Pollution Prevention and Finance

NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

Green Lights' Economics: Graphic Design Considers a Lighting Upgrade

By Michael Tucker, Associate Professor of Finance, Fairfield University

A Phone Call Gets the Ball Rolling

Sam Taylor, owner of Graphic Design, had just received a call from Bob Jackson of Energy Solutions offering a free, no-obligation lighting audit. Using the audit, Jackson would determine how much electricity Graphic Design's lights used and propose an alternative system.

A lighting audit wasn't exactly at the top of Sam's "do-it-now" list. Although he recognized the importance of good lighting, it was something that he thought he had taken care of five years earlier when he redesigned the building's interior and had the current fixtures and bulbs installed. It had cost plenty at the time and seemed to be working fine—why should he replace anything now? Jackson responded that Graphic Design's lighting system was probably using considerably more electricity than necessary.

At nine cents per kilowatt hour (kWh)[1], electricity was not cheap. Then again, thought Taylor, the expense wasn't hurting his bottom line. He was also concerned that the cheaper lighting might be of lower quality. Jackson assured him that this was not the case. Finally, there were rumors, not scientifically substantiated, that radioactive material in the ballasts could be harmful.

Because Taylor owned the building, a lighting upgrade sounded more palatable than if his company had been a tenant. Still, it was likely to cost more than Taylor wanted to spend on something that didn't seem to need fixing. He wondered if that money might be better spent on new equipment or software instead of high-tech lighting Then Jackson mentioned that South Norwalk Power and Lighting (SNP&L) would pick up half the cost of any installation as part of its program to reduce electricity usage. Taylor sensed a bargain and his interest went up a notch. He invited Jackson to inspect his building the following day.

Reducing Greenhouse Gases With "Green" Lights

When Jackson arrived, he described the United States Environmental Protection Agency (U.S. EPA) program from which he had received his training in the energy-efficient lighting business. Called Green Lights, the program reduces power plant emissions of carbon dioxide (the biggest contributor to global warming) and other greenhouse gases by encouraging participants to install energy-efficient lighting.

Greenhouse gases prevent or inhibit heat generated at the surface of the earth from escaping. Venus is an example of an extreme greenhouse effect: the predominantly carbon dioxide atmosphere traps the planet's heat, keeping surface temperatures around 800° F. While Earth is not about to become like Venus, explained Jackson, scientists have concluded that human-induced changes in atmospheric composition (i.e., increasing emissions and the accumulation of greenhouse gasses) are creating greenhouse conditions, and global warming appears inevitable. The degree to which it will occur depends on what actions humanity takes in the near-term to reduce emissions. At the 1992 United Nations Convention on Environment and Development, global warming concerns prompted major industrial nations to agree in principle to roll back carbon dioxide emissions to 1990 levels. Changing to energy-efficient lighting is a small step toward accomplishing this goal.

[1]For example, an appliance that draws 1,000 watts for one hour has consumed 1 kWh.

Green Lights participants typically reduce the lighting portion of their electricity bill by more than half and often improve lighting quality. Although rebates from electric utilities have been a big motivator in some areas of the country, internal rates of return (IRRs) average 47% — this benefit, along with the environmentally positive nature of the program, is often a sufficient motivator for another company to participate in Green Lights.

Environmental stewardship was a major focus of interest at the local high school. Lately, Sam Taylor had been hearing about it from his teenage son. If he bought into this Green Lights program, he could show his son that he was doing more than just talking about making a difference. Of course, if he could "do well [financially] by doing good," all the better.

Can Green Lights Save Money Too?

Jackson explained that utilities, for their part, were not handing out rebates purely out of generosity. Reductions in peak power usage meant lower construction budgets for new power plants. A one-kWh reduction in electricity demand translated into $1,500 of future construction costs deferred or possibly avoided.

