

Smith 'Walks-In' to Energy Savings:

A look at how installing new refrigeration technology can save thousands a year

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EVS 300 Final Paper
5/28/09

Abstract

The Smith College community is committed to addressing issues of global warming by neutralizing its greenhouse gas emissions and becoming a carbon neutral campus. With energy prices on the rise, implementing new products, services, and technologies preserves resources while reducing energy costs. One such project involves electricity use by walk-in coolers and freezers on campus.

National Resource Management (NRM), a company at the forefront of energy saving technologies for refrigeration, has designed three devices, 'Anti-Sweat Door Heater Control', 'Electronically Commutated motors', and 'CoolTrol', which help reduce energy use. Additionally, NRM works with National Grid, the electric company that supplies Smith College, to offer rebate programs. A consultant from NRM visited the campus and completed an energy audit of thirteen locations that housed walk-in coolers and/or freezers. The data gathered was analyzed to form an energy conservation benefit report as well as a consolidated refrigeration proposal that calculated how much energy could be saved upon installation of these products. Furthermore, calculations were provided that explained the initial costs, rebate incentives, and net costs upon implementation. Results showed a 22% decrease in electrical use equaling a savings of \$17,716 per year. Additionally, National Grid will pay 44% of the installation costs, reducing the payback period to 2.95 years.

Smith might be headed toward reaching its goal of becoming carbon neutral while saving money in the process. Additionally, Smith will uphold its prestigious name by

setting an example for its students and the community about being environmentally conscience. This could encourage more to look to innovative technologies and services to help preserve our valuable resources, reduce our greenhouse gas emissions, and become a more sustainable community.

Introduction

Global warming has been a controversial topic for decades; however, concerns over these issues are more intense than ever given the steady rise in environmental disasters that proponents of global warming have been predicting for years. Although fluctuations in global temperature have always occurred, in the last fifty years experts have seen the fastest rates of temperature increases in recorded history. These increases have had a vast range of effects on our planet, including: wildfires seasons in Colorado; floods in Texas; dust storms in Montana; and severe heat waves in Europe that caused over 20,000 deaths (NRDC, 2005).

Naturally occurring compounds from the Earth exist in small quantities and are continuously added and taken away from the atmosphere. However, the onset of the Industrial Revolution was the point when anthropogenic effects such as the burning of fossil fuel and deforestation became a huge contributor of compounds known as greenhouse gases (GHG) into Earth's atmosphere. Massive amounts of gases such as carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) were being introduced into the atmosphere at astronomical rates, and it is not until now that we are seeing their effects on the environment. These contributions have resulted in an increase in the

amount of incoming solar radiation the Earth traps and is unable to radiate back to space, thus raising atmospheric temperatures and in turn changing the Earth's climate (Eby 2004). Although there is an ongoing debate as to whether global temperature changes effect the CO₂ levels or whether CO₂ levels effect the global temperature changes, they are undoubtedly connected and rising (Figure 1; NCDC, 2008; NRDC, 1998).

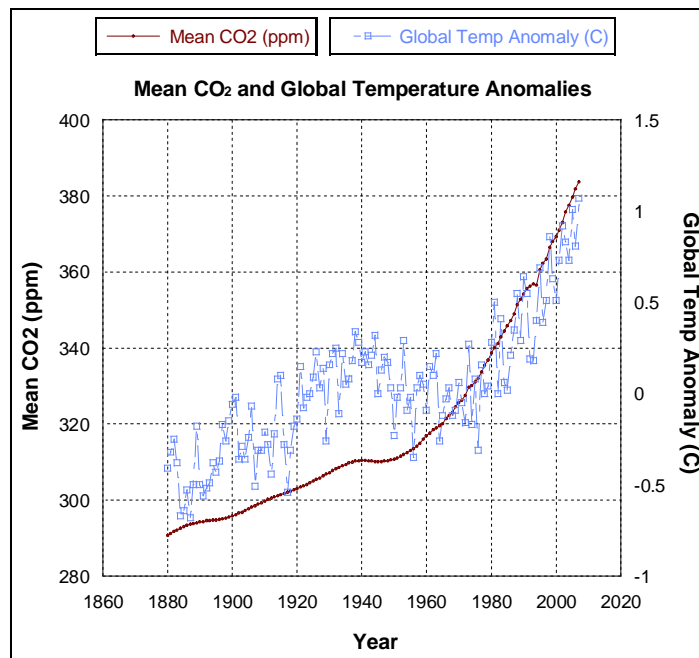


Figure 1. Changes in annual global mean temperatures and carbon dioxide. Earlier values for CO₂ values are from ice cores (1880-1957) and direct measurements from Mauna Loa, Hawaii (NRDC, 1998). Ocean temperature values from the National Climatic Data Center (2008).

