Energy Efficiency: City of Raleigh

Environmental Defense Fund
Climate Corps 2010
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Written by

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EXECUTIVE SUMMARY

Overview

The Environmental Defense Fund Climate Corps Program places trained M.B.A., Master of Public Policy, and Master of Environmental Management fellows into businesses, universities, and local government offices across the country to identify and analyze energy efficient investments that can reduce costs and energy use. The Environmental Defense Fund (EDF) partnered with the City of Raleigh's Office of Sustainability in North Carolina to place two Climate Corps Fellows in city departments to analyze energy efficiency projects. The City of Raleigh is the first city in the country to host EDF Climate Corps Fellows.

For ten weeks, the fellows worked with city officials to identify and develop energy efficiency measures. The first six weeks were spent with the Raleigh Fire Department assessing the energy usage of all 27 firestation and the firefighter training center. The final four weeks were spent with the Facilities and Operations Division of the Raleigh Parks and Recreation Department analyzing energy efficiency investments for One Exchange Plaza, a 104,000 sq. ft. city-owned office building in downtown Raleigh.

Analysis and Results

The Climate Corps fellows identified a combined $106,816 in annual energy cost savings at the Raleigh Fire Department and One Exchange Plaza. This represents an 11% annual reduction in energy costs for the Raleigh Fire Department and a 41% annual reduction for One Exchange Plaza. The annual reduction of 1,485,837 kwh is enough to power 134 residential homes[1] and the annual savings of 816 tons of carbon emissions is equivalent to taking 148 cars off the road[2]. The fellows' identified energy efficiency projects are below:

Recommended projects

Project	Costs (Equipment & Labor)	Estimated Annual Energy Savings (kWh)	Estimated Cost Savings		Payback (Years)	CO2 Reduction (Tons/Yr)
			Annual	5-Year		
Raleigh Fire Department						
Temperature Controls	$40,823.87	284,693	$15,879.00	$79,394	2.57	125.42
Lighting: T-12 to T-8 Retrofit	$13,329.00	27,000	$2,740.00	$13,700.00	4.90	13.90
Vending Machines	$207.00	13,479	$1,078.31	$5,391.57	0.19	5.94
HVAC: Energy Star AC units	$17,803.00	61,368	$5,216.00	$26,080.00	3.4	47.25
One Exchange Plaza						
Lighting: T-12/T-8 to LED	$263,686.25	818,187	$62,182.22	$310,911.10	4.24	464.32
HVAC: OEP VFDs and Fans	$167,400.00	273,986	$19,179.00	$95,895.00	8.73	155.49
Vending Machines	$296.00	7,124	$541.39	$2,706.96	0.55	4.04
TOTAL	$503,545.12	1,485,837	$106,815.93	$534,078.45	4.71	816.36

Conclusion

The fellows completed detailed energy efficiency assessments for both the Raleigh Fire Department and One Exchange Plaza. The respective reports are attached. The fellows would like to thank the staffs at the Environmental Defense Fund and the City of Raleigh for their complete support throughout the fellowship. We hope our findings help the city of Raleigh lead the way in energy efficiency and a better future ahead.

[1] U.S. Department of Energy, http://www.eia.doe.gov/ask/electricity_faqs.asp#electricity_use_home.
[2] U.S. Environmental Protection Agency,http://www.epa.gov/oms/climate/420f05004.htm.

Energy Efficiency: City of Raleigh Fire Department

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August 3rd, 2010

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TABLE OF CONTENTS

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Efforts to reduce energy consumption will not only reduce the Fire Department's operating expenses, but also provide positive recognition for the Fire Department and the City of Raleigh. Cities and Fire Departments around the state are already using the City of Raleigh and the Raleigh Fire Department as a template to initiate their own energy efficiency measures.

Analysis and Results

The Climate Corps fellows conducted thorough assessments of the operations at each of the Fire Department's 27 stations across Raleigh to gain a better understanding of station energy usage. The stations' recent energy bills were analyzed to establish a baseline of energy consumption as well as target stations that had above average energy costs relative to comparable stations. The fellows developed a list of energy saving opportunities related to lighting, HVAC, controls, and office/kitchen equipment while being sensitive to the 24-hour functionality of the fire stations.

The table below summarizes the energy savings and paybacks associated with various projects recommended by the fellows. If all of these projects were implemented, the total energy savings would be 386,540 kWh/year, representing a 10% reduction in the stations' cumulative consumption. The Raleigh Fire Department could also realize an annual reduction of $24,913, or 11%, in energy and maintenance costs. In keeping with the City of Raleigh's goal to reduce green house gas emissions, implementing these projects would reduce CO2 emissions by 192.51 Tons/Year.

Recommended projects

Project	Costs (Equipment & Labor)	Estimated Annual Energy Savings (kWh)	Estimated Cost Savings		Payback (Years)	CO_2 Reduction (Tons/Yr)
			Annual	5-Year		
Temperature Controls	$40,823.87	284,693	$15,879.00	$79,394	2.57	125.42
Lighting: T-12 to T-8 Retrofit	$13,329.00	27,000	$2,740.00	$13,700.00	4.9	13.9
Vending Machines	$207.00	13,479	$1,078.31	$5,391.57	0.18	5.94
HVAC: Energy Star AC units	$17,803.00	61,368	$5,216.00	$26,080.00	3.4	47.254
TOTAL	**$72,162.87**	**386,540**	**$24,913.31**	**$124,565.39**	**2.90**	**192.51**

Many of the projects listed above have additional non-quantifiable benefits as well. For example, improving the lighting provides the firefighters with a better working and living environment and may improve productivity; while improving the HVAC system provides the firefighters with a more comfortable living environment.

Barriers

Financial
The Raleigh Fire Department is a city-funded, public department. It is given a strict annual budget sanctioned by the City of Raleigh in which to operate, making it difficult to finance projects that are not in the current budget. In addition, any money not used or saved by the department during a given fiscal year must be returned to the city's budget. This makes the consideration and approval of energy efficiency projects difficult because the department has little incentive to make the potential upfront investments for efficiency improvements if no savings can be kept. Furthermore, the department's limited budget is justifiably prioritized for fire fighting and fire rescue related expenses, to better serve the department's core mission.

Department Structure
Given its 24-hour functionality, the Fire Department is one of the only city departments where the buildings are managed by a services staff within the department and not by the city's Facilities and Operations Division. While the services staff is knowledgeable about the stations' operations, there is no dedicated trained staff member equipped to manage the electrical and mechanical systems or keep an inventory of the equipment for life-cycle analyses, resulting in old and inefficient systems.

Workplace Culture
The fire station is a residence that operates 24 hours a day, year-round. Firefighters eat, sleep, and bathe at the station, which substitutes for home. However, unlike home, the firefighters never see the energy bills and therefore are not incentivized to turn-off lights, adjust the thermostats, or turn down the temperature on the water heater. Even though there is a department policy to set the thermostats to certain set-points depending on the season, the policy is rarely followed, which leads to inefficiently run or broken HVAC equipment.

Recommendations and Action Plan

The recommended projects above, which are described in more detail in the rest of the report, will decrease energy use, reduce maintenance costs and improve the overall functionality at each fire station. The thermostat controls, lighting, and vending machine projects should be implemented as soon as possible to capture maximum savings and utilize available utility rebates. The Energy Star AC unit project, which also qualifies for utility rebates, should be implemented when the older units fail and need to be replaced.

This report also identifies other actions that will improve the condition of the fire stations and the health and safety of the firefighters. A preventative HVAC maintenance plan will ensure that the AC units function efficiently at little cost. Weatherization of windows and doors will result in better insulated stations and more comfortable living environments. Reducing the water heater temperature settings will trim energy costs and prevent scalding temperatures. Replacing open-top cooking ranges that have exceeded their useful life will prevent natural gas leakages in living spaces and eliminate the energy cost of constantly burning pilot lights. The maintenance plan, weatherization of the stations, and reducing the water heater temperature settings should be implemented as soon as possible to achieve instant savings. Replacing the cooking ranges is a long-term project that will ensure a healthier and safer environment for the firefighters.

We want to thank the Raleigh Fire Department for their openness and kindness. From Fire Chief John McGrath to each firefighter, we were granted total access to their facilities and personnel that allowed for a complete and thorough energy efficiency assessment. We hope this report will provide insight and guidance as the Raleigh Fire Department reaches new levels of sustainability.

OVERVIEW AND BACKGROUND

The City of Raleigh launched an Office of Sustainability in 2008 to responsibly address environmental and energy issues for a growing municipality. The Office of Sustainability has initiated projects that fund energy efficiency projects, inventory greenhouse gas emissions, develop an electric car program and create a green jobs training program. The Office has now partnered with the Raleigh Fire Department, in an unprecedented effort, to analyze and recommend energy efficiency projects for its fire stations.

Raleigh Fire Chief, John McGrath, aspires to have the "greenest" fire department in the country. He believes that being environmentally responsible is not only the right thing to do, but is also a means to achieve financial savings in a tight budgetary economy. Already, under Chief McGrath's leadership, the Raleigh Fire Department and the City of Raleigh have blazed the trail for energy and resource conservation at its fire stations. One station utilizes a solar thermal water heater to trim natural gas usage, while another station boasts a green roof that improves insulation and reduces storm water runoff. A number of stations have installed rainwater catchment systems that allow firefighters to wash their fire trucks with captured rainwater.

This project focused on energy efficiency assessments of 27 Raleigh fire stations across the metro area. The buildings vary tremendously in scale and condition. The oldest station was built in 1949 while the newest station was completed in 2007. The smallest station is 3,564 sq. ft. while the largest is 11,200 sq. ft. Figure 1 is an energy profile of all the fire stations analyzed during this project.

Figure 1: Energy Profile of the Raleigh Fire Department Fire Stations

Fire Stations	Sq. Ft.	Avg. Annual Electric Use (total kWh)	Avg. Annual Gas use (total therms)	Avg. Annual energy cost (kWh and therms)	Avg. Annual energy cost (per sq. ft.)
Station 1	11,200	186,780	4,920	$19,320	$1.72
Station 2	6,300	57,940	3,285	$8,426	$1.34
Station 3	3,564	40,100	1,056	$4,593	$1.29
Station 4	5,280	45,960	2,634	$7,407	$1.40
Station 5	4,627	40,643	2,781	$6,799	$1.47
Station 6	5,408	53,610	3,602	$8,686	$1.61
Station 7	4,584	49,730	2,551	$7,297	$1.59
Station 8	7,267	88,756	1,874	$8,920	$1.23
Station 9	4,500	48,101	1,983	$6,153	$1.37
Station 10	4,327	41,880	2,049	$6,065	$1.40
Station 11	4,923	54,580	2,225	$7,264	$1.48
Station 12	4,189	50,100	2,131	$6,651	$1.59
Station 14	3,616	39,720	2,181	$5,911	$1.63
Station 15	5,664	53,680	2,480	$7,041	$1.24
Station 16	3,984	55,020	2,117	$7,575	$1.90
Station 17	4,875	51,920	1,991	$6,649	$1.36
Station 18	5,185	41,920	2,520	$6,305	$1.22
Station 19	5,293	60,080	3,191	$8,471	$1.60
Station 20	5,168	49,460	2,738	$8,089	$1.57
Station 21	5,225	49,990	3,084	$7,560	$1.45
Station 22	5,222	62,730	2,387	$8,352	$1.60
Station 23	8,873	52,850	2,871	$7,702	$0.87
Station 24*	5,710	66,640	2,325	$8,778	$1.54
Station 25	5,640	47,419	3,010	$7,470	$1.32
Station 26**	10,652	436,860	2,244	$31,630	$2.97
Station 27	6,873	57,040	3,230	$8,356	$1.22
Station 28	10,000	48,580	3,592	$8,215	$0.82
TOTAL	*158,149*	*1,932,089*	*71,043*	*$235,676*	*$1.47*

**Based on avg. natural gas use March 2010 – January 2010 (used propane previously)*
*** Includes Emergency Control Center that shares building with Fire Station 26*
Source: Fire Station's utility bills: July 2008 - June 2010 (compiled by The City of Raleigh Parks and Recreation Dept.)

The Raleigh fire stations are managed by the Fire Services Division. One fire captain is responsible for purchasing appliances and equipment and maintaining facilities. Currently, the Fire Department is working with Raleigh's Office of Sustainability on a lighting retrofit project. The project will enhance lighting and reduce energy consumption in Fire Stations 1, 5, 6, 7, 9 and 19. The remaining stations are expected to undergo lighting retrofit projects by using funds provided by the Energy Efficiency and Conservation Block Grant (EECBG) as part of the American Recovery and Reinvestment Act (ARRA).

RECOMMENDED ENERGY EFFICIENCY PROJECTS AND ACTIONS

Project 1 – Temperature Controls

Basic Project Information

One of the most effective and inexpensive ways to reduce air conditioning and heating costs is to adjust the thermostat settings. In the summer, for each degree the thermostat setting is raised, the seasonal cooling costs are reduced by 7 to 10 percent. In the winter, for each degree the thermostat setting is lowered, the seasonal heating costs are reduced by 7 to 10 percent. [1]

Currently, the Raleigh Fire Department has in place a policy that stipulates that during the winter heating season, facility climate control systems should be set to 68°F in the dayroom and dormitory side and 55°F in the vehicle (apparatus) bay; and that during the summer cooling season, facility climate control systems should be set to 75°F in the dayroom and dormitory side while the vehicle bay does not have air conditioning. During the evaluations of each station, it became apparent that this policy, at least for the summer cooling season, was not being adhered to as seen in the pictures below:

Pictures: Current Thermostat Settings at Various Stations

Lowering the thermostat settings in the summer or raising them in the winter can not only raise the energy costs, but can also strain the HVAC system causing the system to run inefficiently and potentially fail, resulting in increased maintenance and replacement costs. Installing Proliphix internet-managed energy control systems can effectively enforce the thermostat policies for the stations while also monitor the HVAC system and instantly alert the Fire Department's services division when a unit malfunctions or fails.

Project Summary

- Replace all existing station thermostats with Proliphix's Uniphy Network Professional IMT-550 thermostats to control and monitor the HVAC system
- Energy Savings: 284,693 kWh
- Equipment and Labor Cost: $40,824
- **Total Estimated Annual Energy Cost Savings: $15,879**
- **Payback Period: 2.57 years**
- Submit project to Progress Energy for Custom Incentives. If approved, project costs would be $18,048 and payback period would be 1.14 years.

[1] Source: www.progress-energy.com

Financial Analysis

APOGEE interactive energy analysis software was used to determine how energy use and cost would be affected if the thermostat temperatures were raised during the summer and lowered during the winter. The software took into account building type, location, age, square footage, hours occupied, heating type, cooling type, water heater type, lighting, windows, cooking equipment and refrigeration.

Each station was analyzed separately using its own building characteristics and observed current average thermostat settings. Since the only observed thermostat data available was for summer, the average winter thermostat setting for all stations was assumed to be 72°F. After current energy usage was determined, the software's thermostat settings were changed to the Fire Department's policy settings of 75 °F in the summer and 68 °F in the winter. The Fire Department's policy settings are the recommended or proposed thermostat settings. The charts below show the energy analysis of the stations running at their current thermostat setting vs. the proposed settings:

Chart 1: Estimated Annual Energy Consumption: Current vs. Proposed Settings

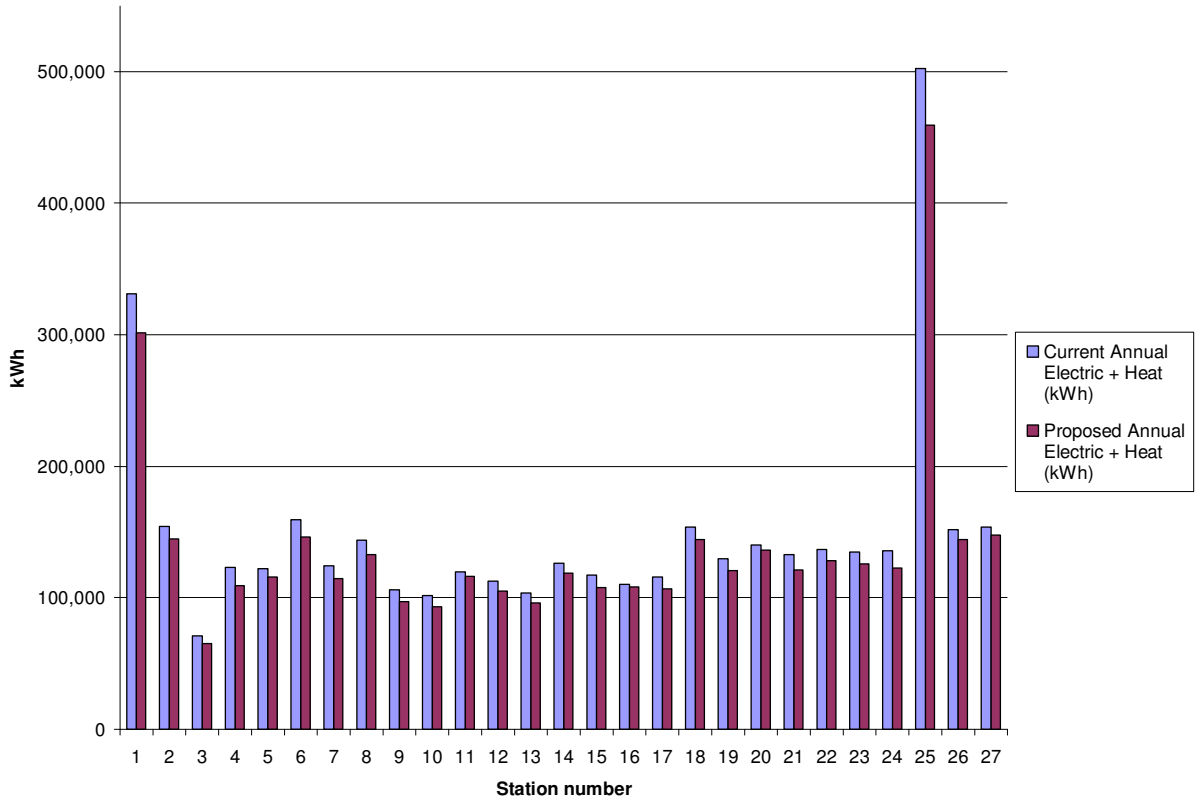
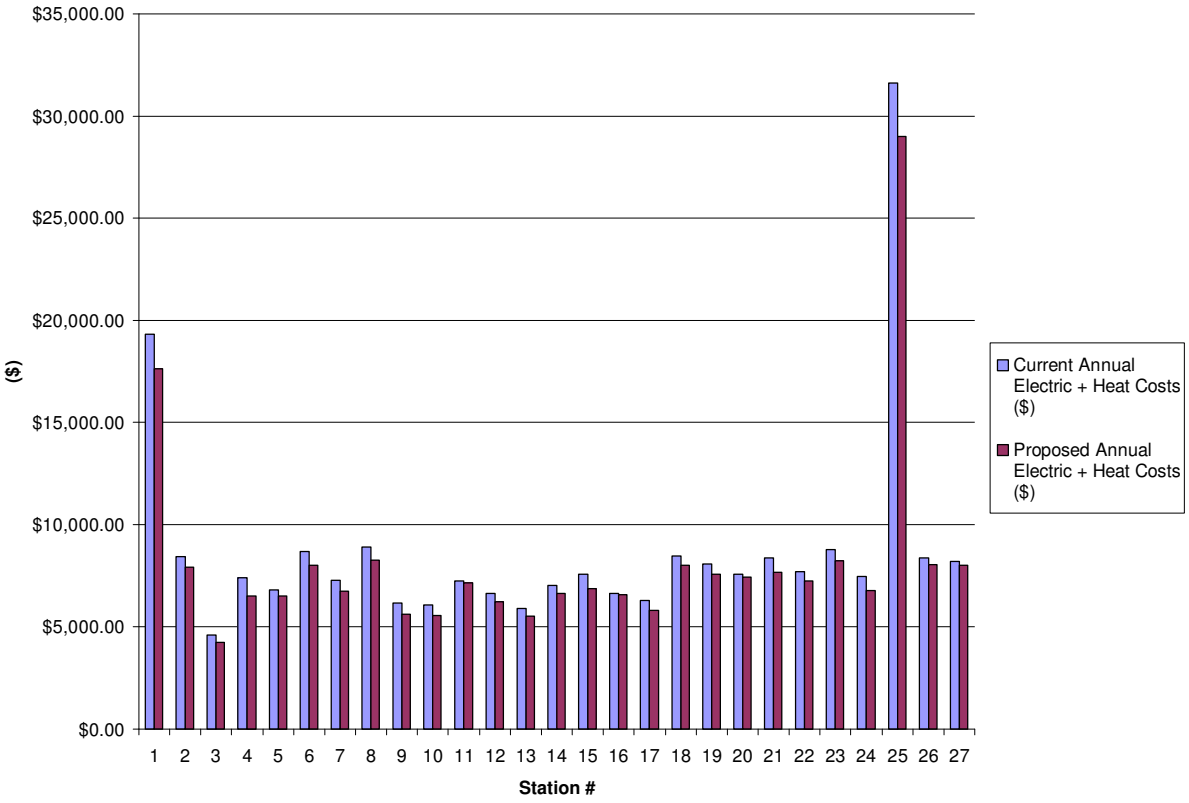


Chart 2: Estimated Annual Energy Costs: Current vs. Proposed Settings



Notes: The software used is APOGEE Interactive. www.apogee.net; numbers are estimates/projections; actual energy/numbers may vary; Software uses electricity costs of $0.0914 per kWh as actual rate is $0.085 per kWh; software uses a natural gas cost of $1.10 per therm. All stations are represented on the graph; there is no station 13 so station 13 is actually station 14, station 14 is station 15, and so on till station 28. Station 25 on the graph (station 26 in actuality) shares the building with the Emergency Command Center and splits the energy costs.

Assumptions

- Energy Savings: Based on the APOGEE energy analysis, a percentage reduction in energy and costs was conservatively estimated for each station resulting in cumulative savings of approximately $15,879 per year and 284,693 kWh per year.
- Equipment Cost & Labor: See **Appendix A** for the estimates of Proliphix Uniphy Network Professional thermostats and labor to install. Conservatively estimated 200 ft of Cat5e cable for the thermostats at $0.10/ft for each station.[2] Assume IT labor to install Cat5e cable provided by IT division of Fire Department at no charge. Costs were calculated before assuming a Progress Energy Custom Incentive of $0.08/kWh saved by the application, added to the estimated annual energy cost savings: $0.08/kWh*284,693kWh=$22,775. Total costs would then be $18,048.
- CO2 emission reductions: CO2 savings were calculated using 1.135lb/kWh.[3]
- Payback period was calculated before assuming a Progress Energy Custom Incentive. The rebate of $0.08/kWh saved by the application added to the estimated annual energy cost savings: $0.08/kWh*284,693kWh=$22,775. $40,824/($22,775+ $15,879)=1.06 years. See **Appendix B** for Progress Energy Custom Incentives Policies.

[2] Raleigh Fire Department IT staff estimate: 1000FT Cat5e 350Mhz Network Cable average price of $74.00.
[3] www.epa.gov. eGRID 2007 Version 1.1.

Recommendations

As the energy analyses show, significant energy savings and costs can be achieved by raising the thermostats in the summer and lowering them in winter using thermostat controls. The fellows recommend replacing all the thermostats at each station with Proliphix's Uniphy Network Professional thermostats to improve HVAC control and reduce energy costs. Other thermostat control ideas were evaluated, but none of them could offer the enforcement and monitoring capabilities of Proliphix's Uniphy Network Professional thermostats.

Easy Application

Proliphix's Uniphy Network Professional thermostats feature standard Internet browser-based configuration and control over a secure Ethernet connection. A member of the Fire Department services division can remotely control and monitor the HVAC systems of all the fire stations from one location. The thermostats deliver e-mail status and alerts to any personal computer or mobile text messaging device so the services staff can diagnose small problems before the firefighters even notice, saving valuable time and potential transportation costs. Proliphix thermostats do not require any proprietary software and the Fire Department's IT staff can use basic Cat5e cable to connect the thermostats to the pre-existing wired LAN environment in each station, see **Appendix C** for more detail. The thermostat management interface on the Internet is configured to clearly display the current most important status and settings of the thermostats. A representative from Proliphix can provide set-up instructions to ensure the services staff uses the features to monitor the HVAC systems properly.

Relevance to Fire Stations

Climate controlled systems can unlock significant energy savings by taking advantage of the firefighters' typical routine. The majority of a firefighter's day, from 8am to 8pm, is spent on one side of the fire station, the dayroom; while the time from 8pm to 8am is spent on the dormitory side. By adjusting the temperature settings of the unoccupied areas, a Proliphix system can utilize the firefighters' typical routine so that the dormitory is not cooled so much in the day; and conversely, the dayroom is not cooled so much at night.

Capabilities

One of the key capabilities of the Proliphix Network Professional thermostats is the keypad lockout with override buttons. The keypad lockout enables the services staff to remotely set the thermostats to the recommended/policy settings and remove the ability to change those settings. This lockout capability enforces the recommended/policy settings and prevents the firefighters from overworking the HVAC systems. The thermostats can also provide set-point override limits that allow for small increases and decreases in the recommended thermostat settings allowing firefighters to adjust the thermostats a limited number of degrees for a limited time before being automatically set-back to the original set-points. Being able to enforce the recommended/policy settings translates into reducing energy and maintenance costs while lengthening the lifespan of the current HVAC systems.

Case Study

The Raleigh Fire Department would not be the only first-responders to have implemented Proliphix internet managed energy control systems. Cataldo Ambulance Service, Inc. of Boston installed Proliphix Network thermostats in fourteen separate Boston area locations to monitor and control energy use and reduce green house gas emissions. Chris Coleman, Cataldo's Director of Information, said that Proliphix has lowered Cataldo's energy consumption and had a positive effect on the company's energy bill. For a case study of Cataldo's implementation of Proliphix thermostats, see **Appendix D**.

Potential Rebates

The fellows also recommend that this project be submitted as soon as possible to qualify for Progress Energy's Custom Incentive of $0.08/kWh, applied to the energy saved. If the project is approved by

Progress Energy, total costs would be reduced to $18,048 and payback period would be reduced to 1.14 years.

Long Term Strategies

In the long term, consider hiring a trained specialist to manage the stations energy usage and operations or consult with the City's Facilities and Operations staff regarding equipment purchasing, maintenance, and system improvements.

Additional Considerations

In addition to controlling the thermostat settings at all the stations, the fellows recommend weatherizing the window and door frames of all the stations to ensure that cooled or heated air does not escape. This can be a cost-effective way to reduce the need to increase or decrease the thermostat settings as well as provide a more comfortable living environment.

