



Department of
General Services



Annual Report on State Building Energy Management

Fiscal Year 2014 - 2015

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BACKGROUND AND STATUTE

Tennessee Code Annotated § 4-3-1012(b)(5) requires the Department of General Services (DGS) to report on the department's activities relative to energy management. The report is to include savings realized by the state as a result of the office's activities expressed in both units of energy saved and monetary cost-avoidance. Historically, this annual report has relied on total energy cost data rather than energy consumption data due to the challenges in gathering complete and accurate information for all state facilities.

The Department of General Services' Real Estate Asset Management Division (STREAM) directly manages more than 150 owned and 350 leased properties across the state. These properties, commonly referred to as the FRF (Facilities Revolving Fund) facilities, comprise almost 10 million square feet, one-tenth of the state's total real estate portfolio. STREAM has an ongoing system for the collection of cost and consumption data for the entire FRF portfolio including historical data back to July 30, 2012. This data, in combination with software for analysis and reporting, allows measurement and trending of building performance. This allows measurement towards energy reduction goals at the building level and for the entire portfolio. This data also allows us to identify poorly performing buildings for targeted improvement in efficiency to reduce operating costs and improve occupancy comfort and productivity. There is a STREAM project in progress as part of EmPower TN to establish such an enterprise system to collect the same data for all state agencies, departments, and institutions.

The successful real estate management model STREAM has developed for FRF buildings includes energy conservation as an integral part of day-to-day operations for our existing buildings. The EmPower TN initiative provides strategic investment in energy efficiency while also addressing deferred maintenance and necessary improvements in those buildings. STREAM continues to refine the planning and scope for the renovation and construction of state facilities in accordance with the Office of the State Architect's sustainable design guidelines and forthcoming high performance building requirements.

This report has been prepared as required by Tennessee Code and provides information regarding energy conservation efforts, projects scheduled for fiscal year 2016, and other issues relevant to energy use and management in state owned buildings for fiscal year 2015.

EMPOWER TN ENERGY INITIATIVE

EmPower TN is Governor Bill Haslam's multi-year initiative to reduce energy costs and consumption in buildings owned and managed by the state of Tennessee. EmPower TN is an enterprise-wide energy management strategy across the entire real estate portfolio. By measuring and controlling energy use, investing in energy efficiency projects and renewable power generation, and creating an operational environment of excellence, EmPower TN will

develop a sustainable path toward utility savings by reducing utility operating costs an estimated 28% over the next 8 years, saving the state up to \$54M per year in annual avoided utility costs. While the focus of EmPower TN will be state-owned and managed facilities, our hope is that this program will be a model and training tool for our local Tennessee governments and will attract the support of private and nonprofit organizations interested in promoting energy conservation, clean energy, renewable energy, and sustainable development. Strategies for energy conservation projects, utility data management, and renewable energy will be discussed in more detail below.

ENERGY CONSERVATION EFFORTS

The focus areas for energy conservation in state facilities are proactive maintenance practices; optimized operation that follows the design intent and industry best practices; and smart planning, design, and construction of new and major renovation projects. Maintenance, operational, and construction decisions should follow a plan and minimize the total cost of ownership. Throughout fiscal year 2015, STREAM has implemented various energy saving projects/initiatives, which are described in more detail below.

A. EmPower TN Projects for Energy Conservation

The first year projects for EmPower TN will target capital maintenance needs. Project applications from state agencies and organizations will include a description of the energy efficiency measure, project cost, and savings estimate. The state is expecting up to \$37.5 million in energy efficiency projects including LED lighting and lighting control retrofits, existing building commissioning, building automation system retrofits, and boiler/chiller optimization. Depending on the type of project, the simple payback will range from two to twelve years. The savings for each project will be recorded and tracked.