Furthermore, data has revealed that along with the increases in global land temperatures, oceans have experienced a similar net warming (Figure 2). Increasing ocean temperatures have been documented in areas from along the continental shelf of the North Atlantic Ocean to areas in the southwest Pacific Ocean (Friedland and Hare, 2007; Bindoff and Church, 1992).

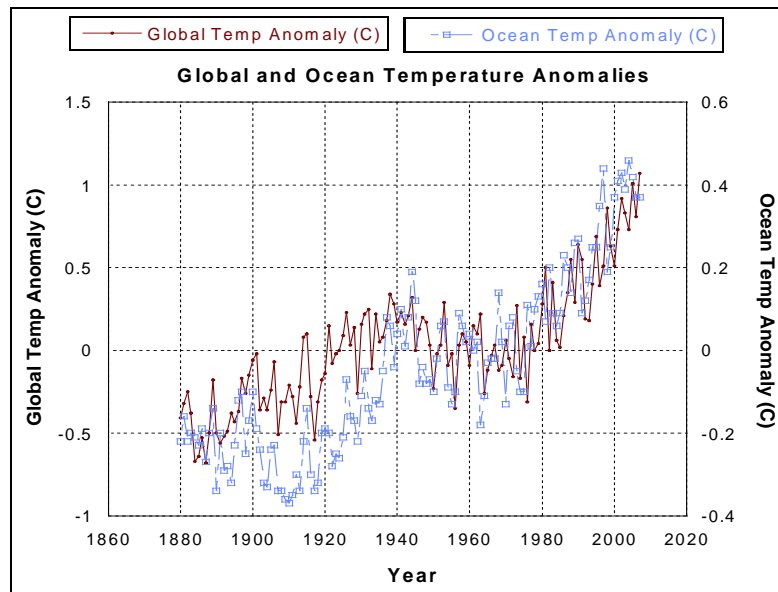


Figure 2. Changes in annual global mean land and ocean temperatures from a 127-year period. Values from National Climatic Data Center.

One positive aspect coming out of these studies is the growing awareness and concern surrounding these issues. Arguments that once debated whether humans are the cause of global warming are now being shifted to what changes can be done about the warming and how to make these changes happen. Now, more than ever, people are seeing that they have an environmental responsibility that can no longer be ignored and terms such as environmental sustainability and ‘going green’ have become creeds to live by and goals that many are now trying to reach.

As one of the top women’s liberal arts colleges in the country, Smith prides itself on setting examples for others to follow. One way Smith has set itself apart from others was shown when Smith’s President Carol Christ signed the ‘American College and University Presidents Climate Commitment’ in 2007. This pact commits Smith to addressing issues of global warming by neutralizing its greenhouse gas emissions and

becoming a carbon neutral campus (Climate Commitment 2007). Although many projects have already been put into effect on campus, there are many more that can be done to help bring Smith towards its goal of carbon-neutrality. We are seeing new technologies emerging that can help reduce our carbon footprint and slow the effects we are having on our Earth. With energy prices on the rise, implementing these new products, services, and technologies not only preserves valuable resources, but it also helps reduce energy costs as well. One such project that can be implemented involves electricity use by walk-in coolers and freezers on campus.

When talk of electricity comes up, most people immediately think of turning off lights or shutting down computers; little do people know that, although this does help, a massive amount of electricity use comes from refrigeration, especially from walk-in coolers. On Smith's campus, the amount of energy used by these systems is enormous, especially when they are constantly running in high traffic areas. Each time the cooler door opens, cold air escapes making the fans work harder to keep a baseline temperature which, in turn, increases the amount of energy used.