Project 2 – Lighting Retrofit: T12 to T8

Basic Project Information

Currently, the Raleigh Fire Department utilizes approximately 1,778 T12 40-watt fluorescent lamps to provide the majority of lighting inside the stations; see **Appendix E** for Fire Station lighting inventory. The lamps are installed in three areas in the fire station: the dayroom (lounge and office, kitchen, dining area), the vehicle bay, and the dormitory (sleep area, shower, and bathroom). The lighting remains on most of the day in the dayroom side, intermittently day and night in the vehicle bays, and then is turned on during the evenings in the dormitory side. It is estimated these lights are operating about 8 hours per day.

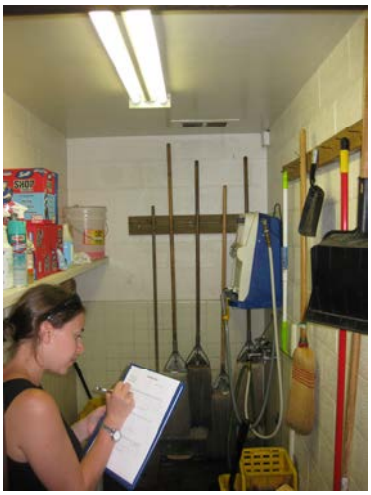
Replacing T12 lighting with T8 lighting will reduce energy, maintenance and replacement costs. T12 lighting is less durable and requires more electricity to function. The ballast, which controls the energy charge to the light, of a T12 lamp also requires more energy and is less durable than a T8 ballast. According to Reliant Energy, T8 lighting is 30% more efficient than T12 lighting. Below is a photo comparison of a T12 and T8 lamp:

Pictures: Comparison of T-12 and T-8 Lighting

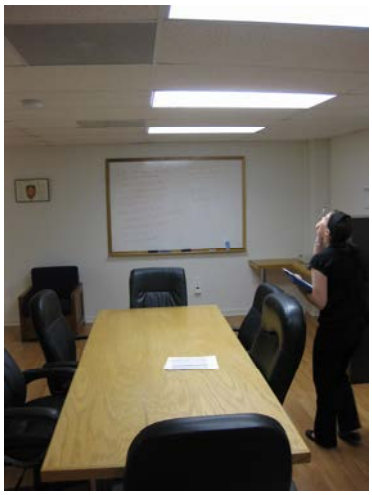
T12 lamp: Typically consumes 40 watts with a magnetic ballast that consumes 12 watts

T8 lamp: Typically consumes 32 watts with an electronic ballast that consumes 8 watts

Pictures: Comparison between T12 lighting at a fire station and a newer T8 light installation:



T12 lighting at Station 18



T8 lighting at Station 8

The T12 lamps emit a yellow, warmer light while the T8 lamps emit a brighter, cooler light. T8 lights will consume less energy and will also emit less heat, which will benefit the fire stations in the summertime. The brighter lighting will also improve the workplace environment for the firefighters.

Project Summary

The Raleigh Fire Department has already installed T8 lighting or better in the fire stations that were built since 1998 (Fire Stations 22-28). The Raleigh Office of Sustainability has also launched a lighting retrofit project that will replace existing T12 lamps with T8 lamps in six fire stations this year (Fire Stations 1, 5, 6, 7, 9 and 19). The lighting retrofit project will:

- Replace the remaining 1,159 T12 lamps and magnetic ballasts with T8 lamps and electronic ballasts.
- Energy Savings: 27,000 kWh
- Equipment and Labor Cost: $13, 329
- **Total Estimated Annual Energy Cost Savings: $2,740**
- **Payback Period: 4.9 years**

Financial Analysis

The project the fellows propose is based on very conservative assumptions. Firstly, given the higher efficiency and brighter lighting of a T8 lamp, the Fire Department could potentially "delamp" existing T12 lighting and fixtures. Therefore, the project costs would decrease because fewer T12 lamps would need to be replaced. Secondly, the electricity demand charge will vary for each station, so the lowest charge was selected (if the demand charge is higher, then switching to a more efficient light will increase savings).

Assumptions

- Electricity rate chage: $0.085
- Electricity demand charge: $4. (Based on Progress Energy's lowest estimate)
- Incremental cost per ballast and fixture: $15. (Based on prices from Lighting.com)
- Hours per week that lights are turned on (8 hrs per day): 56 hours
- Progress Energy Rebate (per 4 ft. lamp installed): $6 (see **Appendix F** for Progress Energy Lighting incentives)

Recommendations

The fellows recommend retrofitting all existing T12 lamps and magnetic ballasts in the Raleigh fire stations with T8 lamps and electronic ballasts. The Raleigh Office of Sustainability has already begun lighting retrofit projects in six fire stations, and municipal officials plan to budget a portion of funding for other fire stations from the Energy Efficiency and Conservation Block Grant (EECBG) as part of the American Recovery and Reinvestment Act (ARRA). The new lighting will reduce energy use, reduce energy costs, reduce maintenance and replacement costs, and provide a better working environment for the firefighters. The City of Raleigh and the Fire Department should continue to retrofit all the fire stations with T8 installations so that the significant annual savings can be obtained.

Project 3 – Vending Machines

Basic Project Information

The 2.5 million refrigerated beverage vending machines in place in the United States consume approximately 7.5 billion kWh per year. This equipment costs American businesses nearly $600 million annually to power.[4] Though the Fire Department has only 2 refrigerated and 1 non-refrigerated vending machines located at the Keeter Training Center, these machines run 24/7, consuming an estimated 27,125 kWh and costing an estimated $2,170 to operate per year.

Pictures: Vending Machines at the Keeter Training Center

The two major energy consuming systems in vending machines are refrigeration and lighting. Vending machine controls now exist that can substantially save energy and reduce operating expenses. The fellows recommend installing a "VendingMiser", a product from USA Technologies, on all the vending machines.

[4] www.aceee.org. The American Council for an Energy-Efficient Economy's Online Guide to Energy Efficient Commercial Equipment.

The VendingMiser monitors the occupancy levels and ambient temperature changes in the area surrounding the vending machine and regulates the power usage of the machine. The device powers down the machine when the area is vacant and automatically re-powers the cooling system at one- to three-hour intervals, independent of sales, to ensure the product stays cold. The VendingMiser for non-refrigerated machines powers down the lighting and electrical systems. Maintenance savings can also be generated through the reduced run-time of vendor components.

Project Summary

- Install VendingMisers on all Fire Department vending machines
- Energy Savings: 13,479 kWh
- Equipment and Labor Cost: $207.00 after Progress Energy Incentives.
- **Total Estimated Annual Energy Cost Savings: $1078.31**
- **Payback Period: 0.19 years**

Financial Analysis

Assumptions

- Energy Savings: Used the current wattage and conservative estimates of power-on hours for the machines before and after VendingMiser installation. Duration of auto-repower estimated at 0.4 hours and time between auto-repower estimated at 2 hours.

- Equipment Cost & Labor: VendingMiser cost is listed at $179.00 and SnackMiser is listed at 79.00.[5] Progress Energy has an incentive of $90.00 for beverage machine controls and an incentive of $50.00 for snack machine controls making costs $89.00 and $29.00 respectively. See **Appendix G** for Progress Energy Vending Machine Incentives Policies. Labor costs assumed to be free since the VendingMisers are plug-in devices.

- CO2 emission reductions: CO2 savings were calculated using 1.135lb/kWh.[6]

[5] www.usatech.com.
[6] www.epa.gov. eGRID 2007 Version 1.1.

Installation of VendingMiser Analysis

Raleigh Fire Department

Input Variables	
Energy Costs ($0.000 per kwh)	$0.080
Facility Occupied Hours per Week	70
Number of Cold Drink Vending Machines	2
Number of Uncooled Snack Machines	1
Power Requirements of Cold Drink Machine (avg watts)	400
Power Requirements of Snack Machine (avg watts)	80
VendingMiser Sale Price (for cold drink machines)	$89.00
SnackMiser Sale Price (for snack machines)	$29.00

One Year Savings Analysis

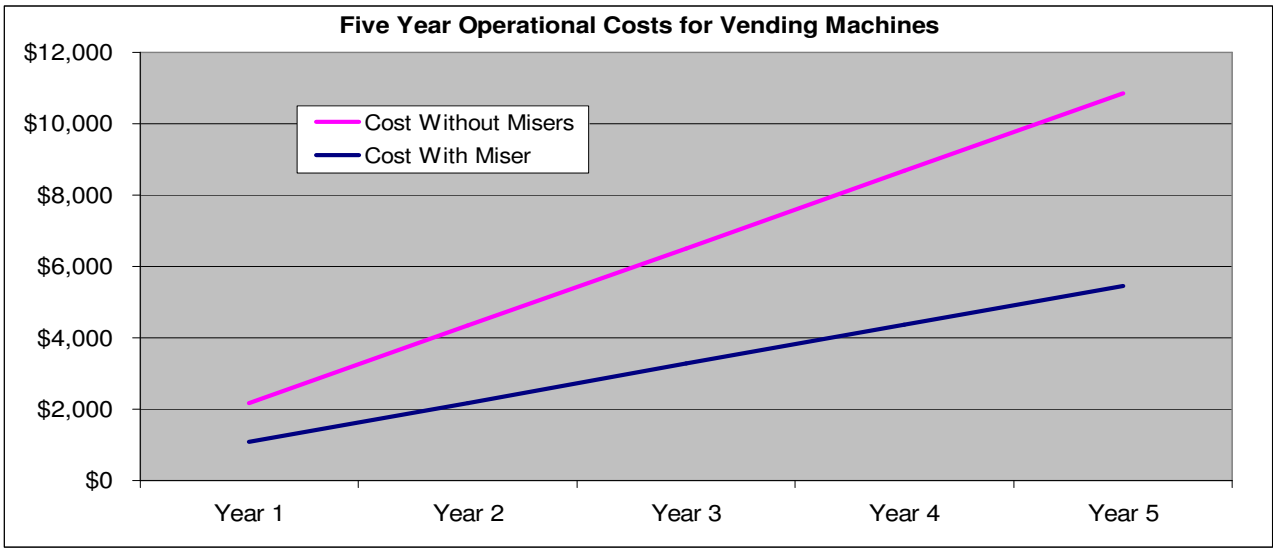
	Before	After	Savings	
Cold Drink Machines	$1,928.91	$991.24	$937.66	Cost of Operation
	24,111	12,391	11,721	kWh
			49%	% Energy Savings
Snack Machines	$241.11	$100.46	$140.65	Cost of Operation
	3,014	1,256	1,758	kWh
			58%	% Energy Savings

Project Summary

Present kWh	Projected kWh	kWh Savings per Year
27,125	13,646	13,479

Present Cost	Projected Costs	Annual Savings	Savings	Total Project Cost	Break Even (Months)
$2,170.02	$1,091.71	$1,078.31	49.7%	$207.00	2.3

Five Year Savings on 3 Machines = $5,391.57
Five Year Return on Investment = 2505%



Version 1.0

Source Data for Generating Chart					
	Year 1	Year 2	Year 3	Year 4	Year 5
Cost With Miser	$1,091.71	$2,183.42	$3,275.13	$4,366.84	$5,458.54
Cost Without Misers	$2,170.02	$4,340.04	$6,510.07	$8,680.09	$10,850.11
Total Number of machines	3				

Recommendations

The fellows recommend purchasing and installing VendingMisers on the 3 vending machines located at the Keeter Training Center as soon as possible. The devices will reduce energy consumption and costs. The Fire Department can also request the vending machine distributors/owners to remove the lighting in the vending machines to eliminate lighting costs altogether.

Station 19 also has a vending machine that was brought in by one of the firefighters. While not owned by the Fire Department, this machine is still using energy and presumably costing the department money. It is recommended that the department purchase a VendingMiser for this machine as well. Although it is not owned by the department, and rather than have it removed from the station, the VendingMiser will decrease the energy consumption and costs associated with the machine.

Project 4 – Energy Star AC Units

Basic Project Information

Twenty-five Raleigh fire stations use residential-like split heating and cooling systems, while Stations 1 and 28 use commercial-grade HVAC systems to heat and cool each building; see **Appendix H** for the AC unit inventory across all Raleigh fire stations. The residential-like split heating and cooling systems require 63 AC units to function. These units cool the dayroom and dormitory of each fire station (the vehicle bays require some heating in the winter, but no air conditioning).

The AC units are necessary to maintain comfortable climates for the firefighters throughout the day and night. However, 38 of these units have low efficiency ratings and therefore consume significant levels of energy. These models have a SEER (Seasonal Energy Efficiency Ratio) of 10 or less. Below are photos of selected 10 SEER units currently used at the fire stations:

York 3.5 ton 10 SEER unit at Station 21

Carrier 3.5 ton 10 SEER unit at Station 6

These units are typically older and are near or have exceeded their useful life. Generally, when these older units no longer function, they are replaced with 13 SEER models. Purchasing Energy Star 14.5 SEER air conditioners to replace the existing units will lead to even greater energy savings.

Project Summary

- Replace 10 SEER AC units when they fail, with Energy Star 14.5 SEER AC units
- Energy Savings: 61, 368 kWh
- Incremental cost of purchasing 38 Energy Star units: $17, 803
- **Total Estimated Annual Energy Cost Savings: $5,216**
- **Payback Period: 3.4 years**

Financial Analysis

Assumptions

- The costs and savings are assumed to occur in one year, but might actually be spread across a number of years (depending on when the 10 SEER units fail).
- The incremental cost of an Energy Star unit is based on the cost of a standard 13 SEER unit, which we assume is currently purchased as a replacement.
- The AC units throughout the Raleigh fire stations range in size between 2 and 5 tons, so an average tonnage of 3.5 is used for the calculations.
- Energy Star qualified AC units are eligible for Progress Energy rebates of $25 per ton (see **Appendix I** for Progress Energy AC unit incentives).

Recommendations

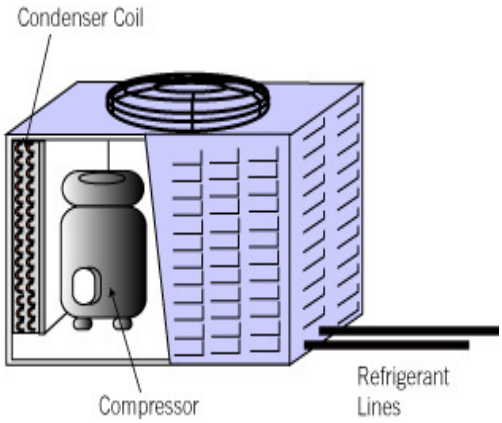
The fellows recommend purchasing Energy Star qualified AC units when the existing 10 SEER units fail; see **Appendix J** for a list of Energy Star qualified units. This is an opportunity to drastically decrease energy consumption and maintenance costs at a fire station. According to the Environmental and Energy Study Institute, a one unit increase in a SEER rating leads to a 10% improvement in energy efficiency. Investing in an Energy Star 14.5 SEER AC unit rather than a standard 13 SEER unit will produce significant savings, and will improve the durability of an appliance that must work hard to meet the demands of a busy fire station.

OTHER GENERAL RECOMMENDATIONS

HVAC Maintenance Schedule

It is recommended that the condenser coils in air conditioning units are cleaned once a year. This increases the efficiency and improves the durability of the units. Below is an illustration of the condenser coils in a central air conditioner unit and a picture of an air conditioner unit at Raleigh Fire Station 6:

Pictures: Illustration of Central Air Conditioner Condenser Coils and Air Condition at Station 6



According to Goodway, Inc., an air conditioner cleaning company, equipment operating with dirty coils can use up to 37% more energy than a unit with clean coils. See **Appendix K** for instructions of coil cleaning. The Fire Department already instructs that the HVAC filters are cleaned monthly and the fellows recommend that the department also includes cleaning the coils, as part of a more comprehensive HVAC preventative maintenance schedule. This will ensure that the systems are functioning at the highest efficiency.

HAZMAT Bay in Station 2

The Station 2 HAZMAT bay, a second and less used vehicle bay in the station, is air conditioned throughout the day. The vehicle and HAZMAT bays at other fire stations are not cooled. Generally, vehicle bays in fire stations do not need to be air conditioned, but do require some heating in the cold months to ensure equipment does not freeze. The fellows were told that the HAZMAT bay in Station 2 was being air conditioned because the firefighters' exercise equipment was located there. Below is a comparison between energy usage in July between Fire Station 2 and another Raleigh Fire Station of similar square footage (minus the square footage of the HAZMAT bay):

Figure 4: Comparison of Electricity Use in July between Station 2 and Station 9

Fire Station	Fire Station Sq. Ft.	Fire Station Sq. Ft. *(minus St. 2 HAZMAT bay)*	Avg. Electric use (kWh), July 2008 and July 2009	Avg. July electric bill, July 2008 and 2009
Station 2	6300	4500	8,140	$642.50
Station 9	4500	4500	5,750	$439.00
Source: Fire Station's utility bills (compiled by The City of Raleigh Parks and Recreation Dept.)				

The month of July was an ideal month to compare energy costs because energy consumption due to air conditioning is at its highest in the hot summer months. However, each station is different, so it is uncertain how much of the $200 difference between the two stations is directly attributable to the air conditioning unit in the HAZMAT bay. Below are photos of the HAZMAT bay and the exercise equipment:

Pictures: Station 2 HAZMAT Bay and Exercise Equipment



A building envelop analysis of the HAZMAT bay was conducted to estimate how much hot and cool air escape. The characteristics of the roof, walls, windows and square footage of the building help determine how insulated it is. Based on these estimates, it requires 8,480 kWh to cool the building annually at a total cost of $720; see **Appendix L** for Station 2 building envelop calculations.

The first recommendation is to relocate the cardio equipment (pictured above) away from the HAZMAT bay into the dayroom living area and the HAZMAT air conditioner be turned off. However, space is a concern in the rest of the station, so moving the equipment might not be possible. Given that, the fellows would recommend sectioning-off the workout area from the rest of the HAZMAT bay using drywall and purchasing an Energy Star window-unit air conditioner. This will drastically reduce the cooling area in the bay and lessen the need for a large, central air conditioner.

Reduce Water Heater Temperature Settings

Across all the fire stations there were a varying degree of water heater temperature settings. In many of these stations, firefighters complained of scalding hot water at times. The fellows recommend that all water heater settings be set optimally to "A" or "B" if necessary. This is equal to the recommended water heater temperatures of 120 – 140 degrees. Below is a temperature index extracted from a State Select (Model GS675XRRS) Gas Water Heater Instruction Manual that is common in almost all of the fire stations:

Temperature Settings	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
VERY HOT= approx. 160°F (71°C)	About 1/2 second
C = approx. 150°F (66°C)	About 1-1/2 seconds
B = approx. 140°F (60°C)	Less than 5 seconds
A = approx. 130°F (54°C)	About 30 seconds
▲ = approx. 120°F (49°C)	More than 5 minutes
LOW = approx. 80°F (27°C)	- - - - - - - - - - - - - - - -

Below are photos of water heater settings at fire stations:

Pictures: Water Heater Settings at Various Fire Stations

Fire Station 10


Fire Station 1

Fire Stations 5, 6, 7, 10, 11, 16, 19, 20, and 21 had water heater settings set to "C" or higher. According to the U.S. Department of Energy, a 10°F reduction in water temperature results in energy cost savings between 3-5%.

RECOMMENDATIONS FOR APPLIANCES

Cooking ranges

As part of the 24 hour, 7 day-a-week operations at each fire station, many meals are cooked at these stations. The firefighters typically cook lunch and dinner for everyone on duty, which can range between 3 – 10 individuals. To accommodate this cooking routine, each station has a commercial grade cooking range. Many of these ranges were installed when the fire stations were built and have not been replaced. According to the Association of Home Appliance Manufacturers, the useful life of a cooking range with a double oven is 18 years. Below are photos of a typical open-top cooking range at Fire Station 18:

Pictures: Open-top cooking ranges at fire stations

Cooking stove and oven at Station 18

Pilot light that remains on 24/7

These older gas ranges require a pilot light that is constantly lit, which is the case in 24 of the 27 fire stations. The approximate annual cost of the pilot light burning all hours each day is $985 and approximately 1,051 therms are consumed per year.

The older open-top cooking ranges also cause health concerns for the firefighters due to natural gas leakage. The pilot light is often times unable to burn all the gas, and what is not burned, permeates the kitchen and living areas.

Refrigerators

Each fire station generally has two refrigerators**;** see **Appendix M** for the refrigerator inventory across all Raleigh fire stations. One refrigerator is placed in the kitchen and is usually full of groceries and cooked items. The second refrigerator, usually the older of the two, is located in the vehicle bay which stores soft drinks that the firefighters share. Although, as the pictures below show, some of these refrigerators in the bay are only partially filled:

Pictures: Refrigerators at Fire Stations

One of the older secondary refrigerators, as seen above, was built in 1984 and consumes approximately 1,444 kWh per year, at an annual cost of $121.87 (pictured above). A new Energy Star refrigerator will only cost $48 per year in energy costs and save nearly 1,000 kWh compared to the older model above. Many of the older refrigerators at the fire stations were brought in by firefighters themselves or were moved to the bay when a new refrigerator in the kitchen was purchased. The fellows recommend that the fire department consider energy usage when cycling out old refrigerators – and can refer to the fellow's refrigerator inventory for each refrigerator's energy information. Hopefully, this will prevent refrigerators that have far exceeded their useful life from consuming excess electricity in the fire stations.

Summary of Energy Efficiency Projects

These projects, when fully implemented, could result in 386,540 kWh of annual electricity savings, $24,913 of annual cost savings, and 192.5 metric tons of CO2 emissions reductions.

Total Investment:	**$72,162.87**
Annual kWh savings:	386,540
Payback Period:	2.90 years
CO_2 emissions avoided:	192.5 metric tons

Action Plan & Timeline

The Raleigh Fire Department should consider projects that offer a quick payback, have a low initial investment, and/or high annual energy savings. Keep in mind any projects that might be eligible for Progress Energy utility rebates (typically investments in equipment upgrades, but custom incentives are available too).

Short Term Implementation (0 months – 1 year)

- Begin the **T-8 to T-12 lighting retrofit** that the City of Raleigh has already committed to, in limited implementation this year using funding from the City of Raleigh's Sustainability Office and the Energy Efficiency and Conservation Block Grant.
- Put into place a **Preventative Maintenance Plan** for the HVAC systems that includes monthly condenser coil cleaning in addition to filter replacement to ensure that the air conditioning and heating units are running efficiently.
- Continue to update and revise the **station equipment inventories** created by the fellows (see **Appendices E, H and M**) in order to track and perform life-cycle analyses on existing units and future purchases.
- Relocate the exercise equipment in the **HAZMAT bay at Station 2** and cut-off the air conditioning unit or consider building out a space for the exercise equipment in the bay and installing an Energy Star window unit.
- Submit the **thermostat controls and vending machine projects** to the City for evaluation and approval in order to qualify for Progress Energy utility rebates that expire in 2013.
- As air conditioning units fail, begin to replace them with Energy Star 14.5 SEER units that quality for utility rebates.
- **Educate Fire Department employees** about ways to improve the energy efficiency of the stations. Publicize the energy bills of the stations every month.

Medium Term Implementation (1 Year – 5 Years)

- Install the VendingMisers on all the vending machines in the Keeter Training Center and Station 19.
- Install the Proliphix Network thermostat controls at every fire station and remotely program the set-points to the recommended/policy settings for winter and summer.

Long Term Implementation (5 Years+)

- **Replace the open-top burner stoves** with electronic ignition stoves. The open-top burner stoves have pilot lights that burn 24/7 costing the stations approximately $985.60/yr, not including additional cooling and ventilation costs as a result of the pilot lights.
- Hire a trained specialist to manage the stations energy usage and operations or consult with the City's Facilities and Operations staff regarding equipment purchasing, maintenance, and system improvements.

OVERCOMING BARRIERS TO ENERGY EFFICIENCY

Barriers

Financial

The Raleigh Fire Department is a city-funded, public department. It is given a strict annual budget sanctioned by the City of Raleigh in which to operate, making it difficult to get projects financed that are not in the current budget. In addition, any money not used or saved by the department during the given fiscal year must be returned to the city. This makes the consideration and approval of energy efficiency projects difficult because the department has little incentive to make the potential upfront investments for efficiency improvements if no savings can be kept. Furthermore, the department's limited budget is justifiably prioritized for fire fighting and fire rescue related expenses, to better serve the department's core mission.

Department Structure

Given its 24-hour functionality, the Fire Department is one of the only city departments where the buildings are managed by a services staff within the department and not by the city's Facilities and Operations Division. While the services staff is knowledgeable about the stations' operations, there is no dedicated trained staff member equipped to manage the electrical and mechanical systems or keep an inventory of the equipment for life-cycle analyses resulting in old and inefficient systems.

Workplace Culture
The fire station is a residence that operates 24 hours a day, year-round. Firefighters eat, sleep, and bathe at the station, which substitutes for home. However, unlike home, the firefighters never see the energy bills and therefore are not incentivized to turn-off lights, adjust the thermostats, or turn down the temperature on the water heater. Even though there is a department policy to set the thermostats to certain set-points depending on the season, the policy is rarely followed, which leads to inefficiently run or broken HVAC equipment.

Recommended Strategies for Overcoming Barriers

Financial
The Raleigh Fire Department should be given the opportunity to keep all or a portion of the savings it will earn through energy efficiency projects. As it stands, the savings that the department obtains must be returned to the city's general fund. The incentives are not properly aligned. The City Council should consider a means to allow the Fire Department, or any other city entity, to keep some of the savings earned through efficient and sustainable projects that improve the quality of the city-owned buildings and reduce energy consumption.

Department Structure
The Office of Sustainability and the Raleigh Fire Department should continue to build upon their partnerships with lighting retrofits, energy conservation projects, and energy efficiency assessments. The Fire Services Division has unique knowledge about maintaining fire stations and the Office of Sustainability, along with the city's Facilities and Operations Division, has important knowledge about maintaining buildings. The city entities should work together to implement life cycle analyses of the fire station's infrastructure and appliances. In doing so, the fire department will be able to maximize energy efficiency savings within its tight budget.

Workplace Culture
On a number of site visits to the fire stations, the firefighters were curious about the energy costs of the stations. Educating the firefighters on energy use could have an incredible impact. Posting monthly energy bills at each station will provide a reminder, and some insight, about energy usage. Energy use can even be turned into a competition between fire stations. Creating incentives and increasing awareness will lead to more energy efficient behavior in the workplace.

Lessons from Overcoming Barriers

While conducting the energy efficiency assessment, it was important to visit every fire station - not only to obtain as much data as possible, but also to meet the firefighters themselves. This allowed us to converse with the men and women who use the stations everyday, and have them learn from us while we learned from them. With some, we discussed the importance of high-efficiency lighting and properly functioning HVAC units, while also discussing the daily routines of firefighters and how they use the station. This helped subtly introduce ideas of energy efficiency into a very traditional and proud workplace culture.