B. EmPower TN Utility Data Management

In compliance with TCA § 4-3-1012 and to reduce the operation cost of state facilities, DGS is procuring a system to manage utility energy consumption, demand and cost across all state facilities. This system will collect historic and ongoing utility invoice data from all state-owned and operated facilities and organize this data for tracking and analysis. This system will be web-based to allow multiple user access. There will be a public portal for general information and education. The interactive internal portal will be a tool for facility managers to monitor and manage their facilities. This software will allow state energy managers to compare facilities against each other and against industry benchmarks to identify energy conservation opportunities; to prioritize facilities with highest use or highest cost; to create and track key performance metrics; and to track and document monthly savings. The contractor for this system should be on board during the first quarter of 2016.

C. EmPower TN Renewable Energy

DGS is preparing a Request for Proposals for the design, delivery, installation, operation, and maintenance of renewable energy systems using solar photovoltaic (PV) electric generating technology at multiple sites across the State. These solar fields will be on state property for behind the meter electrical consumption. This will allow the power generated to be used by the facility and directly offset what would otherwise be purchased from the utility. Solar equipment leases and Power Purchase Agreements (PPA) are common financing structures that would allow the state to take advantage of the Federal Investment Tax Credit (ITC) and accelerated depreciation through an agreement with a third party. In this model, the state will have no capital outlay for the construction of the system. Monthly payments would be based on the amount of energy produced. Viable sites would produce electricity for less than the current utility rate. Significant savings would be expected over the course of a 25 year contract term. State sites with cumulative load of about 20 Megawatts (MW) have been identified as potential locations with a potential savings of \$20 million over 25 years.

D. FRF Real Estate Management Model

STREAM has created a model for real estate management that includes energy management as an integral part of daily operations instead of an add-on or afterthought. Sound facility management is in itself an energy management plan because of the tremendous opportunity to save operating costs in our existing buildings. This whole-building approach to real estate portfolio management becomes the new paradigm for general operation and creates a solid foundation for additional energy conservation opportunities. The basis of the FRF energy management model is planning to support operational goals and the tenant's mission; data collection to allow informed decision-making; and sound facility management to allow proactive operation and maintenance.

Planning considers the goals of an organization in the broad context of asset management. This allows daily operation and capital improvement to move toward the same goal: the efficient fulfillment of the organization's mission. Within our FRF buildings, STREAM is collecting facility information including energy cost and consumption to allow data-based planning.

STREAM continues the successful collection of energy consumption data for FRF facilities through a third year. This experience and lessons learned have helped develop the plan for collecting the same full-spectrum utility cost and consumption data on every state building. Data collection must be reliable. The data should be collected near its source, shared, and organized so it is useful. This utility invoice data collection system will integrate with other state systems including Edison and will be compatible with industry systems including Energy Star.

Facility management staff must be competent, motivated, and accountable. By placing qualified facility management in most of our FRF facilities, DGS has been able to move from reactive operation and maintenance to proactive. In the first two years, the energy consumption in our FRF buildings that are vendor managed has been reduced by approximately 12% as shown in

figure 1 (this consumption data has not been normalized). Sound facility management alone saves energy cost but also provides a critical solid foundation for additional savings through sustainable energy conservation measures.