National Resource Management (NRM), a company founded in 1991, has been at the forefront of energy saving technologies for refrigeration. They have successfully designed and marketed three innovative devices, 'Anti-Sweat Door Heater (DH) Control', 'Electronically Commutated (EC) motors', and a system named 'CoolTrol', that help to reduce the energy used by these massive systems (NRM website). Being one of the leading providers of cost-effective energy products, NRM also works with National Grid, the electric company that provides Smith College campus with its electricity, to offer

rebate programs. These programs, which cover a percentage of the costs of products and installation, help provide even faster returns on investments in innovative energy technology.

The goal of this research paper was to provide an analysis of the walk-in coolers and freezers on Smith College's campus. Data such as length, width, height, temperature set point, and number of fans was gathered and a detailed report is given that calculates how much energy is being used to run these systems presently and, upon installation of NRM's devices, how much energy could be saved. Additionally, pricing specifics were investigated and are presented to show the initial costs of implementing this project, the rebate incentives offered by the electric company, National Grid, and Smith's overall cost of installing these devices campus wide.

Methodology

An energy audit was completed for the entire campus by a consultant from NRM. This was a day long process that required the consultant to visit every location on campus that housed a walk-in cooler or freezer. Thirteen different sites were visited and the information gathered was as follows: the number of coolers and/or freezers in the location, the make and model of each, volts, number of evaporator fans and fan size, number of doors, length, width, height, temperature set point, products stored, and condenser location. Sketches of each area were drawn to accurately depict the site to better serve NRM technicians for possible future installation needs (Appendix 1a-c).

With the information gathered, the consultant then proceeded to compile the data to form an energy conservation benefit analysis for each site visited (Appendix 2a-e). This required inputting the data into a form, provided and prepared by NRM, which calculated the current energy use of each system (kilowatts/hour (KWH)) and, upon installation of NRM's three devices, (DH) Control, (EC) motors, and the CoolTrol system, the energy savings (KWH) that each product could provide. Additionally, the conservation benefit analysis also included a cost summary. Since each device is specifically tailored and designed for each cooler and freezer, the cost summary provided information that included the cost of manufacturing and installing each device, the materials, the utility incentive that would be provided by National Grid, and the net customer cost. With this cost information, a payback period was calculated to help better decide whether to move forward with this project.

During the summer months many of Smith's students are off campus, which lowers the demand of products needed and stored on campus. Seven out of the thirteen locations are shut down for a 2.5 month period during this time. To account for this shut down time, a refrigeration proposal was provided to Smith College by NRM (Appendix 3). This spreadsheet calculated and consolidated the costs and savings for each site, taking this 9.5 month operation and shut down time into consideration.

Results

Although many of the systems are relatively small, they each require a tremendous amount of energy to maintain the optimal temperature for the safe storage of

foods. The cooler set point for each system is 38.0° F and freezer set point for each system is -5° F. The KWHs used per year by each system ranges from 18,495 KWH (Hubbard) to 73,797 KWH (Cutter/Ziskind), with the average being 39,835 KWHs (Figure 3). Cutter/Ziskind was of particular interest because it had by far the most yearly usage. This gave a total of 517,848 KWHs used per year. Using the \$0.155/KWH rate that Smith College is charged for electricity, a total of \$80,266.44 is spent on refrigeration alone.