CONCLUSIONS AND RECOMMENDED NEXT STEPS

The respected community leaders that makeup the Raleigh Fire Department can take charge on yet another front. Energy efficiency is about responsibility and sustainability. If these men and women, who are perhaps the greatest symbols of public service, can also show they accept the responsibility of energy efficiency, then they will show the rest of Raleigh and fire departments across the country the importance and urgency of this issue. Once again we would like to thank the Raleigh Fire Department for their warm hospitality and eagerness to take on this project. We would especially like to thank Lieutenant Michael Furr, Captain John Fanning and Kathy Boone for giving us so much of their valuable time while we worked on this report.

We recommend that the department begins the thermostat project, purchases and installs the vending misers, and retrofits its existing lighting as soon as possible, as the energy efficiency rebates from Progress Energy expire in 2013. We recommend that the Energy Star qualified AC units are purchased once the 10 SEER units no longer function. Lastly, we recommend adopting our general recommendations, when possible, that will also lead to energy savings.

APPENDIX A

Proliphix, Inc.: Estimate #618

Paul Harris [pharris@proliphix.com]

Sent: Wednesday, July 14, 2010 10:29 AM

To: Jentgen, Matt

3 LAN Drive
Suite 100
Westford MA 01886
United States

Estimate

Date	7/14/2010
Estimate #	618
Expires	8/13/2010
Ship Via	UPS Ground

Bill To
Matt Jentgen
Raleigh Fire Department
310 West Martin Street
Suite 200
Raleigh NC 27602
United States

Ship To
Matt Jentgen
Raleigh Fire Department
310 West Martin Street
Suite 200
Raleigh NC 27602
United States

Item Name	Description	Quantity	Rate	Amount
900-03550-000	Thermostat, IMT-550 Wired	65	499.00	32,435.00
			Subtotal	32,435.00
			Shipping Cost (UPS Ground)	48.87
			Total	$32,483.87

Quote valid for 30 days from posted date. Prices subject to change thereafter.

APPENDIX A

Proliphix, Inc.: Estimate #618

Paul Harris [pharris@proliphix.com]

Sent: Wednesday, July 14, 2010 10:28 AM

To: Jentgen, Matt

3 LAN Drive
Suite 100
Westford MA 01886
United States

Estimate

Date	7/14/2010
Estimate #	618
Expires	8/13/2010
Ship Via	UPS Ground

Bill To
Matt Jentgen
Raleigh Fire Department
310 West Martin Street
Suite 200
Raleigh NC 27602
United States

Ship To
Matt Jentgen
Raleigh Fire Department
310 West Martin Street
Suite 200
Raleigh NC 27602
United States

Item Name	Description	Quantity	Rate	Amount
900-03550-010	Thermostat, IMT-550 Wireless	65	549.00	35,685.00
			Subtotal	35,685.00
			Shipping Cost (UPS Ground)	48.87
			Total	$35,733.87

Quote valid for 30 days from posted date. Prices subject to change thereafter.

6.2 Retrofit Custom Incentives

The Energy Efficiency for Business Program offers custom incentives for eligible improvements not listed as prescriptive measures. Measures listed in prescriptive tables that do not meet minimum program specifications cannot be submitted as a custom measure. Qualified custom ECMs reduce electric energy use due to an improvement in system efficiency, i.e. a net decrease in energy use without a reduction in the level of service. For example, installing a lower wattage lamp in place of a higher wattage lamp of the same type does not qualify for a custom incentive. However should the lighting *system* (i.e., lamp, ballast and fixture) demonstrably improve the total lumens per Watt delivered, an incentive will be considered.

Examples of custom measures include, but are not limited to, the following:

- Economizers – air side or water-side
- Energy Star® solid door commercial freezers
- High Intensity Discharge (HID) or fluorescent light fixture improvements not covered under the prescriptive measures
- Variable frequency drives on non-HVAC pump and fan motors serving variable-capacity loads, such as air compressors, pumps, fans, blowers, process chillers and cooling towers.
- Automatic controls, including time switches, sensors, etc.
- Day lighting or light harvesting, when combined with appropriate lighting controls.
- Building envelope improvements (windows, window films, solar screens, cool roofs, etc.)[2].
- Improved process efficiency.
- Compressed air system improvements.
- LED lighting fixtures or retrofit packages.

Incentives for custom measures are based on the electrical energy savings that result from the energy efficiency measure installation and are based upon the calculated annual kWh savings. The applicant must provide sufficient back-up descriptive information, equipment performance data, operating assumptions, measurements, calculations and models to support the energy savings estimates. Guidelines for calculating custom measure energy savings are detailed in **Section 16**.

The Custom incentive shown in Table 6-5 is based on the expected life of the measure. Custom projects eligible for an incentive must have a payback period ≥ one year and ≤ 7 years to qualify for a $0.08 per kWh incentive. Project simplified payback is calculated as follows:

$$\text{Simplified Payback Period} = \frac{\text{Project Cost}}{\text{Annual Energy Savings (kWh)} \times \text{Electricity Rate (\$/kWh)}}$$

[2] Only if facility has electric cooling or heating present.

Table 6-5
Custom Incentives

Incentive	**$0.08 / kWh**[3]
Minimum Payback Period	**One year**
Maximum Payback Period	**7 years**

All Custom incentive applications are subject to the Program's review and analysis. Incentive payments for custom ECMs are capped at 75% of the incremental cost of the measure[4].

6.3 Retrofit Technical Assistance Incentives

The program offers technical assistance incentives for ECMs in qualified existing facilities (retrofit) that may result in sustained energy efficiency improvements. Incentive types, values and limits described in this section are based upon task scope and anticipated outcomes. A detailed work scope of technical assistance activities and costs should be submitted for review and pre-approval to qualify for any technical assistance incentives.

Technical assistance incentives are intended to assist with the initial cost of identifying ECMs and may be combined with Prescriptive and Custom incentive offerings.

Retrofit technical assistance incentives are available for, but not limited to: **feasibility studies, energy assessments** and **retro-commissioning**. **Sections 6.3.1 and 6.3.2** briefly summarize the project requirements associated with each service type and both are intended to provide information and assistance to customers towards implementing ECMs at existing facilities.

All technical assistance incentive payments should be considered "one-time" payments for each Facility during a three year period. These incentives are issued to applicants that agree to implement cost effective ECMs in a timely manner. Failure to implement these ECMs in a timely manner constitutes a forfeit of any future technical assistance incentives until cost effective ECMs are investigated further and/or implemented.

Incentives for qualified retrofit Technical Assistance will be 50% of the total technical assistance costs associated directly with electrical energy savings efforts and will be capped at $10,000 for facilities that use 500,000 kWh to 2,000,000 kWh annually. The cap is increased to $20,000 for facilities who use over 2,000,000 kWh annually. Facilities currently using less than 500,000 kWh annually do not qualify for Retrofit Technical Assistance incentives.

6.3.1 Retrofit Technical Assistance Feasibility Study/Energy Assessment

A feasibility study consists of a detailed engineering analysis to investigate the economics and technical feasibility of one or more ECM options. For purposes of this program, this includes comprehensive energy audits and technology feasibility studies.

A qualified service provider must produce a concise written report detailing the study findings, methodology and supporting documentation. The customer must submit the report plus an Energy Efficiency for Business Program application and copy of the paid invoice.

[3] Incentive is a one-time payment for the value shown multiplied by the annual energy savings for a one year period.
[4] Incremental measure cost is the difference in the cost of energy efficient measure and standard efficient measure. In some cases the incremental measure cost is the full cost of the measure.

APPENDIX C

A Proliphix White Paper

3 Lan Drive
Suite 100
Westford, MA, 01886
978-692-3375
www.proliphix.com

Proliphix Un*ip*hy Overview for IT professionals

By Aaron Smith, CTO

August 09

APPENDIX C

Contents

Introduction

The Uni*p*hy Energy Control Solution (ECS) family of hardware products enables the management of HVAC resources by leveraging a customer's existing networking infrastructure. The facility hardware elements of the Uni*p*hy ECS includes the Professional and Thermal Management Series of Ethernet-connected thermostats. The Professional Series and Thermal Management Series network thermostats connect to an existing Ethernet LAN and use the ubiquitous TCP/IP/Ethernet protocols. The thermostats provide a standard web-browser interface for local access and a published API for integration with 3rd party products.. Another component of the Uni*p*hy family is the central management system that allows easy monitoring and control of all of your installed network thermostats. The Uni*p*hy UniVista Energy Manager (UEM) management software is hosted by Proliphix and provides SAS functionality.

Proliphix Thermostat

The Professional and Thermal Management Series network thermostats are embedded devices that provide control of HVAC equipment either locally through a push-button interface or through the data network interface. The network interface is a standard Ethernet LAN connection that can be plugged into a standard Ethernet switch. A proprietary operating system provides the protocols for networking connectivity. The operating system is not based upon Windows or Linux; the thermostat cannot be used as a gateway for the introduction of viruses into the local network. The thermostats can either have a statically assigned IP address or can obtain one automatically using DHCP. The thermostats contain a web server that resides at the HTTP standard TCP port 80. This port can be changed if necessary. The thermostats also provide an HTTP-based API that can be used by outside programs to manage the devices. All access to the device is controlled by HTTP basic authentication.

Firewall Interaction

If a Proliphix network thermostat is installed into a location protected by a firewall and remote control of that device is desirable, the firewall must be setup to

allow remote connectivity. The thermostat only requires a single port to be forwarded by the firewall; the port selected for HTTP access. If the HTTP port of the firewall is already in use, another port can be used. If the firewall has the capability to map external port number to a different internal port number, the thermostat can keep its web-browser at the HTTP standard port 80. If the firewall cannot map ports, the thermostat can be adjusted such that the web-browser is located at another port, typically 808x. As mentioned previously, the thermostat cannot be used as a gateway for viruses so therefore opening a firewall port does not carry the same risks as it would for a PC.

Network Bandwidth

Thermostat network activity can be broken into three classifications:

1. Periodic server contact that is initiated by the thermostat
2. Management of the device through the HTTP interface (Web browser or API)
3. UEM software polling operations.

Periodic service contact and direct management of the device account for a small portion of thermostat network activity. Management software polling requires the greatest use of network resources.

Period Server Contact (Callhome)

Proliphix thermostats periodically (once an hour) contact a remote management service using a standard HTTP POST message. The message conveys status and verifies the network path from the thermostat to the server software is functional. The callhome operation consumes less than 4500 bytes of network bandwidth once an hour.

Device Management

The thermostat can be managed directly or through the management system. In either case, the bandwidth required is less than 2k bytes per management transaction. A management transaction can be thought of as accessing a web page, changing a parameter setting, and performing a submit operation. The Professional and Thermal Management Series of thermostats are for the most part a “set and forget” type device requiring very little active maintenance. A typical “busy day” for a thermostat would be several temperature setpoint changes spread out over several hours.

Management Software Polling

Proliphix UEM software provides valuable historical information about the performance of your HVAC system. This software periodically polls the thermostat to obtain the zone temperature, sensor temperatures, humidity (if available), comfort setpoints and other data necessary to determining the health and comfort of an HVAC system. The period of the polling can be adjusted from one minute to thirty minutes. One minute polling allows complete analysis of HVAC cycles to determine the presence of “short-cycles” and other detremental effects that an HVAC system can experience. Thirty minute polling can be used to determine a gross level of comfort in a heating or cooling zone.

The typical management poll is less than 1500 bytes. For a single thermostat, the typical poll size translates to less than 200 bits/sec average traffic for a one minute poll period.

Network Topologies

Satellite Offices with Local Internet Access

In a typical installation, several satellite locations will be installed with Proliphix thermostats. Each satellite site will need to be polled by management software. A typical site with five thermostats experiences an average traffic load of less than 1 Kbits/sec across the WAN access boundary with one minute polls. Table 1 shows the bandwidth requirements for a single site and a variable number of thermostats.

Number of Thermostats	Total Traffic	
	Bits / Hour	Bits / Sec
2	1,382,688	384
3	2,074,032	576
4	2,765,376	768
5	3,456,720	960
6	4,148,064	1,152
7	4,839,408	1,344
8	5,530,752	1,536
9	6,222,096	1,728
10	6,913,440	1,920

Table 1: Bandwidth Requirements (Single site with One Minute Poll Period)

Satellite Offices with Central Network Aggregation

Another commonly encountered business network topology requires that all traffic be aggregated at a central location. In this scenario, the bandwidth requirement of all thermostats must be taken into consideration. Table 2 shows typical bandwidth requirements for the central aggregation scenario with a one minute poll period. Table 3 shows the same scenario with a five minute poll period.

Total Number of Thermstats	Total Traffic	
	KBits / Hour	KBits / Sec
50	34,567	10
75	51,851	14
100	69,134	19
200	138,269	38
300	207,403	58
500	345,672	96
1000	691,344	192

Table 2: Bandwidth Requirements (Aggregation with One Minute Poll Period)

Total Number	KBits / Hour	KBits / Sec
50	8,110	2
75	11,879	3
100	15,839	4
200	31,678	9
300	47,517	13
500	79,195	22
1000	158,391	44

Table 3: Bandwidth Requirements (Aggregation with Five Minute Poll Period)

Summary

While the Proliphix thermostats are networked devices, they have little impact upon existing network installations from a bandwidth and security standpoint.

APPENDIX D

AMBULANCE SERVICES CASE STUDY

PROLIPHIX

Cataldo Ambulance Service Reduces Energy Costs and Cuts Greenhouse Gases with Proliphix

PROBLEM

- Rising energy costs
- Environmental concerns

SOLUTION

- Proliphix Un*iph*y Network Thermostats
- Internet-managed energy control

RESULTS

- Lower energy bills
- Improved control – EMTs and paramedics can no longer override thermostat settings
- Greater damage protection - real-time temperature alarms
- Less energy waste – time-of-day temperature scheduling
- More comfortable working and sleeping environment
- Less environmental impact

Since 1977, Cataldo Ambulance Service, Inc., has distinguished itself as a leader in providing routine and emergency medical services. As the needs of the community and the patient change, Cataldo continues to introduce innovative programs to ensure the highest level of care is available to everyone in their service areas. Cataldo is committed to giving back to the community and keeping services as affordable as possible.

With energy costs on the rise and energy conservation garnering increased public attention, Cataldo sought an innovative way to monitor and control energy use and reduce greenhouse gas emissions. After extensive research Chris Coleman, Cataldo's Director of Information Technology, selected Proliphix Internet Un*iph*y Network Thermostats.

With Proliphix, Cataldo uses the Internet to oversee energy use at fourteen separate Boston area locations. "On a hot day, crews would stop into bases in between calls to cool off. After increasing the air conditioning for quick relief, crews would respond to emergency calls without resetting the thermostat. Proliphix prevents crews from overriding thermostat settings and maintains a consistent, comfortable base environment." And by introducing multiple temperature zones, Cataldo was able to improve overall comfort in its larger facilities.

In addition to reducing energy costs, Proliphix helps avert facility and equipment damage. "Temperature alerts help prevent broken pipes and other problems that may result from extreme temperatures."

In times of rising energy costs and increased environmental awareness, innovators like Cataldo are turning to Proliphix to conserve energy and cut greenhouse gases.

"Proliphix has lowered Cataldo's energy consumption and had a positive effect on our energy bill."

Chris Coleman, Cataldo's Director of Information Technology

Cataldo Training and Education Center

APPENDIX E

LIGHTING - ALL STATIONS																													
	Interior lighting																										Exterior lighting		
Fire Stations	95W T-12	75W T-12	60W T-12	40W T-12	34W T-12	20W T-12	32W T-8	17W T-8	28W T-5	14W T-5	40W U-Shape	32W U-Shape	31W U-shape	26W U-shape	32W Circular light	100W Incand.	75W Incand.	60W Incand.	14W CFL	13W CFL	Halogen	20W Prong CFL	13W 2-prong CFL	CFL Prong fixtures (in bay)	Metal halide (in bay)	Metal halide	Photocell	Sodium Vapor
Station 1*				206			6				2							25								4		
Station 2			14	42	2		30				22							6	6							4	Y	
Station 3				50														7	1							3	N	
Station 4				34							80							6	3							3	N	
Station 5*				90														6	7							2	N	
Station 6*			2	53		2							2					4			8					1		
Station 7*				108		5							2					7	1		3					3	Y	
Station 8		2		58			80				22							2	22							2		
Station 9*				27	16	1	48				20							1		3						2	Y	
Station 10				1	1		34				57							5		2						2		
Station 11				63			66											3	1							8		
Station 12				53			80				4							2	2				3			2		
Station 14	2			44							40					12				8			1			6	Y	
Station 15				61	6	6					44							4					1					
Station 16				44							50						1	6	10							9		
Station 17							58				98							3								7		
Station 18				29	2	2					84				9			3								3	N	
Station 19*				33							80							5	2							10		
Station 20					34		3				84							2	3							6	N	
Station 21				3			47				86							6	2							6	Y	
Station 22							94					74						4								4		4
Station 23		14	16	6			113	3											6							2	Y	
Station 24						2	241							17				2								3		
Station 25						2	150												4			3	20			3		
Station 26							146					6							4				8		15	10		
Station 27							182					2							4				12		15	15	Y	
Station 28								10	104	10									2					96		6	Y	
TOTAL LAMPS	2	16	32	1005	61	20	1378	13	104	10	773	82	4	17	9	12	1	109	80	13	11	3	45	96	30	122		4
TOTAL WATTAGE	190	1200	1920	40200	2074	400	44096	221	2912	140	30920	2624	124	442	288	1200	75	6540	1120	169	11	60	585					

*** Stations 1, 5, 6, 7, 9 and 19 scheduled for lighting retrofit this year**

6.1.1 Retrofit Prescriptive Incentives - Lighting

Incentives are paid on a per unit basis as noted in **Table 6-1**. Detailed specifications are provided in **Section 8**. Note that certain prescriptive incentives listed here require pre-approval prior to implementation.

Table 6-1
Retrofit Prescriptive Lighting Incentives

	Equipment Type	Unit	Incentive / Unit
Lamp Replacement	**Replacement of screw-in incandescent lamps with compact fluorescent lamps, (CFLs)**		
	ALL Wattages*	Lamp	$1.50
	Replacement of existing T8 fluorescent lamps with reduced wattage lamps, (electronic ballast already installed)		
	4-foot lamp replacement only (25W or 28W)	Lamp	$0.50
	8-foot lamp replacement only (< 59W)	Lamp	$0.75
	Replacement of incandescent lamps with cold cathode fluorescent lamps		
	Cold Cathode Lamps	Lamp	$4.00
New Fixture/Fixture Upgrade	**Replacement of T12 lamps and ballasts with high performance CEE1.org T8 lamps w/electronic ballasts OR with reduced wattage T8 lamps w/electronic ballasts**		
	4-foot lamp and ballast upgrade to CEE1.org or 90 MLPW	Lamp	$6.00
	8-foot lamp and ballast upgrade to 90 MLPW	Lamp	$8.00
	Replacement of existing fixtures (other than fluorescent fixtures) with T5 or T8 fluorescent fixture w/ electronic ballasts. *Pre-approval is required*.		
	Total Existing Fixture Watts Less Total New Fixture Watts	Watts Reduced	$0.35
	Replacement of incandescent lamps with hardwired compact fluorescent fixture		
	29 W or Less	Fixture	$30.00
	30 W or Greater	Fixture	$55.00
	Replacement of metal halide fixture with ceramic or quartz pulse start metal halide fixture		
	100 W or Less	Lamp	$20.00
	101 W - 200 W	Lamp	$30.00
	201 W - 350 W	Lamp	$55.00
	Replacement of incandescent exit sign fixtures with LED, electroluminescent or photo luminescent exit sign		
	LED or electroluminescent or photo luminescent exit sign	Fixture	$25.00
Lamp Removal	**Permanent lamp removal of T12 or T8 lamps when upgrading remaining lamps. Pre-approval is required.**		
	Remove 4-foot fluorescent lamp	Lamp	$6.00
	Remove 8-foot fluorescent lamp	Lamp	$8.00
	Remove 4-foot fluorescent lamp with reflector addition	Lamp	$10.00
	Remove 8-foot fluorescent lamp with reflector addition	Lamp	$15.00
Lighting Controls	**Addition of occupancy sensor controls (provide separate calculation of total fixtures and watts controlled by sensors)**		
	Occupancy Sensors	Watts Controlled	$0.06

LED lighting measures, excluding exit signs, are assessed and qualified using the custom incentive method.

6.1.1.1 Common Prescriptive Lighting Examples:

Retrofit

1) **T12, 4-lamp, 2x4 troffer retrofitted to T8, 3-lamp without reflector addition:**
   - Incentive = $6 each '4-foot lamp and ballast upgraded', plus $6 each '4-foot fluorescent lamp removed'; Total - $24 per fixture

2) **T12, 4-lamp, 2x4 troffer retrofitted to T8, 2-lamp with reflector addition:**
   - Incentive = $6 each for upgraded lamps, plus $10 for each removed lamp; $32 per fixture

3) **T12, 2-lamp, industrial 8 ft strip retrofitted to T8, 2-lamp, industrial 8 ft strip:**
   - Incentive = 2 ea. 8 ft lamps per fixture x $8 = $16 per fixture

4) **T8, 4-lamp, Standard T8 retrofitted to 4-lamp reduced wattage T8:**
   - Incentive = $0.50 each 4-foot lamp replacement; $2 per fixture

5) **T12, 2-lamp U-Bend, to T8 2-lamp U-Bend:**
   - Incentive = $6 each for upgraded lamps; $12 per fixture

New or Modified Lamp Length Fixture

6) **T12, 4-lamp, 2x4 troffer replaced with a new T8, 2-lamp fixture:**
   - Incentive = reduced Watts x $0.35

7) **T12, 2-lamp, industrial 8 ft strip retrofitted to T8, 4-lamp, 4 ft tandem strip:**
   - Incentive = reduced Watts x $0.35

8) **T12, 1-lamp, 2 ft strip retrofitted to T8, 1-lamp strip:**
   - Incentive = reduced Watts x $0.35

9) **T12, 2-lamp, U-Bend 2x2 troffer replaced with new or modified 2-lamp linear T5 or T8:**
   - Incentive = reduced Watts x $0.35

10) **400W metal halide (458 input Watts) fixture replaced with 6-lamp T5 high bay fixture (265 input Watts):**
   - Incentive = (458W - 265W) per fixture x $0.35 per Watt = $67.55 per fixture

Occupancy sensors

11) **A sensor is installed to control three T12, 4-lamp fixtures. The input Watts for each fixture = 234W.**
   - Incentive = 3 fixtures x 234W per fixture x $0.06 per Watt = $42.12

6.1.3 Retrofit Prescriptive - Refrigeration

The following are some common methods of reducing energy usage in refrigeration. The Energy Efficiency for Business Program is offering incentives for the refrigeration measures shown in **Table 6-3**. The specifications for each of these measures are provided in **Section 10**.

Table 6-3
Prescriptive Refrigeration Incentives

Refrigeration Measures		
Measure	**Incentive Unit**	**Incentive/Unit**
Strip Curtains on Walk-In Coolers and Freezers	Per Square Foot	$3.00
Anti-Sweat Heater Control	Per Linear Foot	$20.00
Electrically Commutated Motor for Walk-in	Per Motor	$50.00
Electrically Commutated Motor for Reach-in	Per Motor	$40.00
Evaporator Fan Control	Per Motor	$60.00
Automatic Door Closers for Walk-in Freezers	Per Door	$140.00
Beverage Machine Control	Per Unit	$90.00
ENERGYSTAR® Beverage Machine	Per Unit	$90.00
Snack Machine Control	Per Unit	$50.00
High-Efficiency Ice Makers (Air Cooled Only) ENERGY STAR® or CEE Tier 1		
Size (lbs / 24 hrs)	**Qualifying kWh per 100 lbs**	**Incentive per Ice Maker**
101 - 200	8.5	$75.00
201 - 300	7.7	$125.00
301 - 400	6.5	$175.00
401 - 500	5.5	$225.00
501 – 1,000	5.2	$300.00
1,001 – 1,500	5.0	$450.00
> 1,500	4.6	$600.00

APPENDIX H

APPENDIX H

HVAC Equipment Information					
Station	**Make**	**Model**	**Tons**	**SEER**	**# of Thermostats**
1	Payne	PA13NRO24-C	2	13	5
2	Goodman	CKL36-1H	3	10	2
2	Rheem	RLKB-A0Z90CL			
2	Ruud	UAKA060JAZ	5	10	
3	Payne	PA10JA060-C	5	10	1
4	Carrier	38CK030310	2.5	10	4
4	Payne	PA13NR030-A	2.5	13	
5	Carrier	48SS-060120331	5	10	3
5	Carrier	48SS-060120331	5	10	
5	Ruud	UKRA-AC48JK10E	4		
6	Carrier	38CKB048300	4	10	3
6	Carrier	710AJ042-A	3.5	10	
6	Goodman			13	
7	Goodman	G8C130481BA	4	13	3
7	Payne	PA10JA06000ACAA	5	10	
7	Carrier	3ACK060300	5	10	
8	Goodman	GSC130601CA	5	13	4
8	Ruud	ACHEVER90 Plus			
8	Goodman	GSZ130301AB	2.5	13	
8	Payne	PA10JA036-A	3	10	
8	Payne	PA10JA036-G	3	10	
9	Payne	PA12NA048-G	4	12	2
9	Carrier	Weathermaker 9200 58MCA			
9	Goodman	CE60-IFB		10	
10	Carrier Tech 2000SS	JKCP39FG			2
10	Goodman Furnace	AFUE 95.0			
10	Payne	PA10JA048-C	4	10	
11	Payne	710AJ60-A	5	10	1
12	Payne	PA10JA048-D	4	10	2
12	Ruud Achiever	UAKA-060JAZ	5	10	
14	Payne	PA13NR048-E	4	13	2
14	Carrier	38CKC048300	4		
15	Payne	PA12NA048-G	4	12	2
15	Payne	PA12NA060-G	5	12	
16	Payne	810AJ048-A	4	10	3
16	Payne	PH10JA048-B	4	10	
16	Payne	PH13NR048-F	4	13	
17	Payne	PA10JA030-G	2.5	10	2
17	Payne	PA13NR030-H	2.5	13	
18	Carrier	38VN030300SM	2.5	10	2
18	Payne	PA10JH030-C	2.5	10	
18	Carrier	38EN030300SM	2.5	10	
19	LG	LWHD8008RY9 (window unit)			2
19	Payne	PA13NA036-C	3	13	
19	American Standard	2A7A1030A1000AA	2.5	10	
19	Trane	BTR730E100A0	2.5	10	
20	Trane	TTR730A100A0	2.5	10	2
20	Trane	TTR730A100A0	2.5	10	
20	Trane	TTR730A100A0	2.5	10	
21	York	H1RA042506A	3.5	10	2
21	York	H2RA036506A	3	10	
22	Payne	PA10JA060	5	10	2
22	Carrier	38CK036340	3	10	
22	Carrier	38CKC060300	5	10	
23	Carrier	38CKC036350	3	10	2
23	Carrier	38CKC060300	5	10	
24	Carrier	24ABB348A510	4	13	2
24	GE	38CKC048520	4	10	
25	Carrier	38CKC048520	4	10	2
25	Carrier	38CKC048520	4	10	
26	Carrier	38BRC0408360	4	12	2
26	Carrier	38BRC060340	5	12	
27	Carrier	38BRC060340	5	12	2
27	Carrier	38BRC048360	4	12	
28	Trane	2YCC3030A1040AA			2
28	Trane	2YCC3024A1040AA			
28	Trane	2YCC3042A1075AA			
28	Trane	2YCC3024A1040AA			

6.1.2 Retrofit Prescriptive Incentives – Cooling & Heating (HVAC)

Unitary air-cooled air conditioning units, air or water-cooled chillers, room air conditioners, packaged terminal air conditioners (PTAC), and variable speed drives (VSDs) for heating, ventilation, and air conditioning (HVAC) motors, are eligible for incentives. Detailed product specifications are discussed in **Section 9**. Cooling equipment must meet the minimum qualifying efficiency levels as shown in **Table 6-2**. Water source heat pumps may qualify for a custom incentive in Section 6.2.