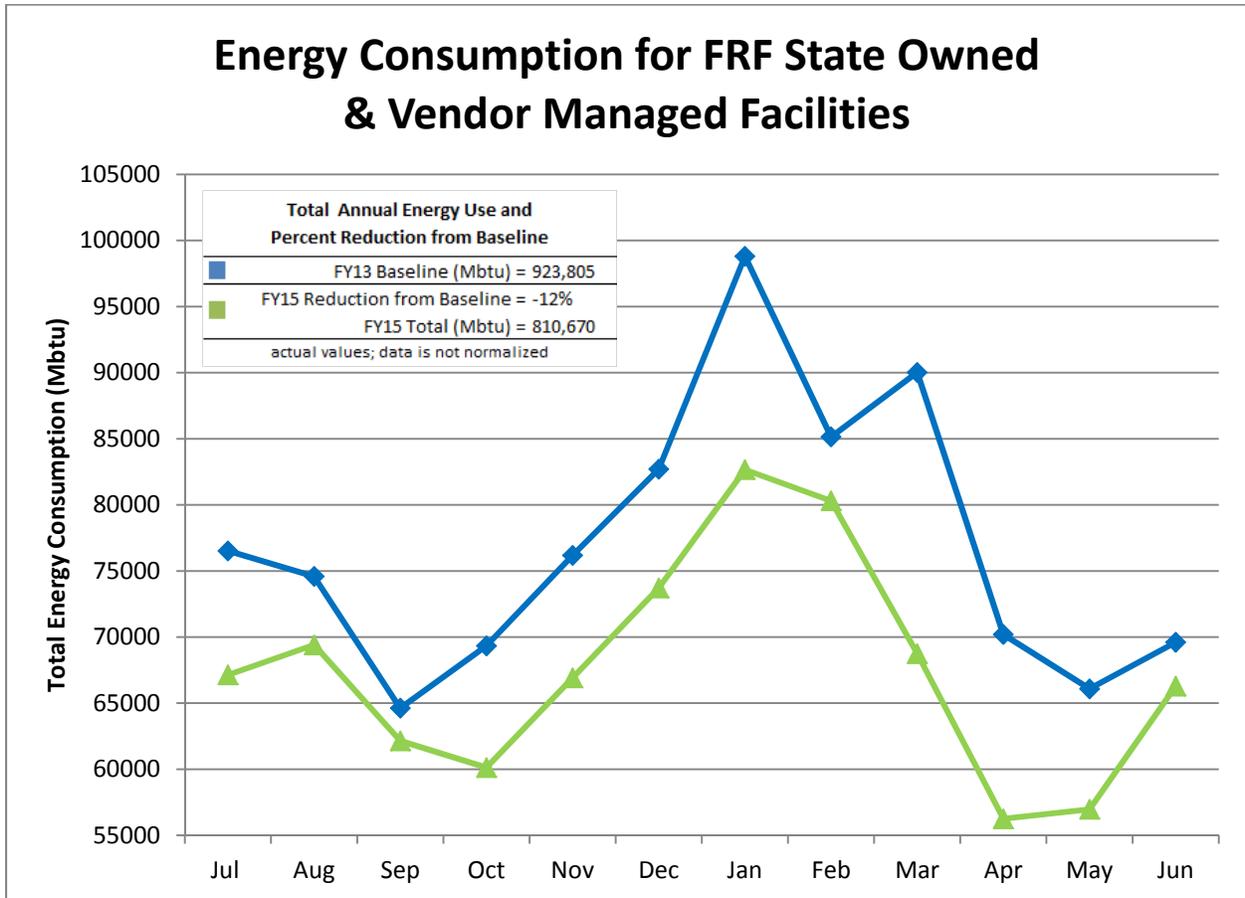


Figure 1: FRF Total Utility Cost Reduction through Operations

E. High Performance Building Program

STREAM's Energy & Sustainability Group is applying the High Performance Building requirements (HPBr) on capital projects. This program provides a consistent approach to new construction, renovation, and the operation and maintenance of buildings that reflects industry best practices. The HPBr include commissioning to make sure energy systems function as designed and meet the needs of the state. A consistent design approach across all state agencies will ensure the unique needs of each state agency are met and will result in efficient, high-performance buildings.

F. Owner's Project Requirements

The Owner's Project Requirements (OPR) is created by the state to document the function, performance and maintenance of a facility to the design team. The OPR is a requirement of the HPBr and the commissioning process as defined by industry and the state. For capital projects,

the OPR is an attachment to the Project Charter. This document forms the basis for design decisions. This document not only gives state expectations for our designers but maintains consistency for systems. STREAM has also created an OPR template for rental property and for maintenance. This is to maintain the same consistency and compatibility in all state facilities.

G. Existing-Building Commissioning

The cheapest and most abundant form of energy is the energy we save, and our greatest opportunity to save energy is in the operation of our existing buildings. Retro-commissioning applies the commissioning process to existing buildings. Retro-commissioning is the assessment of a building’s current use and the operational optimization of the existing HVAC and lighting systems to save energy costs and improve occupancy comfort and productivity. The monitoring that is an integral part of retro-commissioning allows the state to maintain building performance and avoid a drift toward inefficiency that characterizes most buildings.