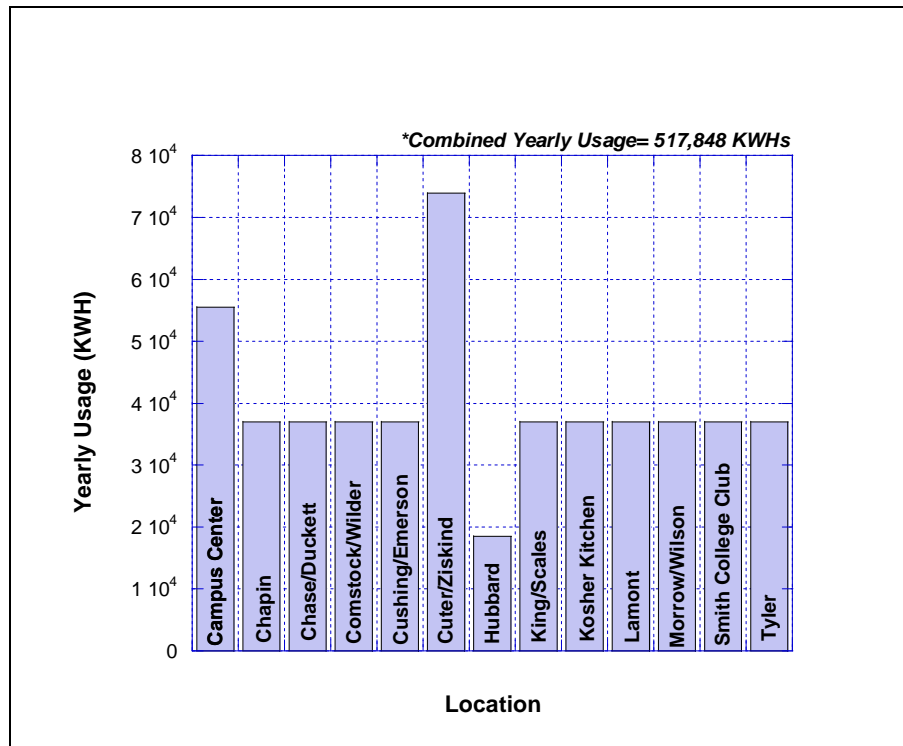


Figure 3. Yearly KWH usage for each site on the Smith College campus analyzed. *Total combined usage of all locations. Information provided by the consultant from NRM inc.

Upon installation of the three devices NRM offers, Smith College could see a dramatic decrease in the amount of KWHs used. The device called Anti-Sweat DH

Control was the first observed (Figure 4). This product is placed on the outside of the cooler or freezer and monitors the temperature, relative humidity, and dew point of the



Figure 4. Photo of a DH Control. Picture provided by www.NRMinc.com

surrounding room. Its job, unlike typical door heater controllers, which run constantly, is to send heat to the door frame only when it is needed. This lowers the amount of energy used while still preventing condensation build-up on the doorframe, which can