hammonasset State Park;
- ✓ Solar photovoltaic electric cash registers at 11 state park facilities that do not otherwise have electricity.

RECOMMENDATIONS

To build on the success of the achievements in energy use reduction to date, DEEP recommends the following:

1. Continue to invest in energy data management improvements, specifically the completion of electronic data transfer between major utilities and the state, to accelerate analysis of energy usage.
2. Implement a standard reporting platform for state agencies so that statewide energy consumption and expenditures may be aggregated and analyzed to inform energy management decisions.
3. Benchmark all state buildings using the US EPA Energy Star Portfolio Manager.
4. Support the CT Green Bank in identifying sustainable financing approaches for medium-scale projects. Additionally, request authorization and allocation of \$15 million annually in general obligation bond funds to support medium-scale projects, pre-development tasks, and technical support to state facilities.
5. Ensure financing for large-scale comprehensive projects is institutionalized and available to support planning for the pipelines of future projects. Determine CT Green Bank's capacity to issue green bonds or other financing mechanisms, or alternately request authorization and allocation of state bond funds to support the development of Energy Savings Performance Contracting at state facilities.
6. Work with CT Green Bank to finance and conduct a feasibility analysis of potential renewable energy generation sources at state facilities that have completed energy efficiency projects. The feasibility analysis will enable DEEP and the CT Green Bank to prioritize opportunities for executing power purchase agreements for renewable energy generation at state facilities.
7. Working through a collaborative inter-agency process, continue to support the development of a pipeline of large-scale comprehensive energy upgrade projects, using the information from benchmarking and feasibility analyses, and integrating energy efficiency, renewable energy generation, and energy storage opportunities as applicable.

Appendix A: State Facilities Energy Efficiency Bond Funded Projects

Lead By Example - State Facilities Status

Approved Bond Funded Projects as of December 19, 2016

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
30	DAS	18/20 Trinity Street	Replace VFDs and Pumps - Tie into BMS	\$28,000.00	\$16,243.00	0.58	Complete
31	DAS	30 Trinity Street	VFD Installation and Tie into BMS	\$13,800.00	\$24,468.00	1.77	Complete
32	DDS	67-87 Mountain Rd Newington CT 06111	Installation of EMS	\$24,796.00	\$79,529.00	3.21	Complete
33	DDS	146 Silvermine Road Norwalk, Ct 06850	Installation of EMS	\$49,227.00	\$86,184.00	1.75	Complete
34	MHA	1635 Central Avenue, Bridgeport, CT 06610	Control System/Gas Condensing Boilers/Condensers	\$115,495.00	\$1,198,737.00	10.38	In Process
37	DOC	285 Shaker Road, Enfield, CT 06082	Robinson HVAC Rooftop Replacement	\$79,397.00	\$401,214.20	5.05	Complete
38	DAS	505 Hudson Street, Hartford CT	High Efficiency Gas Fired Boilers	\$11,279.00	\$137,100.00	12.16	Complete
39	DDS	195 Alvord Rd Torrington CT 06850	Installation of EMS	\$20,214.06	\$67,485.00	3.34	Complete
42	DOC	391 Shaker Road, Enfield	HVAC Rooftop Unit Replacement	\$22,137.00	\$150,690.00	6.81	Complete
43	DAS	79 Elm Street, Hartford, CT 06106	VAVs/FTUs/VFDs	\$131,000.00	\$349,750.00	2.67	Complete
44	OPM	615 Silver Lane East Hartford, CT 06118	Aggregated Efficiency Measures Project	\$168,010.00	\$280,702.10	1.67	Complete
50	DDS	1450 S Britain Rd Southbury CT	Lighting at Power House	\$8,707.00	\$13,811.18	1.59	Complete