STREAM chose the WRS Tennessee Tower to demonstrate the savings that can be realized through retro-commissioning and the sound operation of an existing building. The retro-commissioning assessment of the WRS Tennessee Tower in late 2012 included Energy Star benchmarking and showed an opportunity for substantial energy savings. Retro-commissioning started in December 2012 by optimizing the control sequences for lighting and HVAC equipment, and the savings were immediate.

Table 1 shows the improvement in Energy Star Score from 28 to 57 and corresponding energy use intensity (EUI) reduction totaling 32 percent. These numbers should continue to improve as we implement additional energy conservation measures and through the ongoing retro-commissioning program.

Billing Period	Energy Star Score	Site EUI	EUI % Reduction From Baseline
February 2013 Baseline	28	209.3	N/A
June 2015	57	143.1	31.63%

Table 1: WRS Tennessee Tower Energy Star Score and Percent Energy Reduction

Figure 2 shows the cumulative energy cost savings in the WRS Tennessee Tower since December 2012. During this time, the occupancy count in the WRS Tennessee Tower nearly doubled. These savings can be attributed to retro-commissioning, correction of the maintenance deficiency, the addition of reflective window film, and competent facility management. This holistic approach is representative of the STREAM energy management plan.

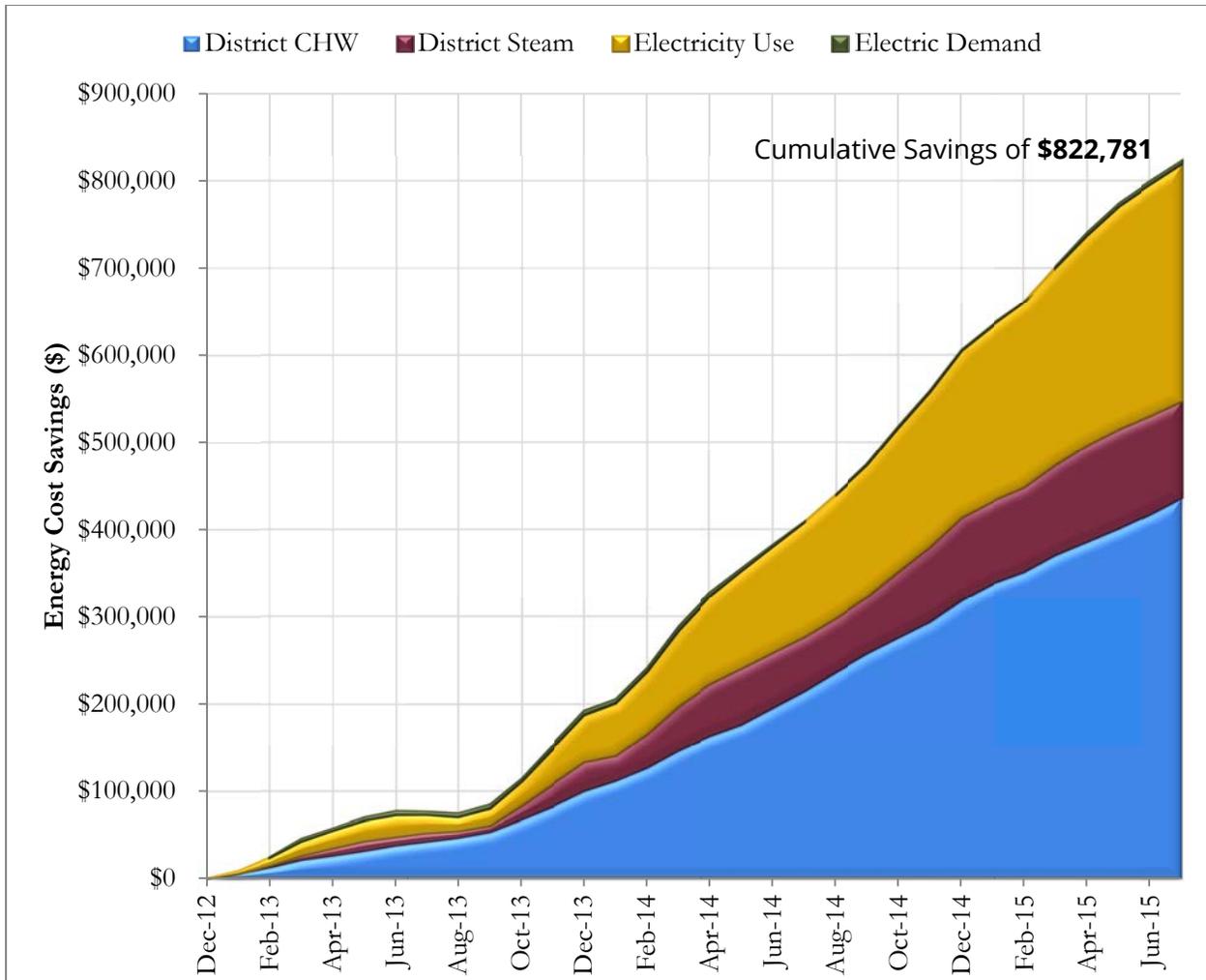


Figure 2: WRS Tennessee Tower Cumulative Energy Cost Savings

H. TVA/NES EnerNOC Demand Response Program

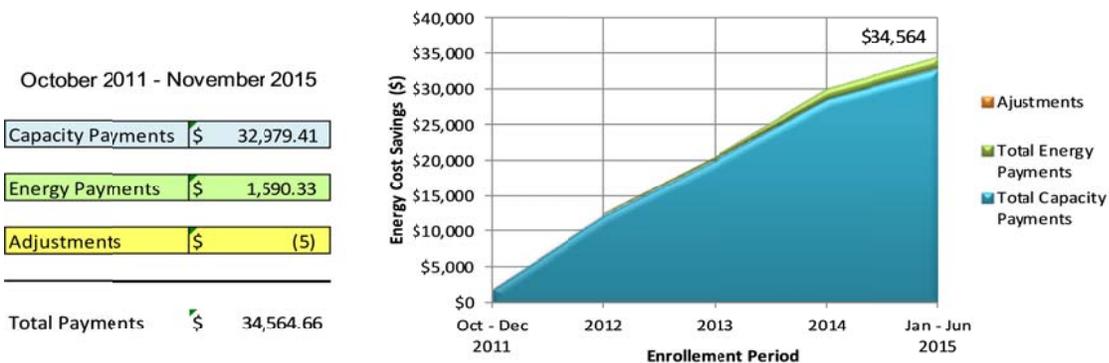