If the equipment usage is for other then human comfort, such as manufacturing process or data centers, then the custom incentive method should be used. See **Section 6.2.**

Table 6-2
Prescriptive HVAC Incentives

Equipment Type	Size Category	Qualifying Efficiency	Incentive (per ton)
Unitary and Split Air Conditioning Units and Air Source Heat Pumps	< 65,000 Btuh (5.4 Tons)	14 SEER	$25
		15 SEER	$45
	≥ 65,000 Btuh (5.4 Tons) and <240,000 Btuh (20 Tons)	11.5 EER	$30
		12 EER	$55
	≥240,000 Btuh (20 Tons) and <760,000 Btuh (63.3 Tons)	10.5 EER	$30
		10.8 EER	$55
	≥ 760,000 Btuh (63.3 Tons)	9.7 EER	$30
		10.2 EER	$55
Water-Cooled Chillers	ALL	Level 1 (see Section 9.2)	$18
		Level 2 (see Section 9.2)	$35
Air-Cooled Chillers	ALL	1.04 kW / ton minimum	$35
Room Air Conditioners	ALL	Level 1 (see Section 9.3)	$25
		Level 2 (see Section 9.3)	$45
PTAC	ALL	13.08-(0.2556 x Btuh / 1000) EER	$30
Equipment Type	**Incentive**		
Variable Speed Drive (VSD) on HVAC Fan and Pump Motors[1]	$45.00 / HP		

[1] Refer to **Section 9.5** for qualified VSD applications pertaining to chillers, fans, pumps and other equipment.

APPENDIX J

Non-AHRI Central Air Conditioner Equipment and Air Source Heat Pump (ASHP) Product List
List Posted July 1, 2010

Manufacturer	Brand	Model Number	Indoor Unit Model Number*	Product Type	SEER	EER	HSPF	Capacity (Btuh)
Cool Air International	AmericAire	Beginnning with ACDE09HP220		ASHP - Split System	15.5	13	8.9	18,000
Cool Air International	AmericAire	Beginnning with ACDE12HP220		ASHP - Split System	16.5	13	9.5	24,000
Cool Air International	AmericAire	Beginnning with ACE09HP110I		ASHP - Split System	19	13.5	9	11,000
Cool Air International	AmericAire	Beginnning with ACE12HP110I		ASHP - Split System	20	13.5	9.5	15,500
Cool Air International	AmericAire	Beginnning with ACE18HP220I		ASHP - Split System	18	13	9	20,500
Cool Air International	AmericAire	Beginnning with ACE24HP220I		ASHP - Split System	16	13	10	28,000
Gree Electric Appliances of Zhuhai	ARTFUL	GWH09AB-D3DNA1B/O	GWH09AB-D3DNA1B/I	ASHP - Split System	23	14.35	9.80	9,000
Gree Electric Appliances of Zhuhai	ARTFUL	GWH12AB-D3DNA1B/O	GWH12AB-D3DNA1B/I	ASHP - Split System	22	12.5	10.50	12,000
Gree Electric Appliances of Zhuhai	COZY	GWH09MA-D3DNA1A/O	GWH09MA-D3DNA1A/I	ASHP - Split System	22	14.2	9.80	9,000
Gree Electric Appliances of Zhuhai	COZY	GWH12MB-D3DNA1A/O	GWH12MB-D3DNA1A/I	ASHP - Split System	20	12.5	9.60	12,000
Gree Electric Appliances of Zhuhai	Gree	GWH12MB-A3DNA1A/O	GWH12MB-A3DNA1A/I(** can be A1 to A9,B1,B2,B3,B7,B8, C1)	ASHP - Split System	20	12	10.00	12,000
Gree Electric Appliances of Zhuhai	Gree	GWH12AB-A3DNA1B/O	GWH12AB-A3DNA1B/I	ASHP - Split System	20	12	10.00	12,000
Gree Electric Appliances of	Gree	GWC12MB-A3DNA1A/O	GWC12MB-	CAC - Split System	20	12		12,000
Gree Electric Appliances of Zhuhai	Gree	GWC12AB-A3DNA1B/O	GWC12AB-A3DNA1B/I	CAC - Split System	22	12		12,000
Gree Electric Appliances of Zhuhai	Gree	GWH18MC-D3DNA1A/O	GWH18MC-D3DN**A/I (** Can be A1 to A9,B3)	ASHP - Split System	18	12	10.20	18,000
Gree Electric Appliances of Zhuhai	Gree	GWH18AC-D3DNA1B/O	GWH18AC-D3DN**B/I (** Can be A1 to A3)	ASHP - Split System	20	12	10.50	18,000

APPENDIX J

Manufacturer	Brand	Model Number	Indoor Unit Model Number*	Product Type	SEER	EER	HSPF	Capacity (Btuh)
Gree Electric Appliances of Zhuhai	Gree	GWC18MC-D3DNA1A/O	GWC18MC-D3DN**A/I (** Can be A1 to A9,B3)	CAC - Split System	18	12		18,000
Gree Electric Appliances of Zhuhai	Gree	GWC18AC-D3DNA1B/O	GWC18AC-D3DN**B/I (** Can be A1 to A3)	CAC - Split System	20	12		18,000
Gree Electric Appliances of Zhuhai	Gree	GWH24MD-D3DNA1A/O	GWH24MD-D3DN**A/I (** Can be A1 to A9,B3)	ASHP - Split System	18	12	10.2	21,500
Gree Electric Appliances of Zhuhai	Gree	GWH24AC-D3DNA1B/O	GWH24AC-D3DN**B/I (** Can be A1 to A3)	ASHP - Split System	19	12	10.5	22,000
Gree Electric Appliances of Zhuhai	Gree	GWC24MD-D3DNA1A/O	GWC24MD-D3DN**A/I (** Can be A1 to A9,B3)	CAC - Split System	18	12		21,500
Gree Electric Appliances of Zhuhai	Gree	GWC24AC-D3DNA1B/O	GWC24AC-D3DN**B/I (** Can be A1 to A3)	CAC - Split System	19	12		22,000
Gree Electric Appliances of Zhuhai	Gree	GWH09MA-A3DNA1A/O	GWH09MA-A3DN**A/ (** can be A1 to A9,B1,B2,B3,B7,B8,C1)	ASHP - Split System	22	14	9.80	9,000
Gree Electric Appliances of Zhuhai	Gree	GWH09AB-A3DNA1B/O	GWH09AB-A3DNA1B/I	ASHP - Split System	23	14	9.80	9,000
Gree Electric Appliances of Zhuhai	Gree	GWC09MA-A3DNA1A/O	GWC09MA-A3DN**A/I (** can be A1 to A9,B1,B2,B3,B7,B8,C1)	CAC - Split System	22	14		9,000
Gree Electric Appliances of Zhuhai	Gree	GWC09AB-A3DNA1B/O	GWC09AB-A3DNA1B/I	CAC - Split System	23	14		9,000
Gree Electric Appliances of Zhuhai	Gree	GWC09MA-D3DNA1A/O	GWC09MA-D3DN**A/I (** can be A1 to A9,B1,B2,B3,B7,B8,C1)	CAC - Split System	22	14.2		9,000

APPENDIX J

Manufacturer	Brand	Model Number	Indoor Unit Model Number*	Product Type	SEER	EER	HSPF	Capacity (Btuh)
Gree Electric Appliances of Zhuhai	Gree	GWC09AB-D3DNA1B/O	GWC09AB-D3DNA1B/I	CAC - Split System	23	14.35		9,000
Gree Electric Appliances of Zhuhai	Gree	GWC12MB-D3DNA1A/O	GWC12MB-D3DN**A/I (** can be A1 to A9,B1,B2,B3,B7,B8, C1)	CAC - Split System	20	12.5		12,000
Gree Electric Appliances of Zhuhai	Gree	GWC12AB-D3DNA1B/O	GWC12AB-D3DNA1B/I	CAC - Split System	22	12.5		12,000
Gree Electric Appliances of Zhuhai	Gree	GWHD12A6ND31A/O	GWHD12A6ND31A/I	ASHP - Split System	14.5	12	8.2	12,000
Hallowell International	Acadia	Acadia 024	AVG24B3XH21	ASHP - Split System	15.5	14.4	9.42	24,000
Hallowell International	Acadia	Acadia 036	AVG36C3XH21	ASHP - Split System	15.2	12.6	9.2	36,000
Isolation Beauport 1978 Inc.	Themoclim	CS-35V1A-E2	CS-35V1A-P75A	ASHP - Split System	20	13.5	9.5	12,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Manuflow	KFR-35GW/BM		ASHP - Split System	16.3	12.1	10	12,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Manuflow	KFR-50GW/BM		ASHP - Split System	16.5	12	12	18,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Manuflow	KFR-25GW/BM		ASHP - Split System	16	8.7	12.3	9,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-25GW/BM		ASHP - Split System	16	8.7	12.3	9,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-50GW/BM		ASHP - Split System	16.5	12	12	18,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-35GW/BM		ASHP - Split System	16.3	12.1	10	12,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-50W/BM	KFR-50G/BM	ASHP - Split System	15.6	8.3	12	18,000

APPENDIX J

Manufacturer	Brand	Model Number	Indoor Unit Model Number*	Product Type	SEER	EER	HSPF	Capacity (Btuh)
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-25W/BM	KFR-25G/BM	ASHP - Split System	15.3	12.3	8.2	9,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-25GW/BMVE	KFR-25GW/BMVE	ASHP - Split System	18.2	13.3	9.3	9,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-35GW/BMVE	KFR-35GW/BMVE	ASHP - Split System	18.1	13	9	12,000
Jiangsu Shinco Air Conditioner Manufacture Co.	Shinco	KFR-50GW/BMVE	KFR-50GW/BMVE	ASHP - Split System	17.9	12.8	8.9	18,000
Kelon USA, Inc.	Wintair	AS-12UR1SWLUH	AS-12UR1SWLUH	ASHP - Split System	16	12	9	12,000
Kelon USA, Inc.	Wintair	AS-12UR1SWLUP	AS-12UR1SWLUP	ASHP - Split System	16	12	9	12,000
Kelon USA, Inc.	Wintair	AS-12UR1SWLVB	AS-12UR1SWLVB	ASHP - Split System	16	12	9	12,000
Kelon USA, Inc.	Wintair	AS-12UR1SWTVC	AS-12UR1SWTVC	ASHP - Split System	16	12	9	12,000
Midea USA Inc.	MSV1-18HRDN1-MQ0W	MSV1-18HRDN1-MQ0W	MSV1-18HRDN1-MQ0W	ASHP - Split System	17.66	12.02	9.54	18,000
Midea USA Inc.	MSV1-12HRFN1-MT0W	MOC-12HFN1-MTOW	MSV1-12HRFN1-MT0W	ASHP - Split System	19.3	12.14	8.9	12,000
Turbo Air Inc.	Turbo Air	TAS-09EH	TAS-09EH/O	ASHP - Split System	19	13.5	9	9,000
Turbo Air Inc.	Turbo Air	TAS-12EG	TAS-12EG/O	ASHP - Split System	20	13.5	9.5	12,000
Turbo Air Inc.	Turbo Air	TAS-18EH	TAS-18EH/O	ASHP - Split System	18	13	9	18,000
USI Holdings Corp.	Hydro Confort	HQ09IVAC/H		ASHP - Split System	19	13.5	9	9,000
USI Holdings Corp.	Hydro Confort	HQ12IVAC/H		ASHP - Split System	20	13.5	9.5	12,000
USI Holdings Corp.	Hydro Confort	HQ18IVAC/H		ASHP - Split System	18	13	9	18,000
USI Holdings Corp.	Mr. Sleep	MSA-09IV/H		ASHP - Split System	19	13.5	9	9,000
USI Holdings Corp.	Mr. Sleep	MSA-12IV/H		ASHP - Split System	20	13.5	9.5	12,000
USI Holdings Corp.	Mr. Sleep	MSA-18IV/H		ASHP - Split System	18	13	9	18,000
YMGI Group, LLC	YMGI	WMMS-09C-V2A(48)	WMMS-09E-V2A(48)	ASHP - Split System	19	13.5	9	9,000
YMGI Group, LLC	YMGI	WMMS-12C-V2A(48)	WMMS-12E-V2A(48)	ASHP - Split System	20	13.5	9.5	12,000

APPENDIX J

Manufacturer	Brand	Model Number	Indoor Unit Model Number*	Product Type	SEER	EER	HSPF	Capacity (Btuh)
YMGI Group, LLC	YMGI	WMMS-18C-V2B(48)	WMMS-18E-V2B(48)	ASHP - Split System	18	13	9	18,000

*For units offered with more than one assembly, the indoor unit that is paired with each matched assembly is listed seperately.

The above listed products have been submitted to EPA by ENERGY STAR partners that do not belong to the trade association AHRI.

The majority of ENERGY STAR qualified products, listed by AHRI members, can be found on the CEE/AHRI Verified Directory.

All products listed in the CEE/AHRI directory meet or exceed ENERGY STAR efficiency levels; however, ONLY those products manufactured by ENERGY STAR CAC-ASHP partners (see link to partner list below) are considered ENERGY STAR qualified.

To see a list of these products,

- Find ENERGY STAR partners Here
- Then find qualifying products they manufacture Here

APPENDIX J

Key Efficiency Criteria

Equipment	Specification
Air-Source Heat Pumps	>= 8.2 HSPF/ >=14.5 SEER/ >=12 EER* for split systems
	>= 8.0 HSPF/ >=14 SEER/ >=11 EER* for single package equipment including gas/electric package units
Central Air Conditioners	>=14.5 SEER/ >=12 EER* for split systems
	>=14 SEER/ >=11 EER* for single package equipment including gas/electric package units

Note:
*Energy Efficiency Ratio

Tube Cleaners
Vacuums
Flexible Shafts, Brushes and Accessories
Vacuum Tools, Kits, Filters and Accessories
Pressure Washers
Cooling Tower Cleaning
Vapor Steam Cleaners
Inspection and Test Instruments
Drain Cleaners
Duct Cleaning

Coil Cleaning

An air conditioning system has two coils, usually made of copper tubes with aluminum fins. The evaporator coil, or indoor coil, is often described as the "cold" coil because it provides indoor cooling. The coil works by absorbing heat from the indoor air that is blown over by the air handler's fan. The condenser coil or outdoor coil is the "warm" coil as it rejects the heat as a fan blows outside air over the surface.

Coils - they're everywhere

Coils are found in refrigeration equipment including those used in supermarkets and restaurants. It is not uncommon to find hundreds of "through-the-wall" fan coil units in a hotel, dormitory or apartment building. As the air moving over the coils contains dust, dirt, pollen, moisture and other contaminants, the coils get dirty and become less efficient. In addition, the evaporator coil and its condensate pan can become fouled with pollen, mold spores and other biocontaminants that can have adverse effects on indoor air quality. If not maintained, the moisture around the evaporator coil can become a breeding ground for bacteria and mold.

Dirty Coils Waste Energy and Cost Money

A coil fouled with dirt and grime cannot supply proper heat transfer and results in greater energy consumption. Equipment operating with dirty coils can use up to 37% more energy than those with clean coils. Additionally, a dirty system’s cooling capacity can be reduced by as much as 30%. Dirty coils increase operating pressure and temperatures that breakdown the compressor’s lubricant and can result in equipment failure. A failed compressor means no cooling and costly repair.

View Goodway's Coil Cleaners

Coil Cleaning Frequency

A coil cleaning program should be instituted when the coils are new, clean, and should be performed with a frequency to prevent deterioration of the coils. This can

be as often as four times a year (monthly cleaning is reported in some areas). If they do not already exist, install easy to open panels to gain access to the coils. This will make the job much easier and consequently, the more likely to be done when coil cleaning is necessary.

How to Clean Coils

If the coil is contaminated with a light dust or dirt not adhered to the fins, blowing low pressure compressed air across the fins or the use of a soft bristle brush may be sufficient. Applying a plain water or mild detergent solution to the surface, allowing it to sit for a short time then rinsing is employed in some cases. More aggressive deposits call for the use of stronger cleaning solutions or solvents as required.

Coils can be steam cleaned but require extra care. Steam must be applied at low pressure and the stream kept parallel to the fins to prevent folding the fins over.

Another popular coil cleaning method employs the use of a garden-type pump sprayer to apply foaming chemical to the coil surfaces. The foam is allowed to dwell on the surface to saturate the fins. The foam is then vacuumed up and the process repeated. Finally, the coil is rinsed with clean water from a hose.

Perhaps the most popular cleaning method used in recent years is using pressure washers to clean coils. Pressure cleaning coils may increase airborne Macromolecular Organic Dust (MOD) which must be contained to the area being cleaned. Pressure cleaning should be done in the opposite direction of air flow through the coil. A cleaning solution can be applied before the pressure rinse using the built in chemical injection system on the pressure washer or a hand sprayer. Care must be taken when using a pressure washer to avoid damaging the fins on the tubes. Water leaving the coil should be free of particulate. If it is not, repeat the process.

Recently, Goodway introduced its line of CoilPro coil cleaning machines.The Model CC-140 is a self contained two-wheeled cart with its own built in water and chemical tanks that can operate on building power or an integrated rechargeable battery. It can carry 5 gallons of water or can be connected to the building water supply for continuous operation. It supplies a water stream at up to 140 PSI at 1 GPM by means of one of four available spray nozzles. The on-board battery and water/chemical tanks allow for use anywhere. Additional models include the CC-600 AC powered unit which delivers up to 600 PSI at 1.6 GPM for thicker coils and the CC-100 backpack coil cleaner unit for extreme portability. These products have been enthusiastically received by maintenance professionals and they represent the first true real break-through developments in coil cleaning in a long time.

APPENDIX K

Coil Cleaning Chemicals

There are many acid and alkaline based cleaners available to clean coils. These chemicals clean by creating a chemical reaction between the cleaner and the metal that harms the surface of the metal. This damages the coils by causing metal loss over time. Acid and alkaline based chemicals carry with them an inherent danger to personnel and equipment.

The foaming properties of many coil cleaning formulations is important to help float debris our of the coil body where it can be rinsed away.

While some chemicals are advertised as "no rinse", many believe that all cleaning chemicals should be thoroughly rinsed from the surface to prevent coil damage.

To clean coils, Goodway offers CoilShine, a biodegradable, expanding foam detergent specifically formulated for use with the CoilPro. This is a non-acidic, non-fuming solution that can be safely washed down drains. CoilShine-BC is a commercial grade, ready-to-use mold inhibitor for HVAC systems that helps prevent the growth of odor, stain and damage causing organisms such as mold, mildew and fungi.

Don't Forget the Condensate Pan

The air drawn across a cooling coil contains water vapor which condenses and collects in a pan under the coil called a condensate pan. The pan is connected to a drain line to keep the pan from overflowing and causing damage to the air handler or other building structures. As it is generally wet, microorganisms can form colonies in the condensate pan. Cleaning the condensate pan and checking for proper drainage is an important part of the coil cleaning process.

To help prevent growth of these organisms, the pan should be treated between cleanings with a biocide. Goodway's PanCare is one example. PanCare is formulated to prevent the build-up of slime and harmful bacteria in condensate pans. It kills 99% of Legionella Pheumophilia and Salmonella Typhii Bacteria. It also contains a ruse inhibitor and an acid rain neutralizer and will work for up to 3 months on a 3 to 5 ton system.

Goodway's Line Of Coil Cleaning Products

Backpack CoilPro Coil Cleaner

Goodway's CC-100 Backpack CoilPro makes your job easier. The unique battery powered coil cleaner is the solution for all your mobile and hard to reach coil cleaning applications. Spray bottles and pump sprayers are simply not effective in penetrating most coil beds. In addition, many "coil cleaner" chemicals can actually damage the coils or create noxious fumes. After a lot of customer input, our

engineers have redesigned our unique coil cleaning system, containing all of the features needed in a truly mobile package!

Features:

- Deep cycle 12 V rechargeable battery
- Integrated 5 gallon water tank
- Integrated 3 quart chemical tank

More Features
See Accessories For The CC-100

Backpack CoilPro with Dolly

Goodway's CC-100-D Dolly mounted CoilPro makes your job easier. This unique battery powered coil cleaner is the solution for all your mobile and hard to reach coil cleaning applications. Spray bottles and pump sprayers are simply not effective in penetrating most coil beds. In addition, many "coil cleaner" chemicals can actually damage the coils or create noxious fumes. After a lot of customer input, our engineers have redesigned our unique coil cleaning system, containing all of the features needed in a truly mobile package!

Features:

- Wheel and Dolly Assembly
- Deep cycle 12 V rechargeable battery
- Integrated 5 gallon water tank
- Integrated 3 quart chemical tank

More Features
See Accessories For The CC-100-D

CoilPro Self Contained Coil Cleaning System

Goodway's CC-140 CoilPro Battery Powered Coil Cleaner is the solution for your coil cleaning applications. Spray bottles and pump sprayers are simply not effective in penetrating most coil beds. In addition, many "coil cleaner" chemicals can actually damage the coils or create noxious fumes. This unique coil cleaning system is most efficient when used with our non-fuming CoilShine, environmentally friendly expanding foam detergent.

Features:

- Integrated water tank
- Integrated soap container
- 12 V rechargeable battery

More Features
See Accessories For The CC-140

CoilPro with CoilVac

The total coil cleaning system! Sames as CC-140 but with CoilVac Dry HEPA Vacuum mounted on dolly, including filters,stainless steel tank, 6' vinyl crush proof hose, two piece 36" wand, 19" flexible extension wand, 3" dual bristle dusting brush, 3" long bristle dusting brush, 5" blower/bulk pickup nozzle, four piece 29" flat wand with crevice tool tip and 6" flat brush, CoilVac mounting bracket and tool bin. The CC-140 is designed to be flexible. The unit can be used for just about any coil cleaning application. It can operate on AC power, or on its integrated rechargeable battery.

Features:

- Integrated water tank
- Integrated soap container
- 12 V rechargeable battery

More Features
See Accessories For The CC-140-KIT

CoilPro Coil Cleaner

For washing those thick, hard to reach coils, turn to the CC-600 High Flow CoilPro Coil Cleaner. With an output water pressure of 300 or 600 PSI at 1.6 GPM, this unit delivers the cleaning force necessary to penetrate thick coil beds. When used with CoilShine, our environmentally friendly, non-fuming, expanding foam detergent, it will give you the cleanest coils possible.The CC-600 is designed to be used on large multiple-pass coil beds. It operates on AC power. The unit can connect to a 3/4" water line for continuous operation, or can draw from either of its own 5 gallon tanks.The operator simply applies a thick layer of CoilShine, Goodway's expanding foam detergent, using the custom foaming nozzle.

Features:

- Integrated 5 gallon water tank

- Integrated 5 gallon chemical tank
- Chemical control valve

More Features
See Accessories For The CC-600

CoilPro Cleaner with CoilVac

The CC-600-KIT Same as CC-600 CoilPro but also includes a CoilVac Dry HEPA Vacuum so the operator can first vacuum heavy debris from the coil before applying chemical and spraying down with the CoilPro. Both the CoilPro CC-600 and CoilVac operate on AC power. The CC-600 can connect to a 3/4" water line for continuous operation, or can draw from either of its own 5 gallon tanks.The operator simply applies a thick layer of CoilShine, Goodway's expanding foam detergent, using the custom foaming nozzle.

Features:

- Integrated 5 gallon water tank
- Integrated 5 gallon chemical tank
- Chemical control valve

More Features
See Accessories For The CC-600-KIT

CoilPro Jr.

The CoilPro line of coil cleaners has become the industry standard for HVAC maintenance professionals. In a constant effort to provide our customers with products designed for their specific application, the CoilPro Jr. was created.

What our Customers Say

Anthony Rizzica, Senior Engineer at Yeshiva University's In New York, NY

When asked about the performance of the CoilPro,
"We actually cleaned the coils so well that we gained almost 50 to 60 tons worth of cooling last summer and saved around $75,000.00 to $80,000.00. If I had to put a return on investment on it, I would say for every 25 to 50 coils that we clean, the machine pays for itself".

When asked what other savings does Anthony see using the CoilPro,
"Well man-hours are a saving - it only takes one man to operate. It's convenient. What used to take us a week, we now do in two or three days."

When asked to compare the CoilPro to conventional pressure washers,
"It's more portable, it's definitely lighter in weight. I like

the tanks that hold the chemical and water – there's no hose involved. The battery pack is a great saver, too. We don't have to worry about cords being plugged in, people tripping, hazards and all. Safety is always a concern around here."

View Goodway's Coil Cleaners

Goodway Technologies Corporation

Goodway Technologies Corporation was founded in 1966 by Per K. Reichborn. Since its earliest days, the company has built a reputation for manufacturing the highest quality cleaning systems in the world. "This commitment" says Reichborn, "not only extends to our manufacturing, but to everything we do, every day, for every product and service. Achieving this high quality of performance is the shared responsibility of each employee in every department."

Today, Goodway cleaning machines span the globe. From Afghanistan to Zimbabwe, Goodway equipment is used in over 125 countries and on every continent, including Antarctica.

To view a complete line of Goodway cleaning machines or to receive more information about a Goodway cleaning machine or to purchase a Goodway cleaning machine please visit Goodway.com or contact Goodway Technologies Corporation at 1 800 333-7467.