To Taylor, Green Lights sounded like just the type of program the country needed to get away from government bureaucracy and still make progress on taking care of the environment. Without being subjected to any new regulations, laws, or threats of fines, companies participating in Green Lights, by cutting their demand for electric power, are reducing future carbon dioxide emissions from power plants by 1,750 million metric pounds per year.[2] This is the equivalent of taking 165,000 cars off the road annually. Major reductions in sulfur dioxide and nitrogen oxides are also being accomplished. In addition to cleaning up the air and cutting back on greenhouse gases, the 1,753 participating companies are going to save at least $98.1 million per year on their future electric bills. This is only the beginning of what is possible: if all eligible companies invested in lighting upgrades, potential energy savings could be as high as $16 billion per year; resulting reductions in carbon dioxide emissions would equate taking a third of all cars in the U.S. (44 million) off the road.

Although the big picture sounded great, Taylor needed to get a handle on what could be done at Graphic Design and what it was going to cost him. The future savings Jackson talked about would have to be large enough to overcome any up-front expenditures. There was also the possibility of selling the old lighting system. Jackson had intended to haul it off to the dump but said it could fetch a few hundred dollars.

One area of savings would be reducing the fixed cost component of Graphic Design's electric bill. Jackson explained that once a year SNP&L measured electricity demand. Based on what a firm was using at that time, the utility estimated the company's peak kilowatt demand. It was the utility's obligation to have adequate capacity to meet the highest likely (peak) demand of Graphic Design and all the other companies and homes on its power grid. For maintaining this capacity, SNP&L charged each company a "peak demand charge": $5.00 per month for every kilowatt measured during the annual visit. If Graphic Design reduced its peak demand, its monthly peak demand charge would also go down. Currently, Graphic Design's annual peak demand charges alone totaled $271.94 (including 6% sales tax).

The Proposal and the Decision

After surveying all the fixtures and querying Taylor on how many hours each light was in use, Jackson briefly described his proposal. First, he would estimate current annual kWh used per fixture and calculate annual electrical costs based on the nine-cent-per-kWh rate charged by SNP&L. Next, he would estimate the reduction in annual kWh consumption that could be accomplished through three methods: (1) installing motion sensor devices that would automatically turn lights off when no one was in a room, (2) replacing the ballasts in the fluorescent fixtures with more efficient ballasts, and (3) replacing the existing fluorescent tubes with tubes requiring less/lower wattage.

Two days later, Jackson faxed Taylor a proposal outlining current usage and potential savings (Table 1), a guarantee that the reductions would actually be realized (Exhibit 1), and a memo detailing the impact of those reductions (Exhibit 2). Energy Solutions' total charge for the installation would be $2,500.

Even though Taylor was impressed by the savings and was looking forward to showing the memo to his son, he still had a few financial questions.

[2]As of March 31, 1995; EPA estimate.

TABLE 1: LIGHTING ENERGY ANALYSIS

Current Lighting System

	Number of fixtures	Lamps per fixture	Wattage	kW	Annual hours of use	Annual kWh usage
President's Office	2	4	168	0.336	2,250	756.0
Signs	6	2	30	0.180	8,760	1,576.8
Loading	2	4	168	0.336	2,250	756.0
Kitchen	1	4	168	0.168	2,250	378.0
Bathroom	1	2	84	0.084	1,000	84.0
Workspace 1	2	4	168	0.336	2,250	756.0
Bathroom 2	1	1	60	0.060	500	30.0
Entrance	1	4	168	0.168	2,250	378.0
Workspace 2	4	4	168	0.672	2,250	1,512.0
Other	13	4	168	2.184	2,250	4,914.0
			total kW demand: 4.524		**total kWh consumed: 11,140.8**	