STREAM, in collaboration with the Nashville Electric Service, has implemented the EnerNOC Demand Response Program in 11 major state office buildings. Table 2 lists the 11 state owned facilities that are currently participating in the program and the earned amount of each from October 2011 through November 2015. Each of these buildings has an Energy Management System that allows automation of energy conservation measures to meet the target demand reduction. During a demand reduction event, these buildings reset space temperature set-points, shut off non-essential lighting, manually curtail select air conditioning units, and/or voluntarily shed non-essential loads, such as lighting, personal fans, printers, etc.

Complex	Buildings	Earned Amount
State of Tennessee - Andrew Jackson Complex	Andrew Jackson Citizen Plaza Rachel Jackson	\$1,833.82
State of Tennessee - Cordell Hull Complex	Cordell Hull John Sevier Central Services	\$983.41
State of Tennessee - Donnelly Hill Building	Donnelly J Hill	\$10,058.56
State of Tennessee - James Robertson Complex	Andrew Johnson Davy Crockett	\$4,263.88
State of Tennessee - Lowell Thomas Building	Lowell Thomas	\$4,728.80
State of Tennessee - TBI Building	TBI (Nashville)	\$12,696.19
Total	11	\$34,564.66

Table 2: State Buildings in EnerNoc Program

The EnerNOC program not only saves the state money, but also helps make state employees more aware of their individual contribution to energy conservation. This program is a valuable introduction into automatic demand reduction and will be included in our broad energy management program. Figure 3 depicts the energy savings realized to date from energy reduction and participation in the EnerNOC Demand Response Program.