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
77	DAS	401 West Thames Street, Norwich, CT	Uncas Domestic Hot Water Boiler	\$2,645.17	\$12,850.00	4.86	Complete
79	DAS	401 West Thames Street, Norwich, CT	Uncas Control Valves	\$6,701.49	\$16,780.00	2.50	Complete
80	DAS	401 West Thames Street, Norwich, CT	Uncas TVCCA Windows	\$9,854.61	\$98,978.40	10.04	Complete
81	JUD	1 Courthouse Square, Norwich, CT 06360	LED Lighting Retrofit	\$6,933.79	\$15,595.00	2.25	Complete
1	ECSU	High Street, Willimantic, CT 06226	ECSU - Allerton Building Automation System	\$76,065.66	\$709,818.00	9.33	Complete
19	AES	123 Huntington Street, New Haven, CT 06511	Windows	\$31,921.00	\$209,574.00	6.57	Complete
21	AES	123 Huntington Street, New Haven, CT 06511	Dual Fuel Burners	\$18,968.00	\$46,900.00	2.47	Complete
24	AES	153 Cook Hill Road, Windsor, CT 06095	Lighting & Occupancy sensors	\$3,806.00	\$9,123.12	2.40	Complete
25	AES	123 Huntington Street, New Haven, CT 06511	Windows	\$23,988.00	\$210,426.00	8.77	Complete
26	DAS	24-38 Wolcott Hill Road, Wethersfield, CT 06109	EMS, RA Conversion, Central Plant Fixture Replace	\$152,988.00	\$915,453.00	5.98	In Process
27	DAS	110 Sherman Street, Hartford CT	Digital Electronic Control System	\$18,039.16	\$308,522.00	17.10	Complete
28	DAS	505 Hudson St., Hartford	Lighting Upgrade - Upper & Lower Garage	\$5,400.78	\$24,058.00	4.45	Complete

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
85	DAS	165 Capitol Avenue, Hartford	SOB - Occupancy Sensors, Basement, Ground, First	\$14,241.34	\$57,427.46	4.03	Complete
87	MHA	500 Vine Street, Hartford	Hot Water DDC Controls	\$45,286.00	\$131,732.00	2.91	Complete
91	DMV	173 Salem Turnpike, Norwich, CT	Lighting upgrade	\$2,517.00	\$12,316.81	4.89	Complete
92	CRDA	100 Columbus Boulevard, Hartford	Convention Center Retro-Commissioning Upgrade	\$61,626.00	\$406,701.00	6.60	Complete
94	DOT	Various locations located throughout the State of Connecticut	Energy Efficiency Improvement at DOT Commuter Parking	\$32,172.00	\$345,000.00	10.72	Complete
96	JUD	1 Court Street, Middletown, CT 06457	Middletown Courthouse Garage Lighting Retrofit	\$8,550.00	\$55,630.80	6.51	Complete
103	BOR	55 Paul Manafort Drive, New Britain CT 06053	Charter Oak -Occ. Sensor Install and HVAC Upgrades	\$21,137.00	\$25,309.00	1.20	Complete
104	DEEP	141 Trout Hatchery Road, Central Village, (Plainfield) CT 06332	Quinebaug Valley Trout Hatchery Phase I	\$55,879.61	\$304,780.00	5.45	In Process
105	JUD	172 Golden Hill Street, Bridgeport	GA 2 Lighting Retrofit	\$86,988.00	\$216,600.00	2.49	Complete
109	JUD	1061 Main Street, Bridgeport	Fairfield JD Lighting Retrofit	\$26,343.00	\$253,631.00	9.63	Complete
111	DDS	71 Mountain Road, Newington CT	Interior/Exterior Lighting Retrofit	\$18,033.00	\$55,305.00	3.07	Complete
113	DCS	1000 Silver Street	DCS Juvenile Training School Fuel cell Study		\$21,000.00	0.00	Complete

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
119	MHA	1000 Holmes Drive, Middletown, CT 06457	RVS - Dutton Home Attic Insulation	\$14,214.85	\$16,500.00	1.16	Complete
122	JUD	400 Grand Street, Waterbury, CT 06702	Waterbury Courthouse Garage Lighting Retrofit	\$14,068.00	\$59,972.45	4.26	Complete
123	JUD	231 Capitol Avenue, Hartford, CT 06106	Supreme Court/State Library Lighting Retrofit	\$8,876.00	\$53,147.80	5.99	Complete
126	MHA	162 Cedar Lane, Middletown, CT 06357	CVH - Water Treatment Plant - Pump Upgrades	\$14,635.00	\$71,073.70	4.86	Complete
127	DMV	150 Torrington Road, Winsted, CT 06098	Lighting and Occupancy Sensors	\$6,648.90	\$30,606.99	4.60	Complete
128	AES	123 Huntington Street, New Haven, CT 06511	CAES - Exterior Lighting Upgrades	\$6,400.00	\$19,875.08	3.11	Complete
130	DEEP	422 Watertown Road, Thomaston, CT 06787	Thomaston Garage - Lighting and HVAC Upgrade	\$4,239.51	\$32,097.00	7.57	Complete
146	DAS	50 & 55 Farmington Avenue, Hartford	Mechanical Renovations 55 Farmington Ave	\$52,513.00	\$662,817.40	12.62	Complete
147	DAS	50 & 55 Farmington Avenue	DAS 55 Farmington Ave-Light/Cool	\$34,853.76	\$520,532.00	14.93	Complete
180	DOC	177 Weston Street, Hartford, CT 06120	Hartford CC Roof Top Unit Replacement	\$45,905.00	\$338,509.00	7.37	Complete
158	DDS	67-87 Mountain Rd Newington CT 06111	DDS HRC Mechanical Systems Energy Upgrades	\$51,276.00	\$369,132.00	7.20	In Process
175	JUD	20 Franklin square, New Britain, CT 06051	New Britain Retro-Commissioning	\$18,271.00	\$97,382.00	5.33	Complete

