Going Green Feasibility Assignment

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**Description**

The purpose of the going green modification is to save energy that is used to light the walk-in coolers or freezers. The residence walk-ins contain 35 compact fluorescent light (CFL) bulbs, 30 fluorescent bulbs, and 5 incandescent bulbs which are turned on at the beginning of every shift and off at the end of every shift. Motion detectors are known to reduce costs in half depending on factors such as how often they are activated and how long they are set to stay on. If the walk-ins at each residence hall are placed on motion sensitive lighting, the lights will remain on only when an employee needs them, allowing energy to be saved in between uses.

**Current Research**

According to Michigan Department of Labor & Economic Growth, energy observer lighting can often cut the price of electricity in half. Often offices will use approximately 29% of their electricity on lighting alone. The sensors consist of a motion sensor, electronic control unit, and a controllable switch/relay which runs on a timer. There are three types of sensors for lighting: “passive infrared, ultrasonic, and hybrid (1).” The passive infrared sensors sense a change in heat patterns. So if a human with a different body heat passes in front of an object such as a wall with a low heat, the sensor notices the change and turns on the light in response. These types of sensors are often used in small spaces that are open enough for the entire room to be in the sensor’s view such as private offices or conference rooms. Passive Infrared lighting are accurate, inexpensive, and save energy. The limitation of this form of sensor however is that it has a limited range and therefore is only useful in small rooms where objects will not block people from the sight of the sensor. In addition, its sensitivity decreases with distance (1).

The ultrasonic sensor is a more efficient sensor that actually emits an inaudible sound pattern. When someone walks through this pattern and breaks it, the sensor notices and turn the light on. Ultrasonic sensors can function around objects in the room such as cabinets or shelving. This form of sensor detects all sorts of motion covering all gaps. However, they are more expensive and may be falsely triggered. For example, something blowing in the wind such a scrap of plastic or a plant could turn the light on. This sensor may interfere with hearing aids or similar sensors, as well. They are used in larger areas such as bathrooms or large conference rooms (1).

Third, the hybrid sensor uses both passive infrared technology and ultrasonic techniques. They can control multiple fixtures if desired, are not falsely triggered, and cover a wide area. They are expensive as well and may require adjustments in their position. But, hybrid sensors can be used in almost any type of area (1).

The desire when installing a motion sensitive device is that it is sensitive enough to stay on when someone is in the room even though they may not be making large movements, but not so sensitive that it is falsely triggered when the room is empty. If it is too sensitive, it will not save energy, whereas if it is not sensitive enough, it will turn off when someone is still in the room. The expense for occupancy sensors usually ranges from approximately $30 to $130 varying according to the model. The time it generally takes to start benefiting the company after the initial pay period may range from 0.5 to 5 years depending on the type of occupancy sensor installed and the normal level of activity in the building or area (1).

Information concerning past energy saving projects at Northern Illinois University was discovered as a result of a discussion with Ken Pugh from materials management at NIU. Approximately two years ago at Northern Illinois University, incandescent lights were changed to the newer compact fluorescent light (CFL) bulbs which are more energy efficient. The light bulbs throughout campus were also changed out from T12 with a magnetic balance to T8 with an electric balance in order to save energy. During this time period, energy efficient lights designed for lower temperatures were not developed yet explaining why motion sensors were never put inside the walk-in coolers or freezers. A fluorescent lamp actually releases such a high-voltage pulse when turned on that the ballast is required to regulate that pulse of electricity in order to prevent the bulb from burning out within seconds. There are two main types of ballasts: magnetic ballasts and electric ballasts. The Energy Policy Act of 2005 caused the production of magnetic ballasts to cease after January 1, 2009 requiring commercial facilities to switch from magnetic ballasts to electric ones which use about 40% less energy. The absence of the magnetic ballast is why the flickering and humming previously associated with fluorescent lighting is no longer present (2).