State of Tennessee



State of Tennessee - Cumulative Savings Total: \$34,564.66

Figure 3: State of Tennessee EnerNOC Savings October 2011 – November 2015

I. Energy Star Portfolio Management

The EPA created Energy Star Portfolio Manager® as an online tool to measure and track energy and water consumption, as well as greenhouse gas emissions. As part of the successful energy cost and consumption data collection for our FRF buildings, STREAM is establishing records in Portfolio Manager for some of our largest buildings as a pilot for a statewide program. Through Energy Star Portfolio Manager, certain property types such as office buildings receive a 1-100 Energy Star score, which compares that property's energy performance to similar properties nationwide. Figure 4 is an example for the Citizen's Plaza Building in downtown Nashville. This building received an Energy Star Score of 57 for our baseline fiscal year, July 2012 through June 2013. The score increased to 71 for fiscal year 2014 primarily through better operation and proactive maintenance. A score of 50 is the median, which means it is performing better than 50% of its peers, and a score of 71 means it is performing better than 71% of its peers.

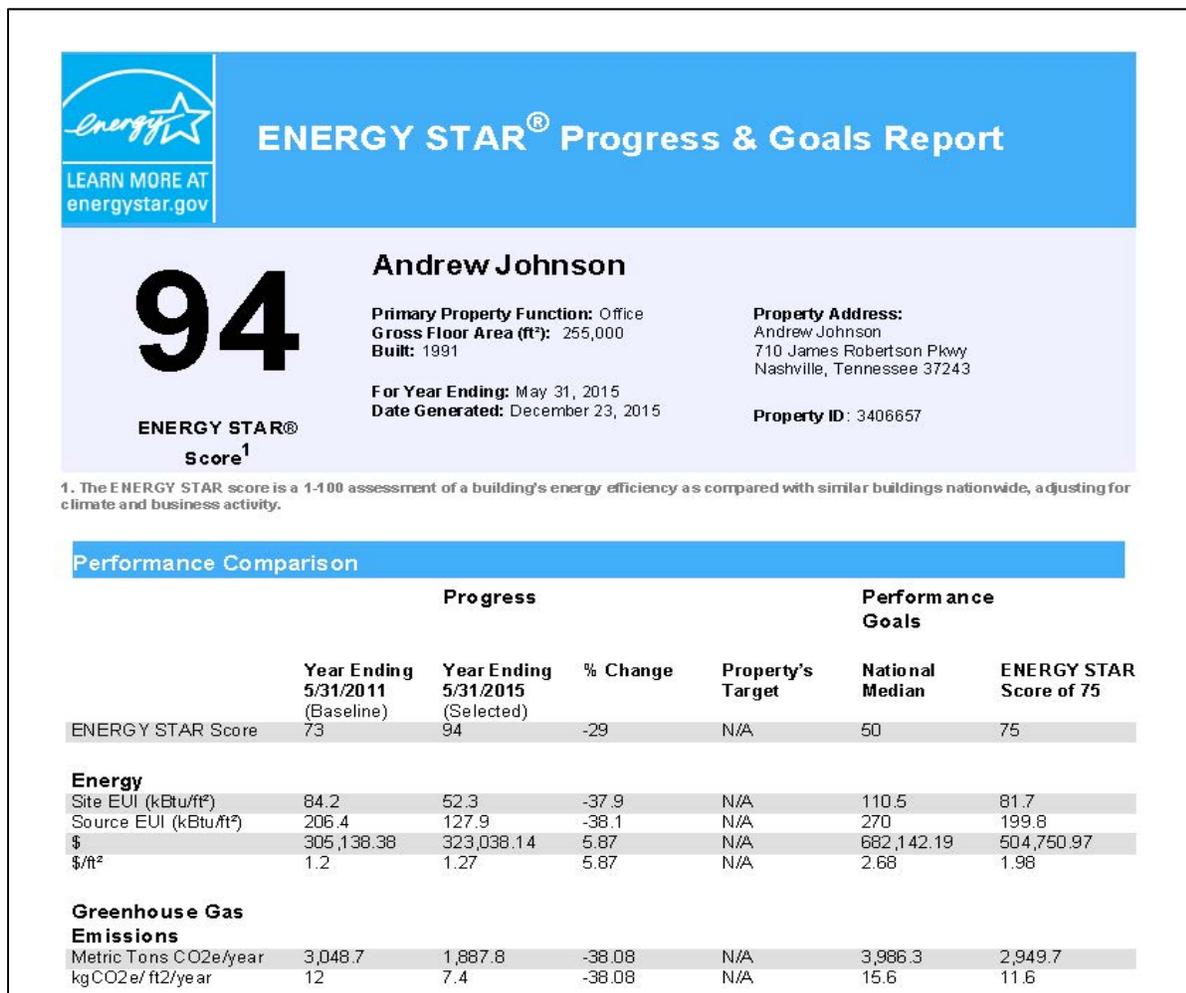


Figure 4: ENERGY STAR Portfolio Manager

J. LED Lighting and Control Systems

Advances in light emitting diodes (LED) and wireless lighting control systems (LCS) have created enormous savings opportunity on capital projects and maintenance lighting retrofits. LED lighting is more efficient and longer lasting. These lights, in combination with wireless control systems, allow control strategies for dimming, daylight harvesting, occupancy sensors, capping, task tuning and scheduling for greater savings and a better work environment. A pilot installation of LED lighting and wireless controls on the 24th floor of the WRS TN Tower has resulted in an energy savings of 83% over the T-8 lighting system that it replaced. Lighting makes up 30-40% of a building energy use, so an LED and LCS retrofit can reduce total building energy consumption by more than 25%.