lead to frame degradation and/or water pooling on the floor creating hazards for employees. Unique features include the ability for user configuration to control doors independently or in combination, resulting in peak demand savings. Additionally, safety features, which include a fail-safe operation that allows the door heater to default to “ON” if the controller loses power and alarm indicators that display when there is a problem with the device, ensure minimal product loss. Installation of this device throughout campus can save up to 2,627 KWHs per unit (Figure 5), with a total saving of 27,646 KWHs campus wide or \$4,285.13 in monetary value. The savings at each location are relatively equal, but again Hubbard and Cutter/Ziskind are points of interest, having the lowest savings.

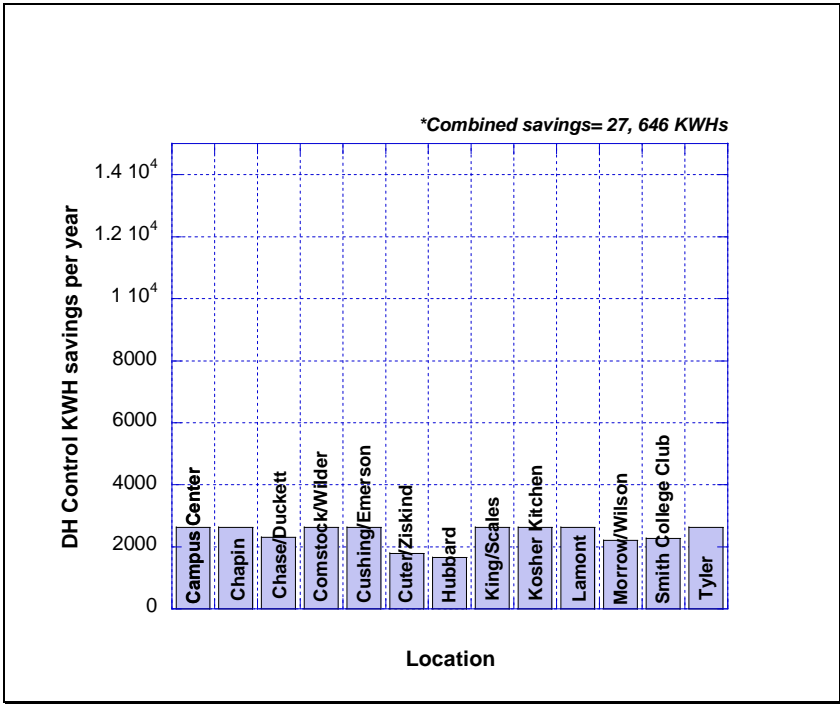
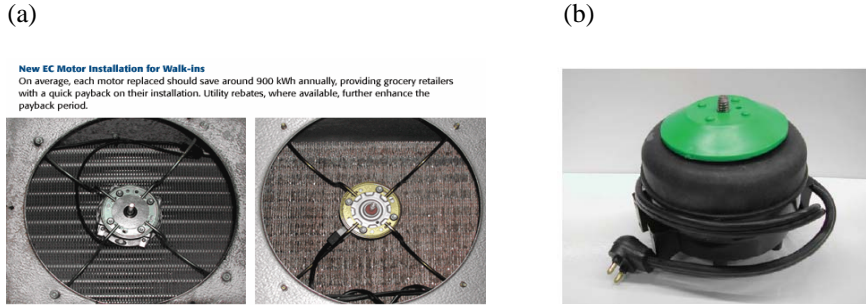