T12 and T8 refer to the size of the fluorescent bulbs with “T” standing for tubular. For example, a T8 is 1 inch in diameter (eight/eight) and T5 is five/eights of an inch (five/eight). Sizes of fluorescent bulbs range from T2 to T17.With fluorescent lamps the bulb must match whatever ballast is in the light fixture. This is not like an incandescent light bulb where different wattage bulbs can be put into the same fixture. A T8 lamp can only fit a T8 fixture and so on (2). T12 are today considered less efficient when compared to T8 or T5. Also, T5 is more efficient than T8 or T12. However, T8 is estimated to be about “20% more expensive than T12”; and T5 is about “3-4 times the cost of T8” (3). T8 bulbs are about “40% more efficient than T12.” T5 is about “9% more efficient than T8” and gives off twice the amount of light T8’s produce making their purchase efficiently justifiable in light of the additional cost between bulbs (3, 4). However, T5 bulbs which are relatively new are not always proven to endure through many environmental conditions that T8 lights handle well such as cold temperatures (3).

When dealing with fluorescent light bulbs, the more the light is turned on and off actually shortens the life of the bulb except it is often more cost effective to still turn off the lamp and replace the bulbs more frequently when they are not needed for 15 minutes or more (2). When dealing with fluorescent light systems on occupancy sensors, T8 lamps especially show a shortened life span. T5 are therefore recommended and their life span is not as limited when frequently turned on and off (6).

Trident Seafoods is an example of a company which upgraded their lights to T5 high-output fixtures in 2005. The originally had 400watt Metal Halide fixture in their facility. Fixtures were replaced in freezers, production areas, and dry good storage areas with 4-lamp T5HO fixtures. One third of their new T5 fixtures were also connected with occupancy sensors. The company determined that their upgrade reduced the power used by lighting by 48% saving them approximately $26,000 per year by reducing the amount of kilowatts used in a year. The project took 2 years to pay off (4).

Additional modifications which NIU has performed include placing motion detectors in less occupied rooms throughout campus. Motion detector switches including the Occupancy Sensor: a multi-technology ceiling sensor has been placed in certain parts of NIU’s campus so when rooms are not in use such as at night, the lighting will automatically shut off in an effort to reserve energy. These lights are designed for temperatures between 32 degrees Fahrenheit and 104 degrees Fahrenheit for 30 minutes. It covers 500 sq. feet, 1000 sq. feet, or 2000 sq. feet depending on the model. Secondly, the Decora Wall Switch Occupancy Sensor was installed throughout NIU’s campus which performs in the same manner. These Decora Wall switches can be set to stay on for either 10 minutes, 20 minutes, or 30 minutes. Also, the range at which they sense the movement may be adjusted from 100% to 36% within a field of 40 by 60 with large motions and 20 by 30 with small motions. The switches are active in temperatures between 32 to 122 degrees Fahrenheit.

**Description of the Project**

The following table provides information on what types of light fixtures are found in each of the walk-ins in Douglas, Lincoln, Neptune, and Stevenson. Grant was excluded because it is closing for remodeling and the new dorm was excluded due to lack of available information.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Walk-in | Douglas | Lincoln | Neptune | Stevenson |
| Salad Cooler | 2 CFL | 4 CFL\* | 1 CFL | 2 CFL |
| Produce Cooler | 1 CFL | 2 CFL\* | 1 CFL | 4 Fluorescent |
| Bread Cooler |  |  |  | 4 Fluorescent |
| Thaw Cooler |  |  | 1 CFL | 6 Fluorescent |
| Dairy Cooler |  |  | 2 CFL |  |
| Cook Cooler | 2 CFL | 2 CFL | 1 CFL | 2 CFL |
| Cook Freezer | 1 CFL | 1 Fluorescent | 1 CFL | 2 CFL |
| Main Freezer | 6 CFL | 5 Incandescent + 1 Fluorescent | 1 CFL +  4 Fluorescent\*\* | 10 Fluorescent |
| Trident Cooler |  |  | 1 CFL |  |
| Total | 12 CFL | 8 CFL  + 5 Incandescent + 2 Fluorescent | 9 CFL +  4 Fluorescent | 24 Fluorescent  + 6 CFL |

\*These CFL’s are grouped with two CFL bulbs per fixture with a square cover.

\*\*These fluorescents are grouped with two fluorescent bulbs per fixture.

Changes would involve the following:

* Replacing the 5 incandescent fixtures and the 1 fluorescent fixture in Lincoln’s downstairs freezer with 6 CFL fixtures as Douglas is designed. The CFL fixtures are product number 1806 made by Kason Industries. Additional information on this product is included within the appendix. The approximate cost of one of these fixtures is $46.19 which includes the clear light cover and 1 CFL bulb.