APPENDIX L

Appendix L: Building Envelop for Station 2

Heating & Cooling Degree Day Calculations:
Area*U factor*DegreeDay*24
1 kWh=3413 BTU

Area on which Batt Insulation will be applied:	1,800	SF
Area of windows:	434	SF
Area of exterior walls:	3,600.00	SF
Heating Degree Days for Raleigh	3397	
Cooling Degree Days for Raleigh	1493	

Assumed Current Building Envelop (using Station 20 as-built plans):

R value (windows)	1.43	
U factor (windows)	0.7	
R value (walls)	9.50	
U factor (walls)	0.11	
R value (roof)	16.67	
U factor (roof)	0.06	
Heating Required	65858318.4	BTUs
	19296.31362	kWh
Cooling Required	28945089.6	BTUs
	8480.834925	kWh
Current Total	27777.14855	kWh
Cost ($)	$2,361.06	
Cooling Cost ($)	$720.87	

APPENDIX M

APPENDIX M

Fire Station Refrigerator Inventory
ranked in order of energy (kWh) consumption

Station	Make	Model	Adjusted Energy Rating (kWh/ yr)	Annual Cost (by station avg. electric cost)
Station 10	GE	TBF17ZC	1,444	$121.87
Station 16	Kenmore	9610584	1,208	$102.80
Station 14	GE	TBF9DB	1,179	$97.39
Station 28	Amana	TM20ML	1,163	$90.95
Station 18	Whirlpool	ET14JKYSN02	1,154	$95.67
Station 2	Westinghouse	MRTZIGNCW1	815	$69.19
Station 8	Westinghouse - White	MRT21GNCNI	815	$64.14
Station 23	Frigidaire	FRT21I25DWG	801	$68.89
Station 9	Frigidaire	FRT21ILSDW	801	$66.16
Station 14	Frigidare	FRT21IL5DWG	801	$66.16
Station 2	Frigidare	FRT21IL50WC	801	$68.00
Station 11	Frigidare	FRT21IL4FW4	801	$66.64
Station 25	Frigidaire	FRT21IL4FW4	801	$68.33
Station 20	Frigidaire	FRT21IL5DWG	801	$72.17
Station 25	Kenmore	2032181PO03	798	$68.07
Station 17	GE	TBX18CIBQRWW	766	$65.11
Station 19	GE	TBX18SIBQRWW	766	$60.21
Station 21	Roper	RT18DKXFW01	760	$63.08
Station 5	Gibson	MRT18FNCD1	751	$72.47
Station 1	GE HotPoint	n/a	745	$55.73
Station 22	Amana	THI21S3	690	$55.55
Station 9	GE	TBX14SYZFRWH	686	$56.66
Station 11	GE	TBX14SYBNMWW	686	$57.08
Station 27	Jenn-Air	JSD2789GES	670	$62.65
Station 26	Jenn-Air	JSD2789GES	670	$45.43
Station 28	Jenn-Air	JSD2695KES	670	$52.39
Station 11	Maytag	MTB1954DRW	657	$54.66
Station 24	Roper	RT21LMXKQ00	514	$50.27
Station 20	Roper	RT21LMXKQ01	514	$46.31
Station 3	Roper	RT21LMXKQ09	514	$43.12
Station 12	Roper	RT2ILMXKO05	514	$43.23
Station 21	Roper	RT21LMXKQ04	514	$42.66
Station 10	Roper	RT21LMXKQ03	514	$43.38
Station 5	Whirlpool	ET1MHKXMQ07	514	$46.59
Station 4	Whirlpool	ET1PHKXPQ07	514	$54.43
Station 16	Whirlpool	ET1PHKXPQ08	514	$43.74
Station 18	Whirlpool	ET1PHKXPQ08	514	$42.61
Station 22	Whirlpool	ET1CHMXKQ06	514	$41.38
Station 19	Whirlpool	ETIMHKYMQ07	514	$40.40
Station 12	Whirlpool	ET1PHKXP007	514	$43.23
Station 17	Whirlpool	ET1CHEXVQ01	514	$43.69
Station 24	GE	GTS18DCPDLBB	482	$47.14
Station 26	Frigidare	FRT1856AWK	479	$32.48
Station 4	GE	GTS18DCMBLWW	478	$50.62
Station 6	GE	GTS18XCSARWW	478	$43.12
Station 8	GE	GTS18XBMDRWW	471	$37.07
Station 6	Whirlpool	ET8GTMXKQ00	470	$42.39
Station 23	Amana 20	n/a		
Station 7	Frigidare	n/a		
Station 7	GE	n/a		
Station 15	GE	n/a		
Station 15	Kenmore	n/a		
Station 1	Whirlpool	n/a		
TOTAL ENERGY CONSUMED			32,754	
TOTAL COST OF ENERGY				$2,765.30

Energy Efficiency: City of Raleigh
One Exchange Plaza

Environmental Defense Fund
Climate Corps 2010

August 20th, 2010

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Overview

The Environmental Defense Fund Climate Corps Program places trained M.B.A., Master of Public Policy, and Master of Environmental Management fellows into businesses, universities, and local government offices across the country to identify and analyze energy efficient investments that can reduce costs and energy use. The Environmental Defense Fund (EDF) partnered with the City of Raleigh in North Carolina to place two Climate Corps Fellows in the Parks & Recreation Department's Facilities and Operations Division to analyze the energy consumption of the office building, One Exchange Plaza (OEP), and identify cost-effective energy efficiency improvements that could be applied to the building and city-wide. The City of Raleigh is the first city in the country to host EDF Climate Corps Fellows.

Efforts to reduce energy consumption will not only reduce the City of Raleigh's facilities' operating expenses, but also reduce greenhouse gas emissions in keeping with the city's greenhouse gas emission reduction strategy. These efforts could also provide positive recognition for the City of Raleigh and inspire other cities around the nation to implement their own energy efficiency measures.

Analysis and Results

The Climate Corps fellows conducted a thorough analysis of the operations at One Exchange Plaza in order to gain a better understanding of the building's energy usage. The building's recent energy bills were analyzed to establish a baseline of energy consumption. The fellows developed a list of energy saving opportunities related to lighting, HVAC, and office/kitchen equipment for the building.

The table below summarizes the energy savings and paybacks associated with various projects recommended by the fellows. If all of these projects were implemented, the total energy savings would be 1,099,297 kWh/year, representing a 40% reduction in the building's cumulative consumption. The Facilities and Operations Division could also realize an annual reduction of $81,902.61, or 41%, in energy and maintenance costs. In keeping with the City of Raleigh's goal to reduce green house gas emissions, implementing these projects would reduce CO2 emissions by 623.85 Tons/Year.

Recommended projects

Project	Costs (Equipment & Labor)	Estimated Annual Energy Savings (kWh)	Estimated Cost Savings		Payback (Years)	CO2 Reduction (Tons/Yr)
			Annual	5-Year		
Lighting: T-12/T-8 to LED	$263,686.25	818,187	$62,182.22	$310,911.10	4.24	464.32
HVAC: VFDs and Fans	$167,400.00	273,986	$19,179.00	$95,895.00	8.73	155.49
Vending Machines	$296.00	7,124	$541.39	$2,706.96	0.55	4.04
TOTAL	**$431,382.25**	**1,099,297**	**$81,902.61**	**$409,513.06**	**5.27**	**623.85**

Many of the projects listed above have additional non-quantifiable benefits as well. For example, improving the lighting provides building occupants with a better working environment and may improve productivity while reducing absenteeism.

Barriers

Financial

The City of Raleigh's Facilities and Operations Division manages the operations and maintenance of the majority of city-owned buildings. The division is city-funded and given a strict annual budget sanctioned by the City Council in which to operate, making it difficult to finance new projects that are not in the current budget. In addition, any money not used or saved by the division during the given fiscal year

must be returned to the city operating budget, with a few exceptions, making it difficult to invest in continual efficiency improvement projects. The division is currently utilizing stimulus money from the Energy Efficiency and Conservation Block Grant (EECBG), in conjunction with the Raleigh Office of Sustainability, as part of the American Recovery and Reinvestment Act (ARRA). Additionally, the division obtains other grant money as well as Capital Improvement Project (CIP) city budget money to implement energy efficiency projects, but the projects are often piecemeal due to limited funds.

Recommendations and Action Plan

The recommended projects above, which are described in more detail in the full report, will decrease energy use, reduce carbon emissions, lower maintenance costs, and improve the overall functionality at One Exchange Plaza.

Lighting
It is understood that the Facilities and Operations Division has already flagged OEP for a T12 to T8 lighting retrofit project, but the fellows recommend that the division install LED lighting in lieu of T8 lighting to capture greater energy and cost savings. Although installing LED lighting has greater upfront costs than installing T8 lighting, the payback periods are comparable. This project may even qualify for Custom Incentives from Progress Energy of $0.08/kWh saved, which would lower the upfront costs considerably. If multiple budget cycles are needed to meet upfront costs, the LED lighting retrofit projects can be phased in. However, **t**he fellows recommend that the LED lighting retrofit project be implemented as soon as possible to take advantage of the potential utility rebates and significant energy savings.

HVAC
The supply and return fans that provide fresh air to OEP's occupants are re-built every 5 years at great expense and are due to be rebuilt soon. This presents an opportunity to replace the current fans with fans that can utilize variable frequency drives, to maximize energy savings. Variable frequency drives regulate fan motors allowing the motors to perform at their most efficient. These drives also qualify for Progress Energy utility rebates. The fellows recommend that the VFD project be implemented immediately to take advantage of the utility rebates and gain energy savings.

Vending Machine Controls
The vending machine project should also be implemented immediately to take advantage of utility rebates and instant energy savings.

Other Recommendations
This report also identifies other actions that will improve the operations and working environment of the building. Replacing the pneumatic controls that currently operate the major HVAC equipment, except for the chiller, with DDC controllers, will allow the Facilities and Operations staff to remotely control and more accurately program the equipment, as well as monitor the equipment for any malfunctions. The current dampers used throughout the building to control the air flow and temperature in occupied spaces do not function properly resulting in daily complaints from occupants. These dampers should be replaced with more effective dampers in order to improve the working environment and reduce maintenance calls. Educating the building's occupants about the benefits of energy efficiency will also make these projects smoother to implement and help secure participation in making energy savings a reality. These actions should be considered in tandem with the recommended projects for implementation.

We would like to thank Billy Jackson, Suzanne Walker and the rest of the staff in the Facilities and Operations division for their unwavering support and enthusiasm as we tackled this project. We would also like to thank Scott and Andrew at OEP for their patience and accessibility, which allowed us to complete a thorough energy assessment of the entire building. We hope this report will provide valuable insight and guidance for the Facilities and Operations division as they continue to strive for new levels of energy efficiency in their operations.

OVERVIEW AND BACKGROUND

The City of Raleigh launched an Office of Sustainability in 2008 to responsibly address environmental and energy issues for a growing municipality. The Office of Sustainability has initiated projects that fund energy efficiency projects, inventory greenhouse gas emissions, develop an electric car program and create a green jobs training program. The Office works collaboratively with the Parks and Recreation's Facilities and Operations Division to promote the implementation of energy efficiency projects throughout the city.

The Parks and Recreation's Facilities and Operations Division oversees the operations and maintenance of over 3,000,000 SF of facilities, including almost 500,000 SF of commercial space, and employs an energy management team dedicated to reducing energy consumption while improving the quality of the facilities. The division is actively engaged in a number of energy efficiency projects that include installing LED light fixtures in building parking lots across the city, utilizing energy management technologies in conjunction with building automation systems, and implementing lighting controls with occupancy sensors.

One Exchange Plaza

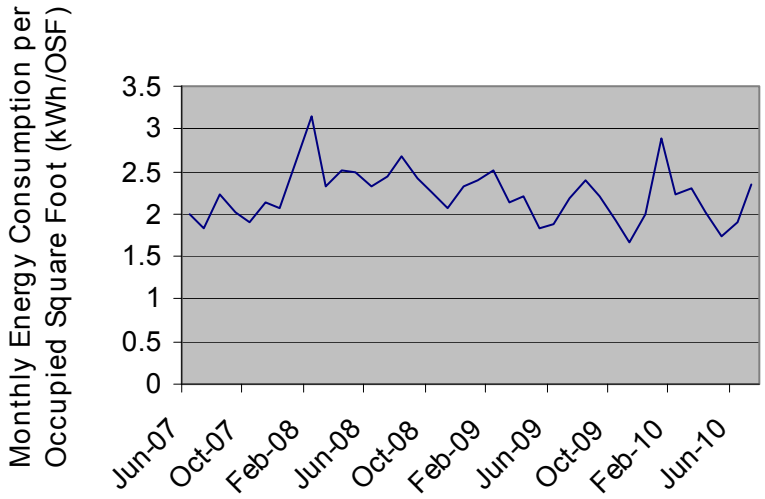
The main focus of this report is One Exchange Plaza, a 104,000 SF office tower completed in 1984. The building contains 10 stories of office space that houses a number of city departments as well as tenant space leased to the state. A restaurant is located on the ground level, but it is independently metered.

The building is well maintained and some improvements in lighting efficiency have been implemented. Facilities staff has upgraded almost all the incandescent light fixtures to compact fluorescents and has installed occupancy sensors in the restrooms on each floor. The staff has also changed out about 30% of the building's T12 fluorescent lamps and ballasts to more efficient T8 fluorescent lamps and ballasts.

The HVAC system is a patchwork of original and new equipment. The chiller was recently replaced and new controls for it were installed; however the supply/return fans and fan motors are the original design from 1984, rebuilt every 5 years. The dampers are original and must be kept open all the time to ensure adequate air circulation. Pneumatic controls are utilized throughout the building and are not compatible with the division's energy management technologies. There is significant room for energy efficiency improvement if the city is willing to approve capital improvement expenditures for this system.

Overall, the energy consumption for One Exchange Plaza is cyclical, peaking when HVAC load is highest in the late summer and mid-winter. Figure 1, shows the monthly data for the past 3 years of energy consumption. This information can be used to asses the effectiveness of future energy efficiency and conservation initiatives and track monthly progress.

Figure 1: Monthly energy consumption per occupied square foot at One Exchange Plaza



RECOMMENDED ENERGY EFFICIENCY PROJECTS AND ACTIONS

Project 1 – Lighting Retrofit: T12/T8 to LED

Basic Project Information

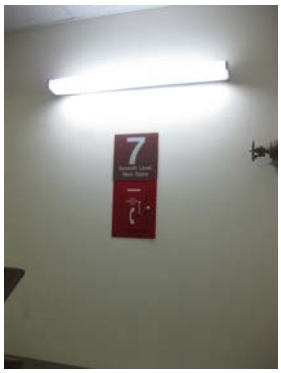
Currently installed at OEP are T12 and T8 fluorescent lamps. The T12 lamps are either 40W or 34W with ballasts that bring total wattage to at least 50W per lamp. The T8 lamps are 32W with ballasts that bring total wattage to 40W per lamp. There are also CFL lamps on numerous floors throughout the building. See **Appendix A** for a complete lighting inventory at OEP.

Pictures: T12 and T8 lamps compared to LEDs

T8 lamps on 7th floor

LED lamps on 7th floor

T12 stairway lighting



LED stairway lighting

The fellows recommend using LED lamps to replace the existing lighting in most areas. A tube LED lamp is 15W and has no ballast. The lamps last up to 80,000 hours – significantly longer than the 12,000 – 20,000 hour lamp life of tube fluorescent lamps (see **Appendix B** for LED product specifications). Given the operating hours at OEP, a non-emergency LED lamp can last up to 30 years.

Picture: T12 and LED comparison in stairwell at OEP (T12 lighting floor 8, LED floor 7)

Project Summary

- Replace existing lighting with LED lamps
- Energy Savings: 818,187 kWh
- Equipment and Labor Cost: $263,686.25
- **Total Estimated Annual Energy Cost Savings: $62,182**
- **Payback Period: 4.24 years**

Financial Analysis

Assumptions

- Annual electricity rate: $0.0763 per kWh – no growth factor included
- Installation cost: $60 per hour (16 lamps per hour)
- Business hours are 55 hours per week and emergency-powered lighting remains on 168 hours per week
- Emergency-powered lighting included in each floor's lamp count
- Maintenance cost savings based on life span of existing lamp and LED
- All T12 lamps considered 34W lamps in analysis
- Financial analysis based on entire project, but can be phased-in
- Cost estimates based on quoted product prices from Lite Energy Solutions

Figure 2: One Exchange Plaza LED Lighting Retrofit Project (separated by floor/area)

Floor/ Area*	Number of lamps on floor/ in area	Total Cost ($)	Annual savings** ($)	Payback	Annual Energy (kWh) savings
Stairs/ Mechanical floor	80	5,360	4,374	1.23	57,555
Elevators and Elev. Lobbies	137	6,855	6,220	1.10	81,838
Ground floor	166	11,182	4,553	2.46	59,903
Mezzanine	287	19,301	3,965	4.87	52,176
5th Floor	554	36,934	7,534	4.90	99,135
6th Floor	565	37,855	7,691	4.92	101,201
7th Floor	571	38,257	8,199	4.67	107,880
8th Floor	481	32,479	6,022	5.39	79,240
9th Floor	494	30,098	7,624	3.95	100,322
10th Floor	460	31,134	5,999	5.19	78,937
Combined lamps	**3,795**	**$249,455**	**$62,182**	**4.01**	**818,187**
Installation		**$14,231.25**			
TOTAL PROJECT		***$263,686.25***	***$62,182***	***4.24***	***818,187***

** Includes emergency lighting*
***Includes energy and maintenance cost savings*
Source: Lite Energy Solutions

Progress Energy Rebate

LED retrofits are not specifically included under Progress Energy's energy efficiency rebates for lighting. Given the substantial energy savings involved, the fellows recommend working with Progress Energy to establish possible rebates.

** Were LED lighting retrofits to qualify for Progress Energy's custom energy efficiency program, the $.08 per kWh hour incentive would generate $65,455 in rebates – lowering total project cost to $198,231 and payback to 3.19 years.* See **Appendix C** for Progress Energy's Custom Incentive rebates.

Phased installation option

If the project costs are better absorbed over a number of budget cycles, the fellows recommend a phasing in of LED lighting. See **Appendix D** for a financial and energy analysis for each floor/ area at OEP – emergency-powered lighting is separated in analysis. Emergency lighting (or any lighting that remains on 24/7) provides the quickest payback and should be implemented immediately. Then LEDs can be installed floor by floor, based on cost and savings. Below is a recommended LED installation schedule:

- *Phase 1: Stairs, emergency lighting on mechanical floor, elevators, and elevator lobbies*
    - Total lamps: 217
    - Total cost: $12,215
    - *Total annual savings: $10,594 and 139,393 kWh*
    - *Payback: 1.15 years*

- *Phase 2: Ground floor, 9th floor*
    - Total lamps: 660
    - Total cost: $41,280
    - *Total annual savings: $12,177 and 160,225 kWh*
    - *Payback: 3.39 years*

- *Phase 3: Mezzanine, 5th floor, 6th floor, and 7th floor*
    - Total lamps: 660
    - Total cost: $132,347
    - *Total annual savings: $27,390 and 360,392 kWh*
    - *Payback: 4.83 years*

- *Phase 4: 8th floor, 10th floor*
    - Total lamps: 941
    - Total cost: $63,613
    - *Total annual savings: $12,021 and 158,177 kWh*
    - *Payback: 5.29 years*

Remaining areas at OEP

The basement level at OEP has 257 T12, T8, and CFL lamps. However, it is excluded from the financial analysis because estimating the lighting hours is difficult, as it is occupied sporadically throughout the day and night. The 3rd and 4th floors at OEP have recently received new T8 and CFL lighting upgrades, so the fellows do not recommend installing LEDs until the remaining building has been retrofitted.

Recommendation

The fellows recommend replacing existing lighting with LEDs throughout most areas in OEP (all floor/ areas listed in Figure 2 above). The stairwell and elevator lighting will achieve significant energy savings and will payback upfront investment in just over one year. The other floors will also produce significant energy and maintenance savings. Additionally, the hours used to calculate energy use did not include "off hours" when cleaning staff might occupy the building. The duration of "off hour" lighting use will only add to OEP's energy savings.

The stronger, focused lighting will enhance the tenant work environments and improve the overall quality of the building. LED lighting also provides a safer, mercury-free work environment. Fluorescent and compact fluorescent lighting contain mercury that can harm individuals if there is frequent contact with a damaged lamp.

If the project cannot be completed in one phase, the fellows recommend a multi-phased approach that utilizes the near-instant savings of the emergency lighting to help fund the remainder of the project.

Project 2 – HVAC: Variable Frequency Drives and Air Circulation Fans

Basic Project Information

OEP's current HVAC system uses two 90 base horsepower supply fans and two 50 base horsepower return fans to control the airflow in the building. The supply fans bring outside air to circulate through the building and the return fans send out inside air or send inside air through the system again. These fans send air supply through the building at a constant volume, irrespective of the load requirement (based on, among many things, occupancy of building and outside temperature). According to Western Michigan's Sustainability department, these constant speed fans are often designed to "handle peak loads that have a safety factor. This often leads to energy inefficiency in systems that operate for extended periods at reduced load."[1]

A variable frequency drive (VFD) will enable the fan motor to match output to load. It will slow down the fan, reduce excess air flow, and lead to significant energy savings. Additionally, the VFDs will lower maintenance costs because the fan motors will no longer run consistently at maximum speed. VFDs can be mounted next to the fan units and connect directly with the fan motors.

Picture: Example of a variable frequency drive (VFD)

[1] http://www.wmich.edu/sustainability/campus/learn/frequency_drives.html

While VFDs can be installed to work with existing fans and fan motors, those currently installed at OEP are not compatible with VFDs because an older design is used (see **Appendix E** for fan specifications). The older style varofoil fans are designed with blades that rotate based on static pressure. VFDs require induction fan blades that remain fixed to optimally reduce fan motor speed. The varofoil fans somewhat control the air supply volume as the blades rotate, but not nearly as effectively as VFDs and also cannot gauge the building load. A VFD with the older, rotating varofoil blades will likely disrupt (or fail to provide) the optimal air supply flow in the building.

The fellows recommend purchasing VFDs for the two supply fans and two return fans, and additionally, replacing the existing fans and fan motors. This will reduce HVAC system energy costs and enhance the durability of the equipment.

Pictures: One of two air system 90 HP supply fans at OEP (motor built inside fan)

Project Summary

- Install four VFDs and replace the four existing HVAC system supply and return fans
- Energy Savings: 273, 986 kWh
- Equipment and Labor Cost: $167,400 after Progress Energy Incentives ($12,600).
- **Total Estimated Annual Energy Cost Savings: $ 19,179**
- **Payback Period: 8.73 years**

Financial Analysis

Assumptions

- Electricity rate: $0.07
- Hours per week HVAC system is powered on: 76.5 hrs
- Progress Energy rebate: $45 per horsepower when installing VFDs (See **Appendix F**)
- Energy savings based upon building load factor and energy modeling from Atlantec Engineers, PA
- Capital costs and installation based on estimate from Newcomb and Company

Energy Savings

Atlantec Engineers, PA was consulted for the energy savings analysis. See **Appendix G** for a detailed analysis of the energy savings. Below is the energy cost of the VFD fans compared to the existing constant volume fans**.**

Figure 3: One Exchange Plaza HVAC System Fan Comparison (Annual Cost)

Component	Current Fans ($)	VFD Fans ($)
Air System Fans	31,857	14,613
Cooling	15,095	13,602
Heating	0	341
Pumps	6,609	5,980
Cooling tower fans	3,305	3,150
Total Cost	*(56,865)*	*(37,686)*
Cost Savings		***19,179***
Source: Atlantec Engineers, PA		

Capital Cost

Installing VFDs and replacing supply fans, return fans and fan motors will cost an estimated $180,001 including installation and overhead. See **Appendix H** for a detailed cost estimate. The recommended equipment purchase costs are below (labor/installation excluded):

- 4 variable frequency drives (VFDs): $30,000
- 4 HVAC System fans (2 supply, 2 return): $80,000

Recommendation

The fellows recommend installing VFDs and replacing the HVAC system supply and return fans at OEP. Nearly $20,000 in annual energy savings will be obtained and less stress will be placed on the HVAC system. The projected energy savings are based on very conservative estimates that set the electricity rate at $0.07 per kWh – lower than the current rate and without expected growth.

** The annual energy consumption of the air system supply fans will be reduced by 54% and 246,343 kWh.*

This recommendation will also benefit those who work in the building. The maintenance staff at OEP constantly struggles to maintain proper temperatures for each tenant floor. Complaints range between too hot and too cold at the same time. The VFD installation will help the building sufficiently meet load requirements and improve the overall working environment of the building.

Project 3 – Vending Machines

Basic Project Information

The 2.5 million refrigerated beverage vending machines in place in the United States consume approximately 7.5 billion kWh per year. This equipment costs American businesses nearly $600 million annually to power.[2] One Exchange Plaza has 3 refrigerated vending machines and 1 non-refrigerated located in the building.

The two major energy consuming systems in vending machines are refrigeration and lighting. While the City of Raleigh has negotiated with vending machine distributors to remove the lighting in the refrigerated vending machines, installing vending machine controls can substantially save energy and reduce operating expenses. The fellows recommend installing a "VendingMiser", a product from USA Technologies, on all the vending machines.

The VendingMiser monitors the occupancy levels and ambient temperature changes in the area surrounding the vending machine and regulates the power usage of the machine. The device powers down the machine when the area is vacant and automatically re-powers the cooling system at one- to three-hour intervals, independent of sales, to ensure the product stays cold. The VendingMiser for non-refrigerated machines powers down the lighting and electrical systems. Maintenance savings can also be generated through the reduced run-time of vendor components.

Pictures: Vending Machines in One Exchange Plaza

Project Summary

- Install VendingMisers on all vending machines located in One Exchange Plaza
- Energy Savings: 7,124 kWh
- Equipment and Labor Cost: $296, after Progress Energy Incentives.
- **Total Estimated Annual Energy Cost Savings: $541.39**
- **Payback Period: 6.6 *months***

[2] www.aceee.org. The American Council for an Energy-Efficient Economy's Online Guide to Energy Efficient Commercial Equipment.

Financial Analysis

Assumptions

- Energy Savings: Used the current wattage and conservative estimates of power-on hours for the machines before and after VendingMiser installation. Duration of auto-repower estimated at 0.4 hours and time between auto-repower estimated at 2 hours.

- Equipment Cost & Labor: VendingMiser cost is listed at $179.00 and SnackMiser is listed at 79.00.[3] Progress Energy has an incentive of $90.00 for beverage machine controls and an incentive of $50.00 for snack machine controls making costs $89.00 and $29.00 respectively. See **Appendix I** for Progress Energy Vending Machine Incentives Policies. Labor costs assumed to be free since the VendingMisers are plug-in devices.