Figure 5. Yearly KWH savings for each location analyzed upon installation of DH controllers. *Total combined savings of all locations upon installation of DH controllers. Information provided by the consultant from NRM inc.

The next device offered by NRM is the Electronically Commutated (EC) motors (Figure 6a-b). The EC motor is a high efficiency replacement fan motor that can be retrofitted into any existing walk-in cooler, which means no existing equipment needs to

Figure 6. EC motors replacement motor (a) installed into a fan motor and (b) unit standing alone. Photos from www.NRMinc.com



be replaced or updated. This device contains a microprocessor controller that provides continuous airflow at a constant speed, and a reduced motor wattage which results in less heat introduced into the cooler space. The system also runs on a six minute off- one minute one on cycle, which greatly reduces the amount of output. Since equipment starting or stopping at full speed applies stress or could damage a product, a feature included in this device is a soft start system. This enables the motor to ramp up the voltage slowly to its full running speed, therefore protecting the device from wear and tear and prolonging its life (Hoske 2008). Installation of this product into the existing coolers and freezers on campus can lead to a savings ranging from 1,651 to 2,627 KWHs per unit (Figure 7), with a total savings of 31,212 KWH per year or \$4837.86.

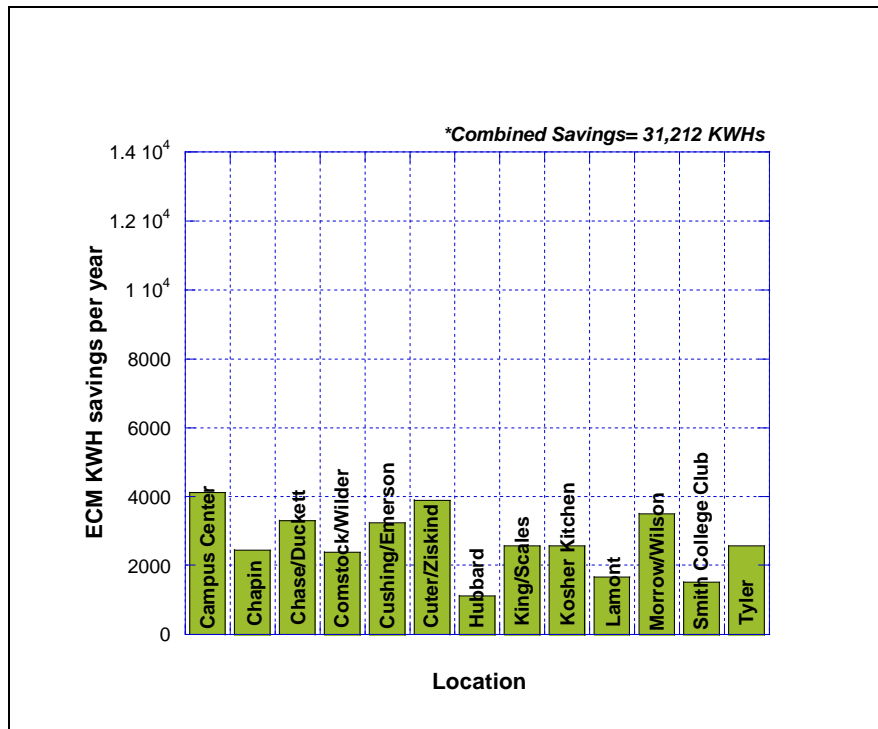


Figure 7. Yearly KWH savings for each location analyzed upon installation of EC motors. *Total combined savings of all locations upon installation of EC motors. Information provided by the consultant from NRM inc.

The final product that NRM has to offer is one that will bring the biggest savings, a system the company named ‘CoolTrol’ (Figure 8). It is installed on the outside of the

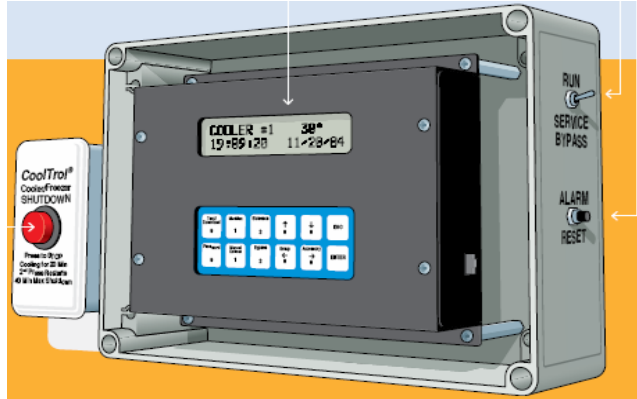


Figure 8. CoolTrol system installed outside of the walk-in system. Photos from www.NRMinc.com

walk-in cooler and serves several functions. The system contains built-in intelligence that tracks temperature, equipment run time, and historical usage patterns, which can provide statistical analysis of performance and energy use. It contains an alarm feature that signals when pre-determined high and low temperatures are exceeded to eliminate spoilage. Finally, it has a ‘cooler load’ button that safely shuts off the cooling system when it is being stocked, which lessens the risk of damage to the system and also reduces the cooling costs during loading. All of these features, along with the intelligence to communicate with both the EC motor and the DH control, help to maximize its performance and reduce costs significantly. Installing this system campus wide could save an additional 55,439 KWHs per year, with an average savings of 4,729.7 KWHs per unit (Figure 9). This calculated into a savings of \$8593.05 per year.