K. The EV Project

DGS participated in The EV Project by the Department of Energy. This project studied the patterns of electric vehicle charging to allow better planning and optimization of the electric vehicle (EV) charging infrastructure for this promising technology. Through our participation in this project, the State of Tennessee received four solar assist EV charging stations. These four chargers are to be relocated near Bicentennial Mall for use by state employees during business hours and the public evenings and weekends. The solar cells on these stations are connected to the NES power grid and the power is sold back to NES under the Green Power Providers program. These chargers are a good example of photovoltaic cell use as a renewable energy source and a compliment to electric vehicle use for state government and the citizens of Tennessee.

ADDITIONAL HIGHLIGHTS

STREAM continues to assist the Division's Capital Projects Management group to encourage energy efficiency in the design and construction of new and modified facilities. Below are five examples of this effort.

- ❖ Fall Creek Falls Landside Cabins Upgrades, SBC# 126/036-03-2012 (completed in FY 2015) and Fisherman Cabins Upgrades, SBC# 126/036-01-2008 (completed in FY 2016): The ten fisherman cabins included replacement of electric heat pumps with individual lake-coupled geothermal systems that utilize water source heat pumps and the lake as a source of heat during winter and as a heat sink for cooling during the summer. This project utilized a Clean TN Energy grant as part of the funding.



Picture 1: Fisherman cabins with lake-coupled geothermal water source heat pumps



Picture 2: Drilling vertical wells for ground source geothermal heat pumps at Fall Creek Falls

Upgrades to the ten landside cabins included replacement of old, electric air source heat pumps with electric ground source geothermal heat pumps. The project was partially funded with Clean TN Energy Funds managed by TDEC.