- CO2 emission reductions: CO2 savings were calculated using 1.135lb/kWh.[4]

- Cost of electricity: $0.076/kWh

Recommendations

The fellows recommend purchasing and installing VendingMisers on the vending machines located in One Exchange Plaza as soon as possible. The devices will reduce energy consumption and costs. The Facilities and Operations division should also continue to request that the vending machine distributors remove the lighting in the vending machines to eliminate lighting costs altogether.

[3] www.usatech.com.
[4] www.epa.gov. eGRID 2007 Version 1.1.

Installation of Vending Miser Analysis

City of Raleigh

Input Variables	
Energy Costs ($0.000 per kwh)	$0.076
Facility Occupied Hours per Week	60
K Factor of Air Conditioner (1.0 - 3.0)	2.0
Air Conditioning weeks/year (0-52)	52
Air Conditioning hrs/week (0-168)	168
Number of Cold Drink Vending Machines	3
Number of Uncooled Snack Machines	1
Power Requirements of Cold Drink Machine (avg watts)	233
Power Requirements of Snack Machine (avg watts)	138
VendingMiser Sale Price (for cold drink machines)	$89.00
SnackMiser Sale Price (for snack machines)	$29.00
Corporate Tax Rate	0%

One Year Savings Analysis

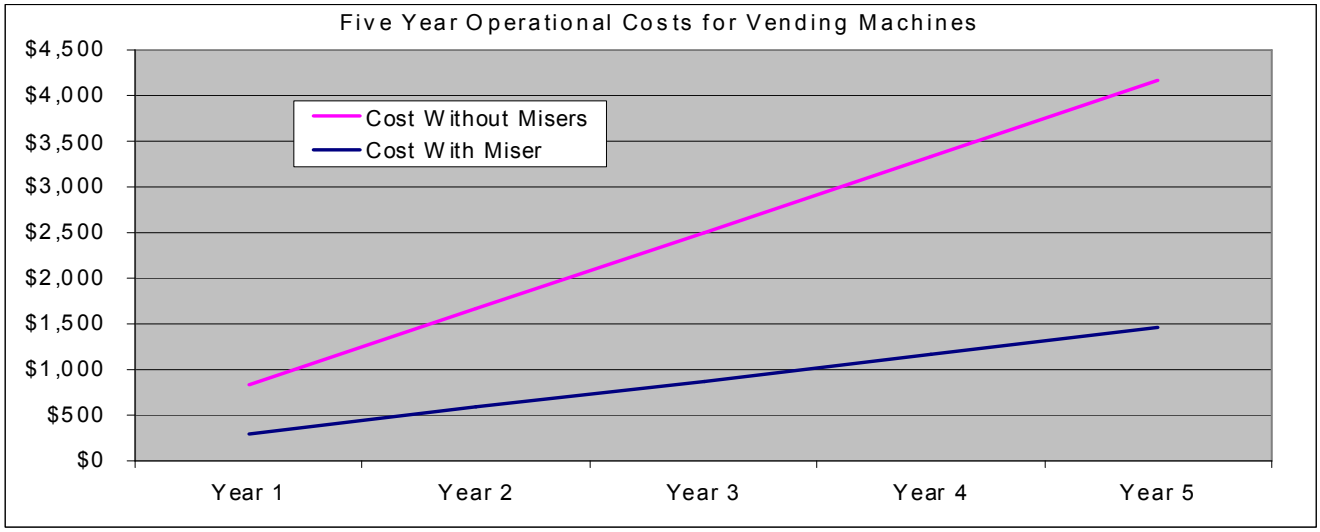
	Before	After	Savings	
Cold Drink Machines	$696.14	$243.10	$453.04	Cost of Operation
	9,160	3,199	5,961	kWh
			65%	% Energy Savings
Snack Machines	$137.43	$49.08	$88.35	Cost of Operation
	1,808	646	1,163	kWh
			64%	% Energy Savings

Project Summary

Present kWh	Projected kWh	kWh Savings per Year	CO_2 Emission Savings (Tons)
10,968	3,844	7,124	4.04

Present Cost	Projected Costs	Annual Savings	Savings	Total Project Cost	Break Even (Months)
$833.57	$292.18	$541.39	65%	$296.00	6.6

Five Year Savings on 4 Machines = $2,706.96
Five Year Return on Investment = 815%



Version 1.0

Source Data for Generating Chart

	Year 1	Year 2	Year 3	Year 4	Year 5
Cost With Miser	$292.18	$584.36	$876.54	$1,168.72	$1,460.90
Cost Without Misers	$833.57	$1,667.14	$2,500.71	$3,334.29	$4,167.86

* Savings results shown are estimates only. Estimates are based on average savings, as documented by hundreds of tests performed by independent parties. Actual "% Energy Savings" for individual machines may be higher or lower than estimated. All calculations depend upon the actual values for energy costs, facility occupied hours, machine power requirements and other variables.

Other General Recommendations

Upgrade HVAC controls: replace current pneumatic controls with DDC controls

OEP Pneumatic controls

OEP Chiller DDC controls

With the exception of the new chiller, all other major HVAC equipment in One Exchange Plaza is controlled by circa 1984 pneumatic controls. While pneumatic controls were the advanced technology of their day, they are not programmable and therefore do not offer the energy efficiency gains that newer control technologies offer.

The fellows recommend that the pneumatic controls be replaced with direct digital controls (DDC) identical to the new chiller's controls. DDC controllers can dictate the position of every damper in the system and can set the run speed or capacity of the fans and pumps thereby achieving significant energy savings. DDC can directly connect with the energy management interface that the Facilities and Operations staff currently uses to remotely control building systems.

Replace dampers/diffusers

OEP pneumatic controlled damper/diffuser

OEP plastic air bladder used in damper/diffuser

Dampers are used to control air flow and help to maintain comfortable temperatures in a given space. The dampers currently installed in OEP have pneumatic thermostats that, when manually set to a desired temperature, inflate or deflate plastic bladders that restrict or allow cooled or heated air. These plastic bladders are relatively flimsy and over time degrade causing the air to flow constantly at uncontrollable temperatures. This in turn causes building occupants to complain about air temperature. Maintenance on these dampers is also time-consuming and disruptive.

Mechanized electric dampers with blades connected to DDC controllers will provide more comfortable air temperatures as well as save energy by fine tuning the air flow based on occupant load without degrading over time. Maintenance costs would also be reduced.

Educate building occupants about energy efficiency

Educating the building's occupants about energy efficiency measures can be a powerful tool in ensuring that energy efficiency gains are realized. The lighting recommendation calls for the installation of LED tube lighting in a number of occupied areas in the building. LED lighting casts a slightly brighter light than typical fluorescent lighting and that may surprise some of the building's occupants. The fellows recommend that the facilities staff inform the occupants of the new lighting retrofits and the benefits of the new lighting.

While OEP has some signage in the building's restrooms about turning the lights off when leaving a room and low flow water fixtures, there is no signage about the lighting occupancy sensors that are located in the restrooms. After surveying the restrooms, it was found that the majority of the sensors had been over-ridden or switched off, which meant that the lights stayed on when no one was in the restrooms and energy was not being saved. The fellows recommend signage in the restrooms informing the users about how the sensors work and ask that they not be switched off.

Summary of Energy Efficiency Projects

These projects, when fully implemented, could result in 1,099,297 kWh of annual electricity savings, $81,902 of annual cost savings, and 623.85 metric tons of CO2 emissions reductions.

Total Investment:	**$431,382.25**
Annual kWh savings:	**1,099,297**
Payback Period:	**5.27 years**
CO_2 emissions avoided:	**623.85 metric tons**

Action Plan & Timeline

The City of Raleigh should consider projects that offer a quick payback, have a low initial investment, and/or high annual energy savings. Keep in mind any projects that might be eligible for Progress Energy utility rebates (typically investments in equipment upgrades, but custom incentives are available too).

Short Term Implementation (0 months – 1 year)

- Install **VendingMisers** on all the vending machines in OEP and apply for the Progress Energy utility rebates associated with vending machine controls
- Begin **LED lighting retrofit** in a phased approach beginning with stairwell emergency lighting and apply for Custom Incentive rebates from Progress Energy
- Begin installation of **new fans/fan motors and VFDs** with DDC controllers and apply for Progress Energy utility rebates associated with variable frequency/speed drive installations.
- Educate building occupants about energy efficiency improvements taking place at OEP and provide information on how to use occupancy sensors properly.

Medium Term Implementation (1 Year – 5 Years)

- Continue LED lighting retrofit on all floors of OEP, if not completed yet.
- Begin replacing pneumatic controls with DDC controllers and replace pneumatic dampers/diffusers with electric mechanized dampers with blades

OVERCOMING BARRIERS TO ENERGY EFFICIENCY

Barriers

Financial

The City of Raleigh's Facilities and Operations Division manages the operations and maintenance of all city-owned buildings, with the exception of the Fire Department's fire stations and the Raleigh Convention Center. The division is city-funded and given a strict annual budget sanctioned by the City Council in which to operate, making it difficult to finance new projects that are not in the current budget. In addition, any money not used or saved by the department during the given fiscal year must be returned to the city operating budget, with a few exceptions, making it difficult to invest in continual efficiency improvement projects. The division is currently utilizing stimulus money from the Energy Efficiency and Conservation Block Grant (EECBG) as part of the American Recovery and Reinvestment Act (ARRA) and other grant money as well as Capital Improvement Project (CIP) city budget money to implement energy efficiency projects, but the projects are often piecemeal due to limited funds.

Recommended Strategies for Overcoming Barriers

Financial

The Facility and Operations Division should be given the opportunity to keep all or a portion of the savings it will earn through energy efficiency projects. As it stands, the savings that the division obtains, with limited exceptions, must be returned to the city's general fund. The incentives are not properly aligned. The City Council should consider a means to allow the Facilities and Operations Division, or any other city entity, to keep some of the savings earned through efficient and sustainable projects that improve the quality of the city-owned buildings and reduce energy consumption.

In addition, City Council should restructure Capital Improvement Project funding to include a separate account for life-cycle analysis costs to ensure that the continual improvements, which are so vital to the overall operations of the city-buildings, are covered. This could also free up funds for energy efficiency projects that would save the city energy and money.

Continue to seek grants and stimulus money to implement energy efficiency projects. Databases like the Database of State Incentives for Renewables and Efficiency (DSIRE) have a wealth of information on incentives and where to find incentives for energy efficiency projects. Also, continue to collaborate with other city departments to implement energy efficiency improvements.

Lessons from Overcoming Barriers

While conducting the energy efficiency assessment of One Exchange Plaza, it was important to keep in mind the financial situation of the city and the Facilities and Operations division. Therefore, the recommendations made in this report are sensitive to up-front costs, payback periods, overall cost savings, and the ability to secure utility rebates that will decrease those up-front costs.

CONCLUSIONS AND RECOMMENDED NEXT STEPS

One Exchange Plaza is a well maintained building full of energy efficiency opportunities. The recommended projects in this report, if implemented, could generate significant savings for the City of Raleigh. Retrofitting the current fluorescent lighting to LED lighting, replacing the fans/fan motors and installing variable frequency drives, and installing vending machine controls are all projects that should be implemented immediately to capture efficiency gains and provide a better working environment for the building's occupants. The general recommendations should also be adopted, when possible, to achieve energy savings.

The recommended projects in this report are not entirely unique to One Exchange Plaza and could be applied city-wide. The City of Raleigh's civic leaders should choose to continue to reinvest in energy efficiency projects that would further the city's mission to become a sustainability leader.

Once again, we would like to thank the Facilities and Operations staff for giving us so much of their valuable time while we were working on this report.

APPENDIX A

LIGHTING - One Exchange Plaza

INTERIOR LIGHTING														Emergency Lighting per Floor			EXTERIOR LIGHTING	
Floor	**40W T-12**	**34W T-12**	**20W T-12**	**32W T-8**	**40W U-Shape**	**32W U-Shape**	**60W Incanescent**	**23W CFL**	**13W CFL**	**25W CFL**	**175W Metal Halide**	**13W 2-prong CFL**	**TOTAL LAMPS PER FLOOR**	**34W T-12**	**32W T-8**	**44W Circular**	**100W Metal halide**	**Photocell**
Basement	10	207		22					8				**247**	**36**				
Ground Floor	6	116		8							4		**134**	**32**			6	Y
Mezzanine	1	22	2	144		66		12					**247**	**10**	**30**			
3	1	19		364		158							**542**	**8**	**24**			
4	2	29		284		154							**469**	**14**	**41**			
5	25	477			2							8	**512**	**42**				
6	26	490											**516**	**49**				
7	25	482											**507**	**64**				
8	17	327		60				23		5			**432**	**44**	**5**			
9	19	367		24									**410**	**76**	**8**			
10	16	296		60			1	44					**417**	**38**	**4**			
Mechanical*	2	32					4						**38**	**16**				
TOTAL LAMPS	**150**	**2,864**	**2**	**966**	**2**	**378**	**5**	**79**	**8**	**5**	**4**	**8**	**4,471**	**429**	**111**	**0**	6	
TOTAL WATTAGE**	**5,988**	**97,386**	**40**	**30,912**	**80**	**12,096**	**300**	**1,817**	**104**	**125**	**700**	**104**	**149,652**				600	

** Includes 34W T-12 emergency lighting*
*** Excluding ballasts*

Elevator and Elevator Lobby Lighting (on 24/7)						
Floor	**34W T-12**	**32W T-8**	**11W CFL**	**23W CFL**	**15W CFL**	**25W Halogen**
Basement				7		
Ground Floor	16					
Mezzanine		6		3		
3		8		3		
4	12					8
5				8		
6				8		
7				8		
8				8		
9	8					
10					6	
Elevators	4		24			
TOTAL LAMPS	40	14	24	45	6	8
TOTAL WATTAGE*	1,360	448	264	1,035	90	200
** Excluding ballasts*						

Stairways and Mechanical Floor Emergency Lighting		
Area	**34W T-12**	**44W Circular**
Stairways	64	10
Mechanical	16	
TOTAL LAMPS	80	10
TOTAL WATTAGE*	2720	440
** Excluding ballasts*		

APPENDIX B

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Product Specifications

- Lengths Available
  1, 2, 3, 4, 5, 6 & 8 feet

- Power Consumption:
  4 Watts/Linear Foot

- Input Voltage: AC 100~277V

- Luminous Flux:
  400 Lumens/Linear Foot

- Color Temperature:
  2800 K (Warm)
  4100 K (Natural)
  5500 K (Day)

- CRI: >80

- Lifespan: > 60,000 Hours

- LED Beam Angle: 120°

- LED Quantity:
  75 LEDs/Linear Foot

- Operating Temperature:
  -4℉ to 113℉ (-20~45ºC)

- UL Listed to UL 1598, 1598B

- ETL Listed to UL STD 1993

- Construction: Clear, impact resistant plastic lens and an integrated Aluminum heat sink

- Physical Characteristics:
  Diameter – 1.0 Inches

LED Retrofit Solutions for T8/T12 Fixtures

The T8/T12 LED Replacement Lamps by ***Lite Energy Solutions*** are the most advanced LED replacement solution for conventional fluorescent fixtures available today.

Our LED lamps fit directly into your existing fixtures with minimal modification converting your current fixtures to state-of-the-art LED lighting technology.

Compared to traditional Fluorescent lamps, our LED lamps will reduce current energy usage by 50% to 60%. LED technology does not require the use of ballast, therefore eliminating the associated energy and maintenance costs.

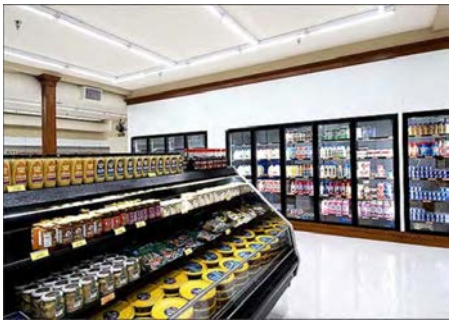
LED lighting technology produces a higher quality of light that is better perceived and processed by our eyes. Therefore, lower lumens (or foot candles) are required to provide the same level of perceived light. Averaging 89 Lumens/Watt, our LED Replacement Lamps are the most powerful LED T8/T12 retrofit solution available in today's market.

The U.S. Department of Energy developed a standard for measuring a lamp's end-of life, which is 70% of its original light output. In accordance with this rating standard, our LED Replacement Lamps are rated for 60,000 hours of maintenance free operation.

LED products do not contain mercury, phosphorus, lead and other environmental contaminants that today's fluorescent tubes contain. Expired fluorescent lamps are considered hazardous waste and it is illegal to dispose of with normal trash or place in a landfill. It only takes 1 gram of mercury to contaminate a 20-acre lake to the extent that fish living in the lake would be unfit for human consumption. Our LED products are 100% recyclable; eliminating EPA disposal requirements, costly compliance management processes, and liability exposure.

Our LED lighting technology eliminates hidden issues of fluorescent lighting technology such as harmful ultraviolet rays and undetectable flickering, which causes eye-strain and headaches.

Replacing fluorescent lamps is not only a way to save on your electric bill, but will also provide better light quality and reduce your environmental impact.



"Get More from LESS"

Lite Energy Solutions, Inc. 909 S Main St Ste 216 Salisbury, NC 28144 Office: (704) 932-0573 Fax: (704) 210-8012

APPENDIX B

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Product Specifications

- Lengths Available
  2 foot; 3" or 6" Leg Spacing

- Power Consumption:
  15 Watts

- Input Voltage: AC 100~240V

- Luminous Flux:
  1400 Lumens

- Color Temperature:
  2800 K (Warm)
  4100 K (Natural)
  5500 K (Day)

- CRI: >80

- Lifespan: > 60,000 Hours

- LED Beam Angle: 120°

- LED Quantity:
  288 LEDs

- Operating Temperature:
  -4℉ to 113℉ (-20~45ºC)

- UL Listed to STD 1310

- Construction: Clear, impact resistant plastic lens and an integrated Aluminum heat sink

- Physical Characteristics:
  Diameter – 1.0 Inches

LED Retrofit Solutions for T8 U-Lamp Fixtures

The T8 U-Lamp LED Replacement Lamps by ***Lite Energy Solutions*** are the most advanced LED replacement solution for conventional fluorescent fixtures available today.

Our LED lamps fit directly into your existing fixtures with minimal modification converting your current fixtures to state-of-the-art LED lighting technology.

Compared to traditional Fluorescent lamps, our LED lamps will reduce current energy usage by 50% to 60%. LED technology does not require the use of ballast, therefore eliminating the associated energy and maintenance costs.

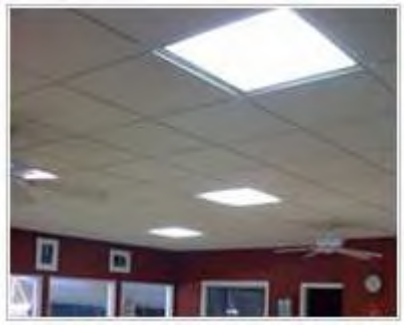
LED lighting technology produces a higher quality of light that is better perceived and processed by our eyes. Therefore, lower lumens (or foot candles) are required to provide the same level of perceived light. Averaging 89 Lumens/Watt, our LED Replacement Lamps are the most powerful LED T8 U-Lamp retrofit solution available in today's market.

The U.S. Department of Energy developed a standard for measuring a lamp's end-of life, which is 70% of its original light output. In accordance with this rating standard, our LED Replacement Lamps are rated for 60,000 hours of maintenance free operation.

LED products do not contain mercury, phosphorus, lead and other environmental contaminants that today's fluorescent tubes contain. Expired fluorescent lamps are considered hazardous waste and it is illegal to dispose of with normal trash or place in a landfill. It only takes 1 gram of mercury to contaminate a 20-acre lake to the extent that fish living in the lake would be unfit for human consumption. Our LED products are 100% recyclable; eliminating EPA disposal requirements, costly compliance management processes, and liability exposure.

Our LED lighting technology eliminates hidden issues of fluorescent lighting technology such as harmful ultraviolet rays and undetectable flickering, which causes eye-strain and headaches.

Replacing fluorescent lamps is not only a way to save on your electric bill, but will also provide better light quality and reduce your environmental impact.



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APPENDIX B

Lite Energy Solutions

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Product Specifications

- Types Available
  PAR 16, 20, 30 & 38

- Power Consumption:
  5 - 15 Watts

- Input Voltage: AC 110~277V

- Luminous Flux:
  Average 58lm/watt

- Color Temperature:
  2800 K (Warm)
  4100 K (Natural)
  5500 K (Day)

- CRI: 80

- Lifespan: > 60,000 Hours

- LED Beam Angle: 120°

- LED Type: CREE

- LED Quantity:
  5 - 12 LEDs

- Operating Temperature:
  -4℉ to 113℉ (-20~45ºC)

- Listing Standards
  UL or ETL Listed

- Construction:
  Extruded Aluminum Housing
  Open or Lens Options

LED Retrofit Solutions for PAR Lamps

The LED Replacement Lamps by ***Lite Energy Solutions*** are the most advanced LED replacement solution for conventional PAR lamps available today.

Our fully dimmable LED PAR lamps screw directly into the existing fixture allowing them to utilize the latest state-of-the-art LED lighting technology.

Compared to traditional PAR lamps, our LED lamps will reduce current energy usage by 75% to 85%. We have LED PAR lamps available in all standard sizes in both spot/flood and dimmable/non-dimmable configurations.

LED lighting technology produces a higher quality of light that is better perceived and processed by our eyes. Therefore, lower lumens (or foot candles) are required to provide the same level of perceived light. Averaging 58 Lumens/Watt, our LED Replacement Lamps are the most powerful LED PAR Lamp retrofit solution available in today's market.

The U.S. Department of Energy developed a standard for measuring a lamp's end-of life, which is 70% of its original light output. In accordance with this rating standard, our LED Replacement Lamps are rated for 60,000 hours of maintenance free operation.

LED products do not contain mercury, phosphorus, lead and other environmental contaminants that today's fluorescent tubes contain. Expired fluorescent lamps are considered hazardous waste and it is illegal to dispose of with normal trash or place in a landfill. It only takes 1 gram of mercury to contaminate a 20-acre lake to the extent that fish living in the lake would be unfit for human consumption. Our LED products are 100% recyclable; eliminating EPA disposal requirements, costly compliance management processes, and liability exposure.

Our LED lighting technology eliminates hidden issues of traditional lighting technology such as harmful ultraviolet rays and undetectable flickering, which causes eye-strain and headaches.

Replacing traditional lamps is not only a way to save on your electric bill, but will also provide better light quality and reduce your environmental impact.

"Get More from LESS"

Lite Energy Solutions, Inc. 909 S Main St Ste 216 Salisbury, NC 28144 Office: (704) 932-0573 Fax: (704) 210-8012

6.2 Retrofit Custom Incentives

The Energy Efficiency for Business Program offers custom incentives for eligible improvements not listed as prescriptive measures. Measures listed in prescriptive tables that do not meet minimum program specifications cannot be submitted as a custom measure. Qualified custom ECMs reduce electric energy use due to an improvement in system efficiency, i.e. a net decrease in energy use without a reduction in the level of service. For example, installing a lower wattage lamp in place of a higher wattage lamp of the same type does not qualify for a custom incentive. However should the lighting *system* (i.e., lamp, ballast and fixture) demonstrably improve the total lumens per Watt delivered, an incentive will be considered.

Examples of custom measures include, but are not limited to, the following:

- Economizers – air side or water-side
- Energy Star® solid door commercial freezers
- High Intensity Discharge (HID) or fluorescent light fixture improvements not covered under the prescriptive measures
- Variable frequency drives on non-HVAC pump and fan motors serving variable-capacity loads, such as air compressors, pumps, fans, blowers, process chillers and cooling towers.
- Automatic controls, including time switches, sensors, etc.
- Day lighting or light harvesting, when combined with appropriate lighting controls.
- Building envelope improvements (windows, window films, solar screens, cool roofs, etc.)[2].
- Improved process efficiency.
- Compressed air system improvements.
- LED lighting fixtures or retrofit packages.

Incentives for custom measures are based on the electrical energy savings that result from the energy efficiency measure installation and are based upon the calculated annual kWh savings. The applicant must provide sufficient back-up descriptive information, equipment performance data, operating assumptions, measurements, calculations and models to support the energy savings estimates. Guidelines for calculating custom measure energy savings are detailed in **Section 16**.

The Custom incentive shown in Table 6-5 is based on the expected life of the measure. Custom projects eligible for an incentive must have a payback period ≥ one year and ≤ 7 years to qualify for a $0.08 per kWh incentive. Project simplified payback is calculated as follows:

$$\text{Simplified Payback Period} = \frac{\text{Project Cost}}{\text{Annual Energy Savings (kWh)} \times \text{Electricity Rate (\$/kWh)}}$$

[2] Only if facility has electric cooling or heating present.

Table 6-5
Custom Incentives

Incentive	**$0.08 / kWh**[3]
Minimum Payback Period	**One year**
Maximum Payback Period	**7 years**

All Custom incentive applications are subject to the Program's review and analysis. Incentive payments for custom ECMs are capped at 75% of the incremental cost of the measure[4].

6.3 Retrofit Technical Assistance Incentives

The program offers technical assistance incentives for ECMs in qualified existing facilities (retrofit) that may result in sustained energy efficiency improvements. Incentive types, values and limits described in this section are based upon task scope and anticipated outcomes. A detailed work scope of technical assistance activities and costs should be submitted for review and pre-approval to qualify for any technical assistance incentives.

Technical assistance incentives are intended to assist with the initial cost of identifying ECMs and may be combined with Prescriptive and Custom incentive offerings.

Retrofit technical assistance incentives are available for, but not limited to: **feasibility studies, energy assessments** and **retro-commissioning**. **Sections 6.3.1 and 6.3.2** briefly summarize the project requirements associated with each service type and both are intended to provide information and assistance to customers towards implementing ECMs at existing facilities.

All technical assistance incentive payments should be considered "one-time" payments for each Facility during a three year period. These incentives are issued to applicants that agree to implement cost effective ECMs in a timely manner. Failure to implement these ECMs in a timely manner constitutes a forfeit of any future technical assistance incentives until cost effective ECMs are investigated further and/or implemented.

Incentives for qualified retrofit Technical Assistance will be 50% of the total technical assistance costs associated directly with electrical energy savings efforts and will be capped at $10,000 for facilities that use 500,000 kWh to 2,000,000 kWh annually. The cap is increased to $20,000 for facilities who use over 2,000,000 kWh annually. Facilities currently using less than 500,000 kWh annually do not qualify for Retrofit Technical Assistance incentives.

6.3.1 Retrofit Technical Assistance Feasibility Study/Energy Assessment

A feasibility study consists of a detailed engineering analysis to investigate the economics and technical feasibility of one or more ECM options. For purposes of this program, this includes comprehensive energy audits and technology feasibility studies.