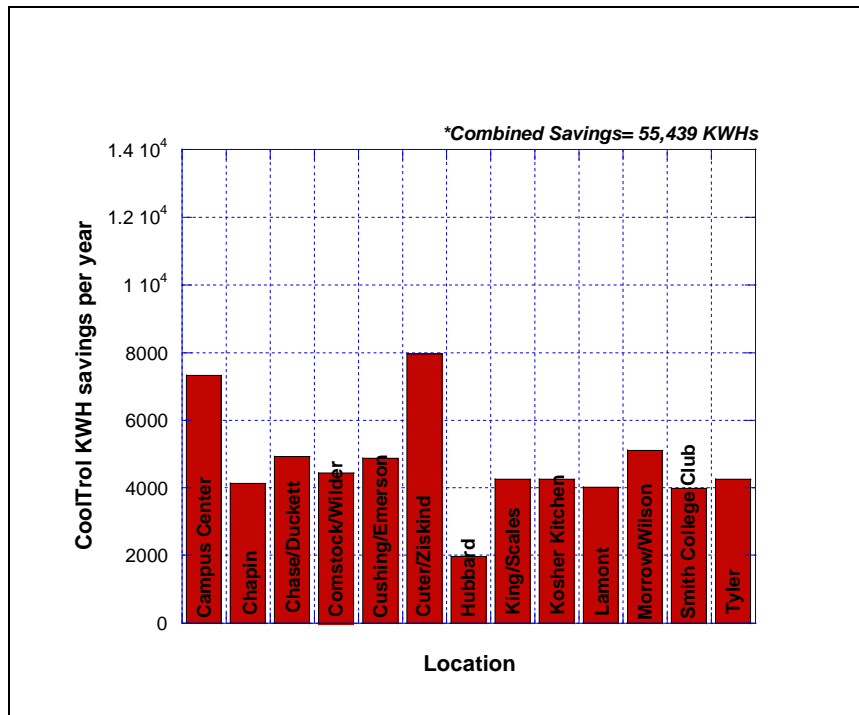


Figure 9. Yearly KWH savings for each location analyzed upon installation of CoolTrol system. *Total combined savings of all locations upon installation of CoolTrol system. Information provided by the consultant from NRM inc.

Overall savings totaled 114,297 KWHs holding a monetary value of \$17,716.04 per year. The Campus Center showed the most total savings upon installation of the three devices (\$2,178.68) while Hubbard had the least (\$732.99) (Figure 10).

An important question to address when discussing the implementation of a campus-wide project such as this is ‘How much will this cost?’ National Grid offers rebate programs which will cover 44% of the costs of products and installation to help provide even faster returns on investments in this innovative energy technology. A total project cost of \$92,762.00 was quoted from NRM for installation, materials, and testing. Having the utility incentive cover 44% of the costs, means \$40,439.25 will be put toward

the total cost, leaving Smith College to pay a net cost of only \$52,322.75. This means an even faster return on the investment and a payback period of only 2.95 years.

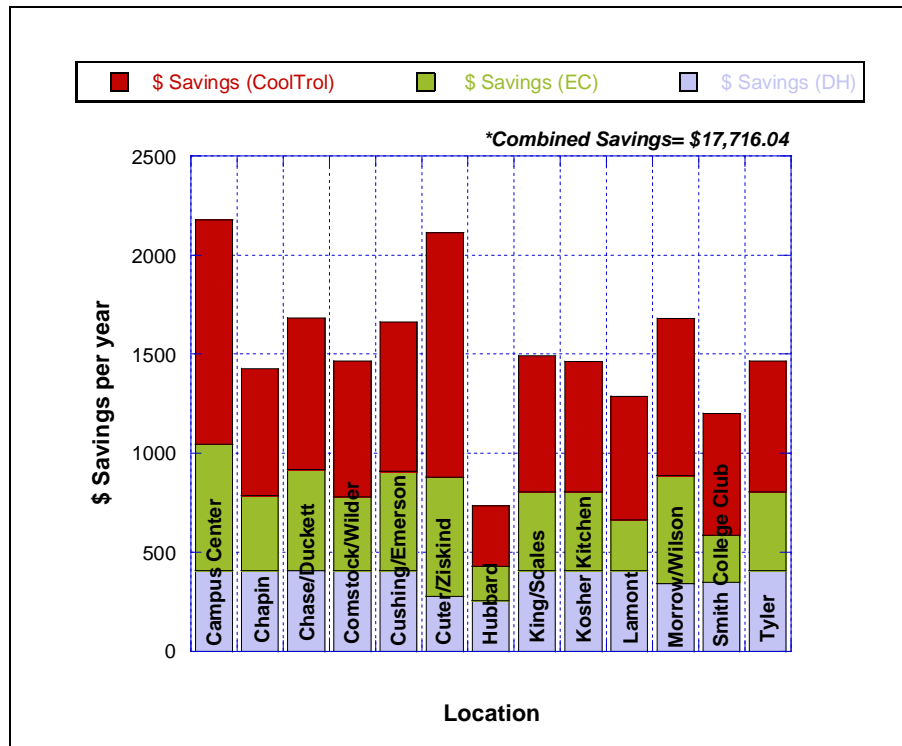


Figure 10. Yearly monetary savings for each location analyzed upon installation of DH controllers (blue), EC motors (green), and CoolTrol (red). *Total combined dollar savings of all locations and upon installation of all three devices. Information provided by the consultant from NRM inc.

Discussion

This project has everything going for it from easy installation processes and quick payback periods to good safety features associated with each product that ensure minimal product loss. Additionally, reducing energy use by installation of these innovative products can not only help Smith College reach its goal of carbon- neutrality, but with the

uncertain economic situation, it can also increase the positive cash flow of the college. Being one of the leading providers of cost-effective energy products, NRM works with National Grid to offer rebate incentives that can not be passed up, thus reducing Smith College's up front costs of implementation of this project campus wide as well as reducing the payback period to less than three years.