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
177	SDE	600 Orange Ave Milford CT 06460	Platt Tech Shop Lighting and Weather -stripping	\$26,762.00	\$74,481.50	2.78	Complete
178	DOC	285 Shaker Road, Enfield, CT 06082	2015 Lighting Upgrade - Library and Gym Areas	\$14,885.00	\$28,480.37	1.91	Complete
155	CRDA	100 Columbus Blvd., Hartford, CT 06103	LED Lighting	\$190,508.00	\$1,805,825.90	9.48	Complete
160	JUD	95 Washington Street, Hartford, CT 06106	Retro Commission Program	\$39,082.00	\$134,618.00	3.44	In Process
163	DOC	59 Hartford Road, Brooklyn, CT 06234	Chiller Replacement	\$19,196.00	\$171,800.00	8.95	Complete
167	DOC	986 Norwich-New London Turnpike, Uncasville, CT 06382	Chiller Replacement	\$9,446.00	\$95,300.00	10.09	Complete
168	DEEP	141 Trout Hatchery Road, Central Village, (Plainfield) CT 06332	Quinebaug Trout Hatchery Phase II	\$232,790.00	\$2,512,479.00	10.79	In Process
169	SDE	600 Orange Avenue, Milford	Platt Tech Lighting	\$20,716.00	\$97,960.89	4.73	Complete
179	MHA	51 Coventry Street, Hartford	Boiler Replacement & Heating System Upgrades	\$9,680.00	\$96,790.00	10.30	Complete
181	DOC	177 Weston Street, Hartford, CT 06120	Boiler Room Pump Replacement	\$13,348.00	\$44,117.94	3.30	In Process
182	JUD	111 Phoenix Ave, Enfield	Roof and HVAC Upgrades	\$66,763.37	\$760,000.00	11.40	In Process
183	DOC	285 Shaker Road, Enfield, CT 06082	Laundry Consolidation and Upgrades	\$135,390.00	\$302,326.00	2.20	Complete

ID	Agency	Building Address	Project Name	Estimated Annual Energy Cost Avoidance	Estimated or Actual Project Cost	Simple Payback (yrs.)	Project Status
186	DOT	2800 Berlin Turnpike, Newington	Headquarters Building Lighting Improvement	\$265,141.56	\$1,332,083.00	5.00	In Process
187	DOC	285 Shaker Road, Enfield, CT 06082	Rooftop Unit Replacement	\$31,957.00	\$294,252.67	9.20	Complete
188	DOC	900 Highland Ave, Cheshire	A&B Dining Areas Roof Top Unit Replacement	\$6,660.00	\$59,832.91	9.00	Complete
189	DDS	67-87 Mountain Rd Newington CT 06111	RTU AC and Window Replacement HRC	\$17,274.91	\$199,868.00	11.60	In Process
190	DOC	986 Norwich-New London Turnpike, Uncasville, CT 06382	Radgowski Kitchen Hood Controls	\$7,222.00	\$23,367.00	3.20	Complete
195	DOC	201 West Main Street, Niantic, CT 06357	Laundry Ozone System	\$27,528.00	\$38,090.00	1.40	Complete
196	MHA	460 Silver Street, Middletown, CT 06457	Boiler Replacement & Heating System Upgrades	\$5,000.00	\$60,000.00	12.00	In Process
199	DOC	285 Shaker Road, Enfield, CT 06082	2016 Exterior Lighting Upgrade	\$39,177.00	\$171,996.00	4.30	In Process
200	DOC	Osborn, 335 Bilton Rd, Somers, CT 06071 Enfield, 289 Shaker Rd, Enfield, CT 06082	Osborn/Enfield Correctional Steam Trap Replacement	\$59,825.00	\$53,739.00	0.90	In Process
Totals				\$2,912,399.52	\$17,898,477.67	Avg. Payback 5.90	