$46.19 x 6 fixtures = **$277.14 CFL Total**

* Installing one occupancy in every cooler and freezer with the exception of coolers and freezers containing fluorescent lighting. Fluorescent lighted coolers or freezers were not included in this study due to the inconsistency of research relating fluorescent lights to occupancy sensors and the additional expense of replacing the fixtures for occupancy sensor designed fluorescent fixtures. Therefore, this would include the installation of 19 occupancy sensors in walk-in coolers containing CFL bulbs. The occupancy sensor product number is OSFHU-CTW made by Leviton Co. and additional information is included in the appendix. This sensor uses passive infrared technology. It can be easily installed into either one of the fixtures or into the electrical junction box. It can be set anywhere from 30 seconds to 20 minutes. Its false detection intelligence prevents false triggering of the device. The project comes with three different caps which can be switched out to adjust for different fields of view. The approximate cost of the occupancy is $74.40 for one sensor.

$74.40 x 19 sensors = **$1413.60 Sensor Total**

* Purchasing emergency glow release handles for all walk-in cooler and freezer doors totaling 25 handles. Safety release handles on the inside of all of the walk-in coolers and freezers are either missing or not glow in the dark. When either someone turns out the lights or the power goes out, all of walk-ins are completely dark until the electricity is restored. Safety glow inside release handles in the walk-ins can help the person find the door to exit if they were inside the walk-in when the lights went out. Since motion sensitive lighting makes it more likely that the lights will go out, it is more necessary for safety reasons to have glow in the dark release handles. However, usually, if the sensors turn the lights off when someone is still inside, the lights will go back on once the person moves back into the view of the sensor. The product number is 0481 made by Kason Industries and additional information is included in the appendix. The approximate cost for one safety glow inside release handle is $19.03.

$19.03 x 25 handles = **$475.75 Handle Total**

**Benefits Expected**

The main benefit of the project is a cost reduction in electricity to Northern Illinois University of approximately $12.46 every week totaling approximately $513 in a year. Additional benefits include expanded life of CFL light bulbs, extended life of light fixtures, and reduction in energy stealing heat within freezers and coolers. Benefits of the safety glow release latches include improved safety of the employees. A final benefit of occupancy sensors is that by saving energy, they aid the environment by reducing the use of previous energy resources such as fossil fuels. Students and DeKalb may be impacted positively by NIU savings and the benefits of energy saving to the environment. Also, any results of success of this project may very well spur additional energy saving projects performed at NIU in the future.

**Project Justification**

Occupancy sensors are easy to install and relatively inexpensive. They are a reasonable energy saving addition to commercial work areas that will not impact the way the work areas function. Once the sensors are installed and pay themselves off over time, they will only benefit the facility in the future by saving money. Such a project is very similar to past energy lighting updates and therefore has a more promising result.

**Costs and Return on Investment**

* Total cost = $3,417.49
  + $475.75 + $1413.60 + $277.14 = $2166.49 Product Total
  + Shipping and Handling/ Misc. Costs $126 Misc. Total
  + Installation costs are estimated to be $30 for each fixture totaling $30 x 25 fixtures = $750. Installation costs are estimated to be $15 for each glow safety inside release handle totaling $15 x 25 = $375.
  + $750 + $375 = $1,125 Installation Total
* $513 saved per year resulting in 6.5 years to pay off costs
  + $15.28 electricity/week prior to changes (calculations in appendix)
  + $2.82 electricity/week after changes (calculations in appendix)
  + Amount of electricity saved = $12.46 electricity/week = approximately $513 per year
  + $3,417.49 cost/$513 per year = 6.5 years

**Timescales**

* Week 1-2 Hire contractor and finalize plans
* Week 3-4 Purchase products and set date for installation
* Week 5 Install and test for safety
* Immediate energy and cost savings
* 6.6 years later, savings break even with initial costs

**Recommendation**

Future considerations include replacing the fluorescent bulbs with 5T bulbs and placing occupancy sensors in downstairs freezer.

**References**

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5. Lighting—Occupancy Sensors. U.S. Department of the Interior Web site. http://www.doi.gov/greening/energy/occupy.html. Accessed April 30, 2012.
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