The energy savings involved with installation of these three devices is equally impressive. Smith College will ultimately see a 22% reduction in electricity use upon installation of these products. This is equivalent to removing 12 cars from the road or planting 20.3 acres of trees, both of which would be hard tasks to accomplish, compared to the simple task of installing these devices on campus. Each location showed a substantial savings in KWHs with the lowest being Hubbard. This low savings is attributed to the fact that this location houses only one walk-in cooler, where all other locations house multiple systems. Additionally, this location only operates for 9.5 months. Likewise Cutter/Ziskind and the Campus Center showed the highest savings due to a few factors: both of these sites house multiple units, contain substantially larger units, due to high traffic and storage demand, and both locations operate year round. Since all units exhibited some form of savings, this means the \$80,266.00 spent now can be reduced to \$62,550.00 and, if recycled back into sustainable projects, this could mean more money will be available to further advance the goal of becoming a carbon-neutral campus.

An important factor that helps to drive the implementation of such a project is having those involved in agreement that it is a good project to move forward with. Not

only are both the Sustainability Director and the Energy Manager of Smith College in agreement that implementing this project makes sense, but the Dining Services Director, Dining Services Area Manager, and Smith's independent refrigeration technician, who helped install such a system in a local business, all agreed to move forward as well. This backing is important for when the time comes to present this idea to the College Board, where spending a large sum of money can cause hesitation with deciding on whether to approve a project or not.

NRM has a strong backing, having installed products throughout the Pioneer Valley and in locations ranging from grocery stores and wholesale distributors to multiple college campuses, such as Harvard University. Although no data was able to be obtained for comparison, many testimonials are given describing the professionalism provided by this company, the reliability of their products, and an average energy savings of 21%, which matches the proposed 22% savings for Smith College, upon installation (Appendix 4). Having such an impressive resume and following is important in knowing that Smith will be dealing with a reliable and professional company that believes in its products, backs them 100%, and cares about its customers.

Overall, I recommend this project be one that is implemented in a timely fashion. With the combination of increasing energy costs and the rebate system from National Grid, Smith might be headed toward reaching its goal of becoming carbon neutral while saving money in the process. Additionally, Smith College will uphold its prestigious name by setting an example for not only its students but for the community about being environmentally conscience. Furthermore, Smith could potentially form an outreach

program where it helps local businesses, who can not afford the upfront costs of NRM's products, by covering the net costs of installation. This could encourage more within the community to do their part in looking to innovative technologies and services to help preserve our valuable resources, reduce our greenhouse gas emissions, and become a more sustainable community.

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Appendix 4 Testimonials

Retrieved May 1, 2009 from www.NRMinc.com

"The *CoolTrol* System has **saved us 20%** on our electric bill this year. It controls both our fans and door heaters and also funnels cool air into the cooler during the winter months. Our electricity savings, combined with the utility rebate, has allowed us to recoup our investment in seven months. In addition, because NRM's System runs the compressors and fans less, we believe we are extending the life of our cooler. The system is definitely sophisticated but very user friendly".

- Peter Turlo, owner of Natick Wine & Spirits.

"I highly recommend to anyone with commercial refrigeration to purchase NRM products. I calculated that our average monthly bill has been reduced almost \$300 or nearly 30% since the installation was performed. In fact, the savings turned out to be at least 50% more than what NRM originally estimated. Combined with a local rebate that NRM obtained from the utility, my payback was less than 4 months! Furthermore, the installation did not intrude on the operations of my liquor store and the equipment has performed without any problems."

- Jack Singh, owner

"I would do this project again in a flash! NRM was good to its word on savings. Between both stores, I have reduced my electric bill by 10% or \$13,500 a year. With the incentive NRM secured for me, my payback was only one year.* Equally impressive is customer support — I call, hang up, and they're there. Bottom line — if you're on the fence about doing business with NRM, I would highly recommend you get this installed — you won't regret it."

- Fred Zanotto, Owner, Zanotto's Family Market