A qualified service provider must produce a concise written report detailing the study findings, methodology and supporting documentation. The customer must submit the report plus an Energy Efficiency for Business Program application and copy of the paid invoice.

[3] Incentive is a one-time payment for the value shown multiplied by the annual energy savings for a one year period.
[4] Incremental measure cost is the difference in the cost of energy efficient measure and standard efficient measure. In some cases the incremental measure cost is the full cost of the measure.

APPENDIX D

Lite Energy Solutions

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Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	STAIRS + MECH EMERGENCY	Net 30	100812-14

Item Number	Description	Qty	Total
T8/T12 REPLACEMENTS			
4T8-15W-D	4 FOOT LED DAYWHITE - 1600 LM+ - 5500K	**80**	$ 5,360.00
CIRCULAR FLUORESCENT			
THERE ARE CURRENTLY NO DIRECT REPLACEMENTS FOR THIS PRODUCT IN LED OPTIONS ARE TO LEAVE AS IS OR REPLACE WITH A NEW LED FIXTURE.			
	Total Amount	**$**	**5,360.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

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APPENDIX D

STAIRWAYS & MECHANICAL LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
2 Lamp 4' T12	40	155	6.200	1.200	168.0	52	8760	54,312	10,512	43,800	$4,143.07	$801.89	$3,341.19	$26,061.27
										Subtotal	$4,143.07	$801.89	$3,341.19	**$26,061.27**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
2 Lamp 4' T12	40	34	$2.50	$200.00	1.3	9.1	$1,400	$4,200	$65.00	10	$2,600.00	$1,200.00	$1,032.97	$9,400.00
													$1,032.97	**$9,400.00**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
Annual KWH Rate			$0.0763

Total Cost	**$**	**5,360.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**4,374.15**
Total First Year Savings	**$**	**4,374.15**
Remaining Energy & Maintenance Savings	**$**	**35,430.65**
Total Savings on Investment	**$**	**39,804.81**
Payback (Years)		**1.23**
Return on Investment		**643%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Quote # 1000812-01

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Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	ELEVATORS AND LOBBIES	Net 30	100812-13

Item Number	Description	Qty		Total
T8/T12 REPLACEMENTS				
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**54**	$	3,618.00
CFL/HALOGEN LED REPLACEMENTS				
MR16-3W-W-DM	3 WATT MR16 WARM WHITE - 200LM+, 2800K	**83**	$	3,237.00
		Total Amount	**$**	**6,855.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

APPENDIX D

ELEVATORS & LOBBIES LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
2 Lamp 4' T12	27	155	4.185	0.810	**168.0**	**52**	8760	36,661	7,096	29,565	$2,796.57	$541.27	$2,255.30	$17,591.35
CFL / Halogen	83	19.15	1.589	0.249	**168.0**	**52**	8760	13,924	2,181	11,742	$1,062.13	$166.39	$895.74	$7,524.21
										Subtotal	$3,858.70	$707.66	$3,151.04	**$25,115.56**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
2 Lamp 4' T12	27	34	$2.50	$135.00	1.3	9.1	$945	$2,835	$65.00	10	$1,755.00	$810.00	$697.25	$6,345.00
CFL / Halogen	83	Varies	$5.00	$415.00	0.7	9.1	$5,395	$16,185	$0.00	10	$0.00	$0.00	$2,371.43	$21,580.00
													$3,068.68	**$27,925.00**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
		Annual KWH Rate	$0.0763

Total Cost	**$**	**6,855.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**6,219.72**
Total First Year Savings	**$**	**6,219.72**
Remaining Energy & Maintenance Savings	**$**	**50,379.75**
Total Savings on Investment	**$**	**56,599.47**
Payback (Years)		**1.10**
Return on Investment		**726%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

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Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	EMERGENCY LIGHTS	Net 30	100812-15

Item Number	Description	Qty		Total
T8/T12 REPLACEMENTS				
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**540**	$	36,180.00

Total Amount $ 36,180.00

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

APPENDIX D

EMERGENCY LIGHTS LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
4 Lamp 4' T12	135	223	30.105	8.100	168.0	52	8760	263,720	70,956	192,764	$20,117.29	$5,412.72	$14,704.57	$114,695.63
										Subtotal	$20,117.29	$5,412.72	$14,704.57	**$114,695.63**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
4 Lamp 4' T12	135	34	$2.50	$1,350.00	1.3	9.1	$9,450	$14,175	$65.00	10	$8,775.00	$4,050.00	$4,005.49	$36,450.00
													$4,005.49	**$36,450.00**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
		Annual KWH Rate	$0.0763

Total Cost	**$**	**36,180.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**18,710.06**
Total First Year Savings	**$**	**18,710.06**
Remaining Energy & Maintenance Savings	**$**	**151,551.51**
Total Savings on Investment	**$**	**170,261.57**
Payback (Years)		**1.93**
Return on Investment		**371%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Quote # 1000812-01

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
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APPENDIX D

Lite Energy Solutions

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www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	MECHANICAL	Net 30	100812-01

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-D	4 FOOT LED DAYWHITE - 1600 LM+ - 5500K	34	$	2,278.00
	INCANDESCENT LED REPLACEMENT			
A19-6W-D-DM	6 WATT A19 DIMMABLE DAY WHITE 475LM+, 5500K	4	$	208.00
		Total Amount	**$**	**2,486.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

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APPENDIX D

MECHANICAL ROOM LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
2 Lamp 4' T12	17	155	2.635	0.510	**168.0**	**52**	8760	23,083	4,468	18,615	$1,760.81	$340.80	$1,420.00	$11,076.04
60W A19	4	240	0.960	0.024	**168.0**	**52**	8760	8,410	210	8,199	$641.51	$16.04	$625.47	$5,253.95
										Subtotal	$2,402.31	$356.84	$2,045.48	**$16,329.99**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
2 Lamp 4' T12	17	34	$2.50	$85.00	1.3	9.1	$595	$1,785	$65.00	10	$1,105.00	$510.00	$439.01	$3,995.00
60W A19	4	60	$1.00	$4.00	0.7	9.1	$52	$780	$0.00	10	$0.00	$0.00	$91.43	$832.00
													$530.44	**$4,827.00**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**2,486.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**2,575.91**
Total First Year Savings	**$**	**2,575.91**
Remaining Energy & Maintenance Savings	**$**	**20,864.91**
Total Savings on Investment	**$**	**23,440.82**
Payback (Years)		**0.97**
Return on Investment		**843%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Quote # 1000812-01

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	GROUND FLOOR	Net 30	100812-03

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**130**	$	8,710.00
	METAL HALIDE LEDREPLACEMENT			
PAR38-15-W	15 WATT PAR 38 WARM WHITE, NON-DIMMABLE 1000LM+ - 2800K	**4**	$	328.00
		Total Amount	**$**	**9,038.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

GROUND FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
2 Lamp 4' T8	4	64	0.256	0.120	**55.0**	**52**	2868	734	344	390	$56.00	$26.25	$29.75	$717.03
2 Lamp 4' T12	3	155	0.465	0.090	**55.0**	**52**	2868	1,334	258	1,075	$101.73	$19.69	$82.04	$1,977.12
4 Lamp 4' T12	29	223	6.467	0.870	**55.0**	**52**	2868	18,546	2,495	16,051	$1,414.77	$190.33	$1,224.45	$29,509.15
175W MH	4	207	0.828	0.060	**168.0**	**52**	8760	7,253	526	6,728	$553.30	$40.09	$513.21	$4,208.29
										Subtotal	$2,125.81	$276.36	$1,849.44	**$36,411.59**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
2 Lamp 4' T8	4	32	$2.50	$20.00	3.8	27.9	$147	$441	$65.00	10	$260.00	$120.00	$34.67	$967.37
2 Lamp 4' T12	3	34	$2.50	$15.00	3.8	27.9	$110	$330	$65.00	10	$195.00	$90.00	$26.00	$725.53
4 Lamp 4' T12	29	34	$2.50	$290.00	3.8	27.9	$2,129	$3,194	$65.00	10	$1,885.00	$870.00	$289.53	$8,078.03
175W MH	4	13	$35.00	$140.00	0.9	9.1	$1,416	$607	$75.00	10	$300.00	$9,000.00	$1,244.20	$11,322.22
													$1,594.41	**$21,093.14**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**9,038.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**3,443.86**
Total First Year Savings	**$**	**3,443.86**
Remaining Energy & Maintenance Savings	**$**	**92,639.71**
Total Savings on Investment	**$**	**96,083.57**
Payback (Years)		**2.62**
Return on Investment		**963%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

Project: One Exchange Plaza

Quote # 1000812-01

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	MEZZANINE	Net 30	100812-04

Item Number	Description	Qty		Total
T8/T12 REPLACEMENTS				
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	167	$	11,189.00
2T8-8W-N	2 FOOT NATURAL WHITE - 800LM+, 4100K	2	$	98.00
U SHAPE LED REPLACEMENTS				
2T8-8W-N-U	2 FOOT, 15 WATTS, 1400 LUMENS, 4100K	66	$	4,422.00
CFL LED REPLACEMENTS				
PAR38-12-WDM	12 WATT PAR 38 DIMMABLE WARM WHITE, 800LM+, 2800K	12	$	912.00
		Total Amount	**$**	**16,621.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

MEZZANINE LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
4 Lamp 4' T8	48	128	6.144	1.440	55.0	52	2868	17,620	4,130	13,490	$1,344.11	$315.03	$1,029.09	$24,800.97
2 Lamp 4' T12	11	155	1.705	0.330	55.0	52	2868	4,890	946	3,943	$373.00	$72.19	$300.81	$7,249.43
1 Lamp 4' T12	1	78	0.078	0.030	55.0	52	2868	224	86	138	$17.06	$6.56	$10.50	$253.07
2 Lamp 2' T12	1	64	0.064	0.015	55.0	52	2868	184	43	141	$14.00	$3.28	$10.72	$258.34
U Lamp 2' T8	33	64	2.112	0.990	55.0	52	2868	6,057	2,839	3,218	$446.88	$209.47	$237.40	$5,721.40
23W CFL	12	23	0.276	0.144	55.0	52	2868	792	413	379	$58.40	$30.47	$27.93	$701.04
										Subtotal	$2,253.45	$637.01	$1,616.44	**$38,984.25**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
4 Lamp 4' T8	48	32	$2.50	$480.00	3.8	27.9	$3,524	$5,286	$65.00	10	$3,120.00	$1,440.00	$479.23	$13,370.53
2 Lamp 4' T12	11	34	$2.50	$55.00	3.8	27.9	$404	$1,211	$65.00	10	$715.00	$330.00	$95.35	$2,660.26
1 Lamp 4' T12	1	34	$2.50	$2.50	3.8	27.9	$18	$110	$65.00	10	$65.00	$30.00	$8.01	$223.49
2 Lamp 2' T12	1	20	$2.50	$5.00	3.8	27.9	$37	$110	$65.00	10	$65.00	$30.00	$8.67	$241.84
U Lamp 2' T8	33	32	$2.50	$165.00	3.8	27.9	$1,211	$3,634	$65.00	10	$2,145.00	$990.00	$286.05	$7,980.79
23W CFL	12	23	$5.00	$60.00	2.8	27.9	$598	$1,794	$0.00	10	$0.00	$0.00	$85.71	$2,391.43
													$963.02	**$26,868.34**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**16,621.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**2,579.47**
Total First Year Savings	**$**	**2,579.47**
Remaining Energy & Maintenance Savings	**$**	**69,387.68**
Total Savings on Investment	**$**	**71,967.15**
Payback (Years)		**6.44**
Return on Investment		**333%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	3RD FLOOR	Net 30	100812-05

Item Number	Description	Qty	Total
	T8/T12 REPLACEMENTS		
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**384**	$ 25,728.00
	U SHAPE LED REPLACEMENTS		
2T8-8W-N-U	2 FOOT, 15 WATTS, 1400 LUMENS, 4100K	**158**	$10,586.00
		Total Amount	**$ 36,314.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

APPENDIX D

3RD FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
4 Lamp 4' T8	91	128	11.648	5.460	**55.0**	**52**	2868	33,405	15,658	17,746	$2,548.21	$1,194.47	$1,353.74	$32,625.08
2 Lamp 4' T12	10	155	1.550	0.300	**55.0**	**52**	2868	4,445	860	3,585	$339.09	$65.63	$273.46	$6,590.39
U-Lamp 2' T8	79	64	5.056	2.370	**55.0**	**52**	2868	14,500	6,797	7,703	$1,106.09	$518.48	$587.61	$14,161.44
										Subtotal	$3,993.40	$1,778.59	$2,214.81	**$53,376.92**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
4 Lamp 4' T8	91	32	$2.50	$910.00	3.8	27.9	$6,681	$10,022	$65.00	10	$5,915.00	$2,730.00	$908.54	$25,348.29
2 Lamp 4' T12	10	34	$2.50	$50.00	3.8	27.9	$367	$1,101	$65.00	10	$650.00	$300.00	$86.68	$2,418.42
U-Lamp 2' T8	79	32	$2.50	$197.50	3.8	27.9	$1,450	$8,700	$65.00	10	$5,135.00	$2,370.00	$632.81	$17,655.46
													$1,628.03	**$45,422.17**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**36,314.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**3,842.84**
Total First Year Savings	**$**	**3,842.84**
Remaining Energy & Maintenance Savings	**$**	**103,372.52**
Total Savings on Investment	**$**	**107,215.36**
Payback (Years)		**9.45**
Return on Investment		**195%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

Quote # 1000812-01

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	4TH FLOOR	Net 30	100812-06

Item Number	Description	Qty	Total
	T8/T12 REPLACEMENTS		
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**315**	$ 21,105.00
	U SHAPE LED REPLACEMENTS		
2T8-8W-N-U	2 FOOT, 15 WATTS, 1400 LUMENS, 4100K	**154**	$10,318.00
		Total Amount	**$ 31,423.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

APPENDIX D

4TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
4 Lamp 4' T8	71	128	9.088	4.260	**55.0**	**52**	2868	26,063	12,217	13,846	$1,988.17	$931.95	$1,056.21	$25,454.74
2 Lamp 4' T12	15	155	2.325	0.450	**55.0**	**52**	2868	6,668	1,291	5,377	$508.64	$98.45	$410.19	$9,885.59
U-Lamp 2' T8	77	64	4.928	2.310	**55.0**	**52**	2868	14,133	6,625	7,508	$1,078.09	$505.35	$572.74	$13,802.92
										Subtotal	$3,574.89	$1,535.75	$2,039.14	**$49,143.25**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
4 Lamp 4' T8	71	32	$2.50	$710.00	3.8	27.9	$5,213	$7,819	$65.00	10	$4,615.00	$2,130.00	$708.86	$19,777.24
2 Lamp 4' T12	15	34	$2.50	$75.00	3.8	27.9	$551	$1,652	$65.00	10	$975.00	$450.00	$130.02	$3,627.63
U-Lamp 2' T8	77	20	$2.50	$192.50	3.8	27.9	$1,413	$8,480	$65.00	10	$5,005.00	$2,310.00	$616.79	$17,208.49
													$1,455.68	**$40,613.36**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**31,423.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**3,494.81**
Total First Year Savings	**$**	**3,494.81**
Remaining Energy & Maintenance Savings	**$**	**94,010.52**
Total Savings on Investment	**$**	**97,505.33**
Payback (Years)		**8.99**
Return on Investment		**210%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

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APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	5TH FLOOR	Net 30	100812-07

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**502**	$	33,634.00
	U SHAPE LED REPLACEMENTS			
2T8-8W-N-U	2 FOOT, 15 WATTS, 1400 LUMENS, 4100K	**2**		$134.00
	CFL LED REPLACEMENT			
PL9W-N	P WALL 2-PRONG NATURAL WHITE - 920L+, 4100K	**8**	$	352.00
		Total Amount	**$**	**34,120.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

APPENDIX D

5TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
4 Lamp 4' T12	100	223	22.300	6.000	55.0	52	2868	63,953	17,207	46,746	$4,878.53	$1,312.61	$3,565.92	$85,938.73
3 Lamp 4' T12	32	189	6.048	1.440	55.0	52	2868	17,345	4,130	13,215	$1,323.11	$315.03	$1,008.08	$24,294.83
2 Lamp 4' T12	3	155	0.465	0.090	55.0	52	2868	1,334	258	1,075	$101.73	$19.69	$82.04	$1,977.12
U-Lamp 2' T12	1	155	0.155	0.030	55.0	52	2868	445	86	358	$33.91	$6.56	$27.35	$659.04
13W CFL	8	13	0.104	0.072	55.0	52	2868	298	206	92	$22.75	$15.75	$7.00	$175.71
										Subtotal	$6,360.03	$1,669.64	$4,690.39	**$113,045.43**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
4 Lamp 4' T12	100	34	$2.50	$1,000.00	3.8	27.9	$7,342	$11,013	$65.00	10	$6,500.00	$3,000.00	$998.40	$27,855.26
3 Lamp 4' T12	32	34	$2.50	$240.00	3.8	27.9	$1,762	$3,524	$65.00	10	$2,080.00	$960.00	$298.43	$8,326.32
2 Lamp 4' T12	3	34	$2.50	$15.00	3.8	27.9	$110	$330	$65.00	10	$195.00	$90.00	$26.00	$725.53
U-Lamp 2' T12	1	34	$2.50	$5.00	3.8	27.9	$37	$110	$65.00	10	$65.00	$30.00	$8.67	$241.84
13W CFL	8	13	$5.00	$40.00	2.8	27.9	$399	$1,196	$0.00	10	$0.00	$0.00	$57.14	$1,594.29
													$1,388.65	**$38,743.23**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**34,120.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**6,079.04**
Total First Year Savings	**$**	**6,079.04**
Remaining Energy & Maintenance Savings	**$**	**163,526.11**
Total Savings on Investment	**$**	**169,605.15**
Payback (Years)		**5.61**
Return on Investment		**397%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
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www.liteenergysolutions.com

Project: One Exchange Plaza

Quote # 1000812-01

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	6TH FLOOR	Net 30	100812-08

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**516**	$	34,572.00
		Total Amount	**$**	**34,572.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

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APPENDIX D

6TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
4 Lamp 4' T12	125	223	27.875	7.500	55.0	52	2868	79,942	21,509	58,433	$6,098.17	$1,640.76	$4,457.40	$107,423.42
3 Lamp 4' T12	0	189	0.000	0.000	55.0	52	2868	0	0	0	$0.00	$0.00	$0.00	$0.00
2 Lamp 4' T12	8	155	1.240	0.240	55.0	52	2868	3,556	688	2,868	$271.27	$52.50	$218.77	$5,272.31
										Subtotal	$6,369.44	$1,693.27	$4,676.17	**$112,695.73**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
4 Lamp 4' T12	125	34	$2.50	$1,250.00	3.8	27.9	$9,178	$13,766	$65.00	10	$8,125.00	$3,750.00	$1,248.00	$34,819.08
3 Lamp 4' T12	0	34	$2.50	$0.00	3.8	27.9	$0	$0	$65.00	10	$0.00	$0.00	$0.00	$0.00
2 Lamp 4' T12	8	34	$2.50	$40.00	3.8	27.9	$294	$881	$65.00	10	$520.00	$240.00	$69.35	$1,934.74
													$1,317.34	**$36,753.82**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
Annual KWH Rate			$0.0763

Total Cost	**$**	**34,572.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**5,993.51**
Total First Year Savings	**$**	**5,993.51**
Remaining Energy & Maintenance Savings	**$**	**161,225.49**
Total Savings on Investment	**$**	**167,219.00**
Payback (Years)		**5.77**
Return on Investment		**384%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Quote # 1000812-01

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	7TH FLOOR	Net 30	100812-09

Item Number	Description	Qty	Total
	T8/T12 REPLACEMENTS		
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**507**	$ 33,969.00

Total Amount $ 33,969.00

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

7TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
4 Lamp 4' T12	120	223	26.760	7.200	**55.0**	**52**	2868	76,744	20,649	56,095	$5,854.24	$1,575.13	$4,279.11	$103,126.48
3 Lamp 4' T12	0	189	0.000	0.000	**55.0**	**52**	2868	0	0	0	$0.00	$0.00	$0.00	$0.00
2 Lamp 4' T12	14	155	2.170	0.420	**55.0**	**52**	2868	6,223	1,204	5,019	$474.73	$91.88	$382.84	$9,226.55
										Subtotal	$6,328.97	$1,667.01	$4,661.95	**$112,353.03**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
4 Lamp 4' T12	120	34	$2.50	$1,200.00	3.8	27.9	$8,811	$13,216	$65.00	10	$7,800.00	$3,600.00	$1,198.08	$33,426.32
3 Lamp 4' T12	0	34	$2.50	$0.00	3.8	27.9	$0	$0	$65.00	10	$0.00	$0.00	$0.00	$0.00
2 Lamp 4' T12	14	34	$2.50	$70.00	3.8	27.9	$514	$1,542	$65.00	10	$910.00	$420.00	$121.35	$3,385.79
													$1,319.43	**$36,812.11**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
Annual KWH Rate			$0.0763

Total Cost	**$**	**33,969.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**5,981.38**
Total First Year Savings	**$**	**5,981.38**
Remaining Energy & Maintenance Savings	**$**	**160,899.17**
Total Savings on Investment	**$**	**166,880.55**
Payback (Years)		**5.68**
Return on Investment		**391%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Quote # 1000812-01

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APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	8TH FLOOR	Net 30	100812-10

Item Number	Description	Qty	Total
	T8/T12 REPLACEMENTS		
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**404**	$ 27,068.00
	CFL LED REPLACEMENTS		
PAR38-12-WDM	12 WATT PAR 38 DIMMABLE WARM WHITE, 800 LM+ - 2800K	**28**	$2,128.00
		Total Amount	**$ 29,196.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

8TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
4 Lamp 4' T8	15	128	1.920	0.900	55.0	52	2868	5,506	2,581	2,925	$420.04	$196.89	$223.14	$0.00
4 Lamp 4' T12	82	223	18.286	4.920	55.0	52	2868	52,442	14,110	38,332	$4,000.40	$1,076.34	$2,924.06	$70,469.76
2 Lamp 4' T12	8	155	1.240	0.240	55.0	52	2868	3,556	688	2,868	$294.35	$56.97	$237.38	$5,720.81
23W CFL	28	23	0.644	0.336	55.0	52	2868	1,847	964	883	$145.88	$76.11	$69.77	$0.00
										Subtotal	$4,440.62	$1,209.42	$3,231.20	**$76,190.57**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
4 Lamp 4' T8	15	32	$2.50	$150.00	3.8	27.9	$1,101	$1,652	$65.00	10	$975.00	$450.00	$149.76	$4,178.29
4 Lamp 4' T12	82	34	$2.50	$820.00	3.8	27.9	$6,021	$9,031	$65.00	10	$5,330.00	$2,460.00	$818.69	$22,841.32
2 Lamp 4' T12	8	34	$2.50	$60.00	3.8	27.9	$441	$881	$65.00	10	$520.00	$240.00	$74.61	$2,081.58
23W CFL	28	23	$5.00	$140.00	2.8	27.9	$1,395	$4,185	$0.00	10	$0.00	$0.00	$200.00	$5,580.00
													$1,093.29	**$30,502.89**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**29,196.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**4,324.50**
Total First Year Savings	**$**	**4,324.50**
Remaining Energy & Maintenance Savings	**$**	**116,328.93**
Total Savings on Investment	**$**	**120,653.42**
Payback (Years)		**6.75**
Return on Investment		**313%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
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www.liteenergysolutions.com

Project: One Exchange Plaza

Quote # 1000812-01

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	9TH FLOOR	Net 30	100812-11

Item Number	Description	Qty	Total
	T8/T12 REPLACEMENTS		
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**410**	$ 24,470.00
		Total Amount	**$ 24,470.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

9TH FLOOR LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
3 Lamp 4' T8	8	96	0.768	0.360	**55.0**	**52**	2868	2,203	1,032	1,170	$168.01	$78.76	$89.26	$2,151.10
4 Lamp 4' T12	92	223	20.516	5.520	**55.0**	**52**	2868	58,837	15,831	43,006	$4,488.25	$1,207.60	$3,280.65	$79,063.63
2 Lamp 4' T12	9	155	1.395	0.270	**55.0**	**52**	2868	4,001	774	3,226	$331.14	$64.09	$267.05	$6,435.91
										Subtotal	$4,987.41	$1,350.45	$3,636.96	**$87,650.65**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
3 Lamp 4' T8	8	32	$2.50	$60.00	3.8	27.9	$441	$881	$65.00	10	$520.00	$240.00	$74.61	$2,081.58
4 Lamp 4' T12	92	34	$2.50	$920.00	3.8	27.9	$6,755	$10,132	$65.00	10	$5,980.00	$2,760.00	$918.52	$25,626.84
2 Lamp 4' T12	9	34	$2.50	$67.50	3.8	27.9	$496	$991	$65.00	10	$585.00	$270.00	$83.93	$2,341.78
													$1,077.07	**$30,050.20**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**24,470.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**4,714.02**
Total First Year Savings	**$**	**4,714.02**
Remaining Energy & Maintenance Savings	**$**	**126,807.26**
Total Savings on Investment	**$**	**131,521.28**
Payback (Years)		**5.19**
Return on Investment		**437%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	10TH FLOOR	Net 30	100812-12

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	372	$	24,924.00
	CFL LED REPLACEMENTS			
PAR38-12-WDM	12 WATT PAR 38 DIMMABLE WARM WHITE, 800 LM+ - 2800K	44		$3,344.00
	INCANDESCENT LED REPLACEMENT			
A19-6W-W-DM	6 WATT A19 DIMMABLE WARM WHITE - 475LM+, 2800K	1	$	52.00
		Total Amount	**$**	**28,320.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082 Office: (704) 932-0573 Fax: (704) 932-7830

APPENDIX D

10TH FLOOR LED ROI WORKSHEET

Energy Savings20

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	TOTAL ENERGY SAVINGS
3 Lamp 4' T8	20	96	1.920	0.900	55.0	52	2868	5,506	2,581	2,925	$420.04	$196.89	$223.14	$5,377.76
4 Lamp 4' T12	74	223	16.502	4.440	55.0	52	2868	47,325	12,733	34,592	$3,610.11	$971.33	$2,638.78	$63,594.66
2 Lamp 4' T12	8	155	1.240	0.240	55.0	52	2868	3,556	688	2,868	$294.35	$56.97	$237.38	$5,720.81
23W CFL	44	23	1.012	0.528	55.0	52	2868	2,902	1,514	1,388	$229.24	$119.60	$109.63	$2,751.82
60W A19	1	60	0.060	0.006	55.0	52	2868	172	17	155	$13.59	$1.36	$12.23	$315.58
										Subtotal	$4,567.32	$1,346.15	$3,221.17	**$77,760.63**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	Total Maintenance Savings
3 Lamp 4' T8	20	32	$2.50	$150.00	3.8	27.9	$1,101	$2,203	$65.00	10	$1,300.00	$600.00	$186.52	$5,203.95
4 Lamp 4' T12	74	34	$2.50	$740.00	3.8	27.9	$5,433	$8,150	$65.00	10	$4,810.00	$2,220.00	$738.81	$20,612.89
2 Lamp 4' T12	8	34	$2.50	$60.00	3.8	27.9	$441	$881	$65.00	10	$520.00	$240.00	$74.61	$2,081.58
23W CFL	44	23	$5.00	$220.00	2.8	27.9	$2,192	$6,576	$0.00	10	$0.00	$0.00	$314.29	$8,768.57
60W A19	1	60	$1.00	$3.00	2.1	27.9	$40	$199	$0.00	10	$0.00	$0.00	$8.57	$239.14
													$1,322.80	**$36,906.14**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**28,320.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings		**$4,543.97**
Total First Year Savings	**$**	**4,543.97**
Remaining Energy & Maintenance Savings	**$**	**122,232.82**
Total Savings on Investment	**$**	**126,776.79**
Payback (Years)		**6.23**
Return on Investment		**348%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

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Project: One Exchange Plaza

Quote # 1000812-01

APPENDIX D

Lite Energy Solutions

Specializing in Efficient Lighting Technologies

www.LiteEnergySolutions.com

Customer:	One Exchange Plaza	Contact Person:	Matt Jentgen
Address:		Phone Number:	502-664-6541
City, ST Zip:	Raleigh, NC	E-mail Address:	matt.jentgen@raleighnc.gov

Date	FOB	Project Reference	Terms	Quote Number
8/12/2010	Manufacturer	BASEMENT	Net 30	100812-02

Item Number	Description	Qty		Total
	T8/T12 REPLACEMENTS			
4T8-15W-N	4 FOOT NATURAL WHITE - 1600LM+ - 4100K	**240**	$	16,080.00
	CFL LED REPLACEMENTS			
PAR30-9-WWDM	9 WATT PAR 30 DIMMABLE WARM WHITE 600LM+ - 2800K	**8**	$	520.00
		Total Amount	**$**	**16,600.00**

Thank You for the opportunity to provide this quotation for our quality products and services.