- ❖ TWRA Central Office Building Mechanical, Electrical Upgrades, SBC# 220/018-01-2013: Design of the project began in FY 2014. The project will replace the current natural gas fired boiler and electric chiller with a combination of distributed variable flow refrigerant systems and a ground source geothermal dedicated outside air system. The combined systems are expected to cool and heat the 3-level office building with approximately 65 percent of the electrical energy required by a conventional chilled water/boiler system. Lighting upgrades include efficient LED lighting and controls. TVA conducted a pre-design audit in addition to the pre-planning work commissioned by the state prior to designer selection. The project is expected to qualify for financial incentives through TVA's Energy Right Solutions program.
- ❖ TN Veterans Home – Clarksville, SBC# 680/000-01-2011: The new facility began construction during FY 2014 and incorporated variable refrigerant flow systems for heating and cooling along with a building automation system to help optimize the operation of building comfort systems. The HVAC systems allow a high level of individual control for comfort by the residents and staff at the facility and provided a net present value in energy and maintenance savings of over \$600,000 over twenty years.
- ❖ New High School, TN School for the Deaf, SBC# 168/007-01-2013: Design of the new high school, begun in FY 2014, is serving as a pilot project for application of the state's high performance building requirements (HPBr), including at least a 35% annual reduction in predicted energy use compared to that achievable through design to minimum building codes. Multiple HVAC systems have been evaluated resulting in a system selection that is expected to achieve a 36% reduction in energy use over the life of the equipment relative to the baseline. Efficient LED lighting for the building and surrounding campus as well as a building automation system to help manage building mechanical, electrical, and security systems will be included.



Picture 1: Rendering the HPBr pilot project, Tennessee School for the Deaf

- ❖ HVAC and Energy Management System Upgrades (at J. R. Fleming Training Center, Murfreesboro), SBC No. 402/002-01-2012: Project involves replacement of antiquated

and inefficient HVAC systems, addition of a building automation system for control of HVAC and lighting, upgraded lighting, replacement of thermally broken window panes and addition of an entrance vestibule to help isolate the building interior from outdoor conditions. Design is to begin in mid-FY 2016 and will evaluate the relative economics of alternative mechanical systems to optimize energy efficiency. Improvements will reduce energy costs for the facility.

- ❖ Civilian Conservation Corp. Cabins Restoration at Norris Dam S.P. (126/063-01-2013): For renovation of the historic guest cabins at the park, existing air conditioning units and electric heaters were replaced with variable capacity heat pumps that will reduce cooling costs by over 30% and heating costs by 50%. Replacement lighting included LED fixtures.



Picture 2: Cabin Restoration at Norris Dam S.P. includes variable capacity heat pumps and LED lighting

- ❖ The aggregate projected annual electrical energy saved for the Tennessee Army National Guard (TNARNG) projects listed below is 1,543,558 kWh and the estimated natural gas energy saved is 144,043 therms. The associated energy cost savings are \$185,125 for electricity and \$130,775 for natural gas.

TNARNG replaced old, inefficient heating and cooling equipment, domestic tank type water heaters, and upgraded lighting at 54 locations across the State. A total of 62 projects were approved and funded. The projects replaced approximately 70 heating & cooling units, replaced 8 gas-fired heating boilers, installed 32 tankless type domestic water heaters, upgraded 1,375 fluorescent lighting fixtures and installed 24 LED lighting fixtures. TNARNG received three Clean Tennessee Energy Grants (CTEG) from the Tennessee Department of Environment & Conservation (TDEC) totaling \$1,000,000 for this work. The grant funding was combined with 50% matching federal funds from the National Guard Bureau (NGB).

Energy upgrade projects at TNARNG Brownsville Readiness Center in Haywood County and Union City Readiness Center in Obion County were completed. These projects replaced the HVAC equipment installed during the original construction with high efficiency variable refrigerant flow (VRF) equipment to heat and cool the administrative and classroom areas of the readiness centers. The gas-fired unit heaters serving the Assembly Hall and Storage Areas were replaced with high efficiency heaters. Exhaust fans throughout the buildings were replaced with new equipment with high efficiency motors. The original HVAC controls were replaced with direct digital controls (DDC) which can also be remotely monitored. These projects were funded under the Capital Improvements and Maintenance budget using federal matching funds.

Selmer Readiness Center in McNairy County is undergoing the same energy upgrade as Brownsville and Union City during FY 16.

STREAM continues to evaluate and identify buildings throughout the state for opportunities to apply energy efficient technologies and practices and seek financial means needed to implement energy cost savings measures. The individual measures in this report combine to create an effective energy management program.