Price does not include freight or applicable sales tax. Quote valid for 30-days.

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APPENDIX D

BASEMENT LED ROI WORKSHEET

Energy Savings

Fixture Type	Total # Fixtures	Watts/ Fixture	Total KW Used	Total LED KW	Wkly Hours "ON"	Wks/Yr	Annual Hours "ON"	Current Annual KWH	LED Annual KWH	Annual KWH SAVED	Current Energy Costs	LED Energy Costs	Annual Energy Savings	**TOTAL ENERGY SAVINGS**
2 Lamp 4' T8	11	64	0.704	0.330	**168.0**	**52**	8760	6,167	2,891	3,276	$470.44	$220.52	$249.92	$1,949.38
2 Lamp 4' T12	5	155	0.775	0.150	**168.0**	**52**	8760	6,789	1,314	5,475	$517.88	$100.24	$417.65	$3,257.66
4 Lamp 4' T12	52	223	11.596	1.560	**168.0**	**52**	8760	101,581	13,666	87,915	$7,748.88	$1,042.45	$6,706.43	$52,310.17
13W CFL	8	13	0.104	0.072	**168.0**	**52**	8760	911	631	280	$69.50	$48.11	$21.38	$175.35
										Subtotal	$8,806.70	$1,411.32	$7,395.39	**$57,692.56**

Bulb, Ballast and Maintenance Savings

Fixture Type	Total # Fixtures	Lamp Rating	Cost/Lamp	Total Lamp Cost	Life Cycle (yrs)	LED Life Cycle (yrs)	Re-Lamp Savings	Re-Lamp Labor ($15/Fixt.)	Ballast Costs	Life Cycle (yrs)	Ballast Savings	Ballast Labor ($30/fixt)	Annual Maint. Savings	**Total Maintenance Savings**
2 Lamp 4' T8	11	32	$2.50	$55.00	1.3	9.1	$385	$1,155	$65.00	10	$715.00	$330.00	$284.07	$2,585.00
2 Lamp 4' T12	5	34	$2.50	$25.00	1.3	9.1	$175	$525	$65.00	10	$325.00	$150.00	$129.12	$1,175.00
4 Lamp 4' T12	52	34	$2.50	$520.00	1.3	9.1	$3,640	$5,460	$65.00	10	$3,380.00	$1,560.00	$1,542.86	$14,040.00
13W CFL	8	13	$5.00	$40.00	0.9	9.1	$404	$1,213	$0.00	10	$0.00	$0.00	$177.78	$1,617.78
													$2,133.82	**$19,417.78**

Complete Utiltiy Rate Calculator

Month	Total KWH	Total Bill Amount	Avg KWH Rate
Jan	301500	$20,983	$0.0696
April	210750	$15,549	$0.0738
July	245250	$19,371	$0.0790
Oct	199500	$16,513	$0.0828
	Annual KWH Rate		$0.0763

Total Cost	**$**	**16,600.00**
First Year Tax Savings	**$**	**-**
Annual Energy & Maintenance Savings	**$**	**9,529.21**
Total First Year Savings	**$**	**9,529.21**
Remaining Energy & Maintenance Savings	**$**	**77,186.58**
Total Savings on Investment	**$**	**86,715.78**
Payback (Years)		**1.74**
Return on Investment		**422%**

*Note: Additional Tax Incentives and Rebates may be available. Please consult your tax accountant for additional information.

Project: One Exchange Plaza

Lite Energy Solutions, Inc. PO Box 1330 Kannapolis, NC 28082
Office: (704) 932-0573 Fax: (704) 932-7830
www.liteenergysolutions.com

Quote # 1000812-01

THE ENGLISH ELECTRIC CORPORATION
102 MIDLAND AVENUE
PORT CHESTER, NEW YORK 10573

TELEPHONE (914) 937-7450

Telex No. 137376
Fax No. (914) 937-7450

APPENDIX E

DATE: Oct. 16, 1985

Job Ref: Raleigh Federal Savings & Loan

EQ/NO: 3837

Location/Unit No.	SF- 1 & 2	RF- 3 & 4
Quantity	two (2)	two (2)
Performance Required	62,500 cfm at 7"SP	53,125 cfm at 4" SP
Fan Type	varofoil	varofoil
Code No.	125JG-56A-4-9 D250MP	125JG-56A-4-6 D200/46
Electrical Supply	480/3/60	480/3/60
RPM	1765	1765
Volume Flow, CFM	62,500	53,125
Pressure, Inches SP	7" (6.45" with cone)	4"
Pressure, Inches TP	8.3"(7.85" with cone)	5"
Pitch Angle	22 degrees	16 degrees
Total Efficiency	77 %	83.5 %
BHP (Absorbed)	90	50
Motor HP Rating	100 Nema B	60 Nema B
Sound Power Level, db (10-12 Watts)	117	114
SWL, Spectrum, db	105/107/113/111/109/105/99/93	104/107/109/107/106/102/96/90
Form of Running	b	b
Bearings	ball	ball
Special Features	controllable pitch	controllable pitch
Accessories	Inlet bell/screen flexible connectors & clips pilot positioner pneumatic actuator Mt. ft.	Pilot positioner pneumatic operator Mt. ft. flexible connectors & clips
Full Load/Starting Amps	114/780	73/500

Table 6-2
Prescriptive HVAC Incentives

Equipment Type	Size Category	Qualifying Efficiency	Incentive (per ton)
Unitary and Split Air Conditioning Units and Air Source Heat Pumps	< 65,000 Btuh (5.4 Tons)	14 SEER	$25
		15 SEER	$45
	≥ 65,000 Btuh (5.4 Tons) and <240,000 Btuh (20 Tons)	11.5 EER	$30
		12 EER	$55
	≥240,000 Btuh (20 Tons) and <760,000 Btuh (63.3 Tons)	10.5 EER	$30
		10.8 EER	$55
	≥ 760,000 Btuh (63.3 Tons)	9.7 EER	$30
		10.2 EER	$55
Water-Cooled Chillers[1]	ALL	Level 1 (see Section 11.2)	$18
		Level 2 (see Section 11.2)	$35
Air-Cooled Chillers	ALL	1.04 kW / ton-IPLV	$35
Room Air Conditioners	ALL	Level 1 (see Section 11.3)	$25
		Level 2 (see Section 11.3)	$45
PTAC	ALL	13.08-(0.2556 x Btuh / 1000) EER	$30
Equipment Type	**Incentive**		
Variable Speed Drive (VSD) on HVAC Fan and Pump Motors[2]	$45.00 / HP		

[1] Single pass water cooled chillers (& other equipment) do not qualify for an incentive payment.
[2] Refer to **Section 9.5** for qualified VSD applications pertaining to chillers, fans, pumps and other equip.

Table 9-3
Room Air Conditioner Qualifying Efficiencies

Size (Btuh)	Level 1 2000 ENERGY STAR® (EER)	Level 2 SEHA Tier 1 (EER)
< 8,000	10.7	11.2
8,000 to 13,999	10.8	11.3
14,000 to 19,999	10.7	11.2
≥ 20,000	9.4	9.8

9.4 Package Terminal Air Conditioning Units (PTAC)

Package terminal air conditioners and heat pumps are through-the-wall, self-contained units.[12] All EER values must be rated at 95ºF outdoor dry-bulb temperature. Minimum requirements are shown in the **Table 9-4**.

Table 9-4
PTAC Minimum Efficiency Requirements

Capacity (Btuh)	Minimum Efficiency (EER)
≤ 7,000	11.3
7,001 - 8,000	11.0
8,001 - 9,000	10.8
9,001 - 10,000	10.5
10,001 - 11,000	10.3
11,001 - 12,000	10.0
12,001 - 13,000	9.8
13,001 - 14,000	9.5
14,001 - 15,000	9.4
≥ 15,000	9.2

9.5 Variable Speed Drive on HVAC Chillers, Cooling Towers, Fans, and Pumps

Variable-speed drives (VSDs) installed on existing chillers, cooling towers, HVAC fans, or HVAC pumps used for human comfort are eligible for a prescriptive incentive. The installation of a VSD must accompany the permanent removal or disabling of any flow control or throttling devices such as inlet vanes, bypass dampers, and valves.

New chillers or other equipment with integrated VSDs are likely eligible as a custom measure.

VSDs for non-HVAC applications, including chillers, fans, pumps, cooling towers, air compressors and other equipment may be eligible for a custom measure incentive.

[12] These units have a combination of heating and cooling assemblies intended for mounting through the wall. It includes refrigeration, outdoor louvers, forced ventilation, and may connect to external heating source or have electric resistance heating.

Annual Cost Summary

09080 - OEP Chiller
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08/11/2010
07:52PM

Table 1. Annual Costs

Component	OEP - Current fans ($)	OEP - VFD Fans ($)
Air System Fans	31,857	14,613
Cooling	15,095	13,602
Heating	0	341
Pumps	6,609	5,980
Cooling Tower Fans	3,305	3,150
HVAC Sub-Total	**56,865**	**37,686**
Lights	48,809	48,809
Electric Equipment	24,404	24,404
Misc. Electric	0	0
Misc. Fuel Use	0	0
Non-HVAC Sub-Total	**73,213**	**73,213**
Grand Total	**130,079**	**110,900**

Table 2. Annual Cost per Unit Floor Area

Component	OEP - Current fans ($/ft²)	OEP - VFD Fans ($/ft²)
Air System Fans	0.286	0.131
Cooling	0.135	0.122
Heating	0.000	0.003
Pumps	0.059	0.054
Cooling Tower Fans	0.030	0.028
HVAC Sub-Total	**0.510**	**0.338**
Lights	0.438	0.438
Electric Equipment	0.219	0.219
Misc. Electric	0.000	0.000
Misc. Fuel Use	0.000	0.000
Non-HVAC Sub-Total	**0.657**	**0.657**
Grand Total	**1.167**	**0.995**
Gross Floor Area (ft²)	111494.0	111494.0
Conditioned Floor Area (ft²)	111494.0	111494.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 3. Component Cost as a Percentage of Total Cost

Component	OEP - Current fans (%)	OEP - VFD Fans (%)
Air System Fans	24.5	13.2
Cooling	11.6	12.3
Heating	0.0	0.3
Pumps	5.1	5.4
Cooling Tower Fans	2.5	2.8
HVAC Sub-Total	**43.7**	**34.0**
Lights	37.5	44.0
Electric Equipment	18.8	22.0
Misc. Electric	0.0	0.0
Misc. Fuel Use	0.0	0.0
Non-HVAC Sub-Total	**56.3**	**66.0**
Grand Total	**100.0**	**100.0**

Annual Component Costs - OEP - Current fans

09080 - OEP Chiller
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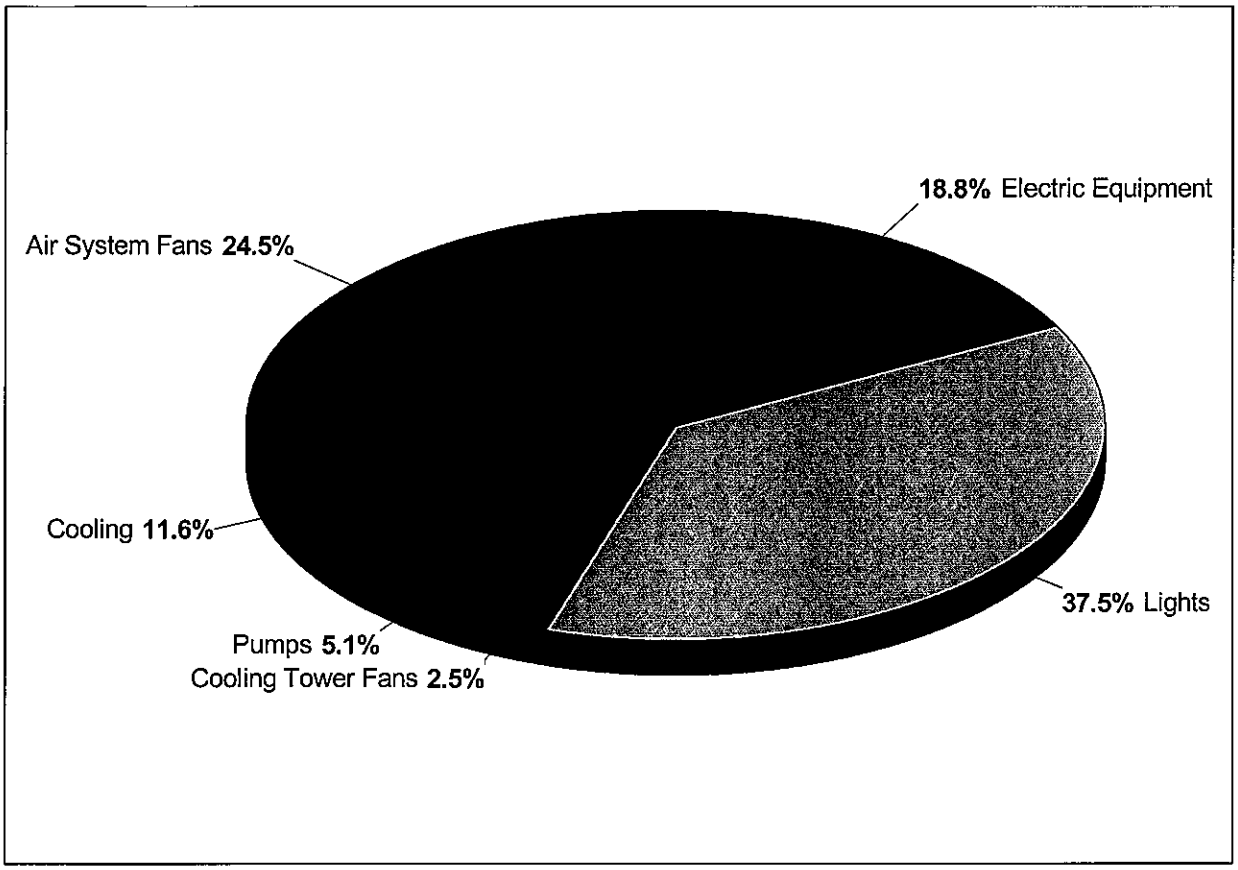
08/11/2010
07:52PM



1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	31,857	0.286	24.5
Cooling	15,095	0.135	11.6
Heating	0	0.000	0.0
Pumps	6,609	0.059	5.1
Cooling Tower Fans	3,305	0.030	2.5
HVAC Sub-Total	**56,865**	**0.510**	**43.7**
Lights	48,809	0.438	37.5
Electric Equipment	24,404	0.219	18.8
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**73,213**	**0.657**	**56.3**
Grand Total	**130,079**	**1.167**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **111494.0** ft²
Conditioned Floor Area ..... **111494.0** ft²

Monthly Energy Use by Component - OEP - Current fans

09080 - OEP Chiller
ATLANTEC ENGINEERS

08/11/2010
07:52PM

APPENDIX G

1. Monthly Energy Use by System Component

Component	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air System Fans (kWh)	30554	27866	31881	34964	37478	39252	43319	40870	39902	37973	29998	31269
Cooling												
Electric (kWh)	3336	3904	6585	10849	20430	31001	37836	38995	24881	14294	5891	3530
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote CW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Heating												
Electric (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Pumps (kWh)	2656	3054	4733	6469	9905	11130	12118	12041	10065	8538	4940	2587
Clg. Tower Fans (kWh)	945	606	1535	2759	5239	6865	7653	7575	5825	3420	921	781
Lighting (kWh)	56906	49949	53160	54587	55211	52536	56906	53160	54587	56906	50841	56906
Electric Eqpt. (kWh)	28453	24975	26580	27294	27606	26268	28453	26580	27294	28453	25420	28453
Misc. Electric (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Fuel												
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0

Annual Component Costs - OEP - VFD Fans

09080 - OEP Chiller
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08/11/2010
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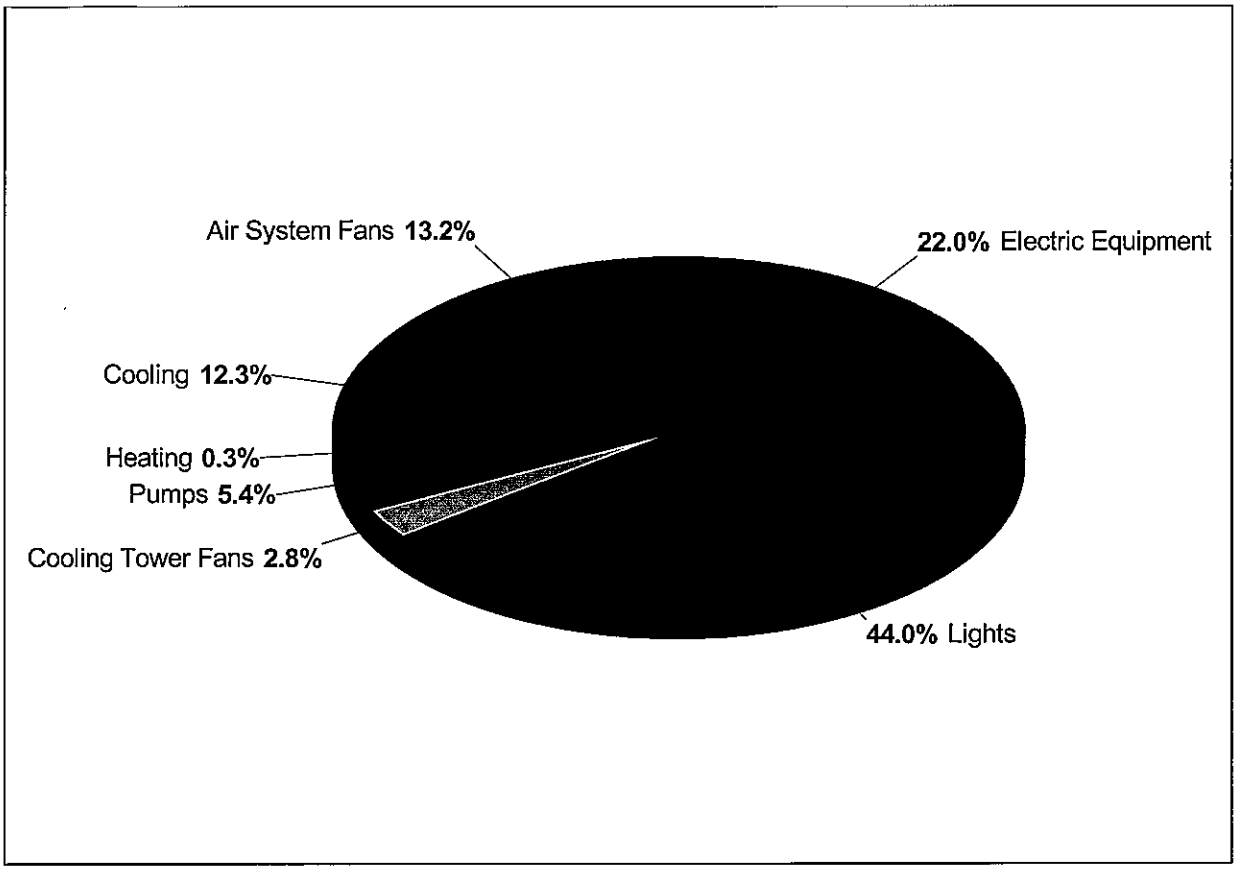

1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	14,613	0.131	13.2
Cooling	13,602	0.122	12.3
Heating	341	0.003	0.3
Pumps	5,980	0.054	5.4
Cooling Tower Fans	3,150	0.028	2.8
HVAC Sub-Total	**37,686**	**0.338**	**34.0**
Lights	48,809	0.438	44.0
Electric Equipment	24,404	0.219	22.0
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**73,213**	**0.657**	**66.0**
Grand Total	**110,900**	**0.995**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **111494.0** ft²
Conditioned Floor Area ..... **111494.0** ft²

Monthly Energy Use by Component - OEP - VFD Fans

09080 - OEP Chiller
ATLANTEC ENGINEERS

08/11/2010
07:52PM

APPENDIX G

1. Monthly Energy Use by System Component

Component	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air System Fans (kWh)	7305	7999	11882	14746	18356	23105	26173	25541	23252	17750	10718	8272
Cooling												
Electric (kWh)	2110	2671	5416	9192	18351	29145	35889	37095	22990	12235	3936	2572
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote CW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Heating												
Electric (kWh)	1659	1316	2	0	0	0	0	0	0	0	0	1578
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Fuel Oil (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0
Pumps (kWh)	1696	2200	4007	5534	9196	10946	12065	11911	9690	7549	3304	1740
Clg. Tower Fans (kWh)	698	435	1344	2600	5011	6801	7590	7495	5634	3107	641	705
Lighting (kWh)	56906	49949	53160	54587	55211	52536	56906	53160	54587	56906	50841	56906
Electric Eqpt. (kWh)	28453	24975	26580	27294	27606	26268	28453	26580	27294	28453	25420	28453
Misc. Electric (kWh)	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Fuel												
Natural Gas (na)	0	0	0	0	0	0	0	0	0	0	0	0
Propane (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote HW (na)	0	0	0	0	0	0	0	0	0	0	0	0
Remote Steam (na)	0	0	0	0	0	0	0	0	0	0	0	0

8/12/2010 APPENDIX H

Newcomb and Company
Mechanical Estimate Summary

Job Name: OEP Fans and VFD's
City of Raleigh

Total Tonnage of Equipment		
Labor Rate per Crew Hour	OT	$ 72.60
Warehouse Labor % of Materials		8.00%
Supervision Cost % of Labor		7.5%
Direct Cost		**$157,675.15**
Gross Margin		**$22,326.27**

Tax Rate 7.75%

0.0%

14.16%

Material and labor		Material	Labor	Man Hours	Tax	
Fans	4	80,000.00	$2,178.00	30.00	$5,600	
VFD's	4	30,000.00	$1,452.00	20.00	$2,100	
Start-up	4	100.00	$726.00	10.00	$7	
		0.00	$0.00	0.00	$0	
		0.00	$0.00	0.00	$0	
		0.00	$0.00	0.00	$0	
Misc	5.00%	5,505.00	$217.80	3.00	$385	
		0.00	$0.00	0.00	$0	
Demo	4	0.00	$2,904.00	40.00	$0	
		0.00	$0.00	0.00	$0	
Total Piping		**$115,605.00**	**$7,477.80**	**103.00**	**$8,092**	

Project Sub-Totals		**$115,605.00**	**$7,477.80**	**103.00**	**$8,092**
Project Totals		**$115,605.00**	**$7,477.80**	**103.00**	**$8,092**

Subcontracts		
Controls		**$8,500.00**
Insulation		**$1,500.00**
Electrical		**$3,500.00**
Crane and Rigging		**$10,500.00**
Test and Balance		**$2,500.00**
Total Subcontracts		**$26,500.00**

TOTAL MATERIALS		**115,605**
SALES TAX		**8,092**
Overhead and Profit on Materials		**18,555**
LABOR		**7,478**
Overhead and Profit on Labor		**1,122**
WARRANTY		**0**
SUBCONTRACT		**26,500**
Overhead on Subs		**2,650**
TOTAL COST		**180,001**
SELLING PRICE		**180,001**

		0

Quote Price		**180,001**

6.1.3 Retrofit Prescriptive - Refrigeration

The following are some common methods of reducing energy usage in refrigeration. The Energy Efficiency for Business Program is offering incentives for the refrigeration measures shown in **Table 6-3**. The specifications for each of these measures are provided in **Section 10**.

Table 6-3
Prescriptive Refrigeration Incentives

Refrigeration Measures		
Measure	**Incentive Unit**	**Incentive/Unit**
Strip Curtains on Walk-In Coolers and Freezers	Per Square Foot	$3.00
Anti-Sweat Heater Control	Per Linear Foot	$20.00
Electrically Commutated Motor for Walk-in	Per Motor	$50.00
Electrically Commutated Motor for Reach-in	Per Motor	$40.00
Evaporator Fan Control	Per Motor	$60.00
Automatic Door Closers for Walk-in Freezers	Per Door	$140.00
Beverage Machine Control	Per Unit	$90.00
ENERGYSTAR® Beverage Machine	Per Unit	$90.00
Snack Machine Control	Per Unit	$50.00
High-Efficiency Ice Makers (Air Cooled Only) ENERGY STAR® or CEE Tier 1		
Size (lbs / 24 hrs)	**Qualifying kWh per 100 lbs**	**Incentive per Ice Maker**
101 - 200	8.5	$75.00
201 - 300	7.7	$125.00
301 - 400	6.5	$175.00
401 - 500	5.5	$225.00
501 – 1,000	5.2	$300.00
1,001 – 1,500	5.0	$450.00
> 1,500	4.6	$600.00