Proposed Lighting System

	Number of fixtures	Lamps per fixture	Wattage	kW	Annual hours of use	Annual kWh consumption
President's Office	2	4	106	0.212	1,125	238.5
Signs	6	2	11	0.066	8,760	578.2
Loading	2	4	60	0.120	750	90.0
Kitchen	1	4	60	0.060	1,125	67.5
Bathroom	1	2	60	0.060	500	30.0
Workspace 1	2	4	106	0.212	1,800	381.6
Bathroom 2	1	1	15	0.015	500	7.5
Entrance	1	4	60	0.060	2,250	135.0
Workspace 2	4	4	106	0.424	1,500	636.0
Other	13	4	106	1.378	2,250	3,100.5
			total kW demand: 2.607		**total kWh consumed: 5,264.8**	

	utility charge	tax	savings
Peak Demand Reduction: 1.917 kW	**$5.00 * 12 months**	**0.06**	**$121.92**
Annual Use Reduction: 5,876 kWh	**$0.09/kWh**	**0.06**	**560.57**
		Total annual savings	**$682.50**

EXHIBIT 1

Energy Reduction Guarantee

Customer: **Graphic Design**
130 North Avenue
Norwalk, Connecticut

Energy Solutions hereby guarantees a reduction in kilowatt usage, as outlined in the Lighting Proposal, which, in turn, shall yield specific financial savings.

Graphic Design is guaranteed that upon completion of the retrofit there shall be a reduction in lighting energy demand of 1.92 kWh, plus or minus 10%.

Graphic Design agrees that the Current Lighting System as described in the Lighting Energy Analysis is a correct representation of the building's present system.

Any disputes as to the effectiveness of the new retrofit system's ability to reduce Graphic Design's kW load shall be settled by taking wattage readings from a reasonable number of fixtures to determine the new kW load. The number shall be compared against present lighting system kW load. In the event that kW savings fail to meet those promised (above), Energy Solutions will pay the difference between savings promised (minus 10%) and savings attained that would have accrued for the subsequent two years.

Energy Solutions is not responsible for changes in the financial analysis due to increases (decreases) in utility rates or customer operational hours.

_____

Robert Jackson
Energy Solutions

EXHIBIT 2

Environmental Memo

To: Sam Taylor, Graphic Design

From: Bob Jackson, Energy Solutions

The EPA estimates that, on average, installing the proposed lighting system will accomplish the following environmental goals every year:

Energy Consumption Reduction:	**5,876 kWh**
Reduction of Coal Consumption	**4,701 lbs.**
Reduction of Carbon Dioxide Emissions	**3,056 lbs.**
Reduction of Sulfur Dioxide Emissions	**53 lbs.**
Reduction of Nitrogen Oxide Emissions	**29 lbs.**

This installation is the equivalent of removing 0.28 automobiles from the road every year savings are achieved.

Questions

1. Taylor wanted to know how much his savings would be if he only installed the motion sensors (thereby reducing the hours of light usage) compared to the savings he would accomplish by only installing new ballasts and lamps (thereby reducing energy consumed per hour of usage).

2. Having been a business major in college, Taylor was familiar with net present value (NPV) analysis. He wanted to know the NPV of the installation's cash flows, taking into consideration that any of his savings would be taxed 31% by the federal government and 4.5% by the state. The 50% rebate offered by NP&E would save him $1,250, but the 6% state sales tax would apply to the entire $2,500 cost. For tax purposes, Taylor intended to expense the entire cost of the installation. Looking at 10 years worth of cash flows would be sufficient for the analysis. When Taylor first prepared a business plan for his company, he applied a 20% discount rate to projected cash flows. He recalled from a college finance course that, in some cases, it was appropriate to apply a risk-free discount rate to cash flows if there was no uncertainty attached to their occurrence. Currently the Treasury Bill rate was 6%. Of course, calculating the IRR would also be useful, particularly given his uncertainty about which rate to use; it was also a calculation that the EPA required of its Green Lights participants.

3. Taylor knew that SNP&L would not be keeping rates at 9¢/kWh forever. Assuming future inflation to be 3.5% per year, he wondered what the installation's NPV would be, beginning with the following year, when he would begin realizing savings from the installation. Concomitant with rate hikes was the assumption that the local economy would be improving and Graphic Design would be getting more work. This would lead to expanded hours of operation, with both workspaces being used up to 5% more each year for the next seven years, by which time their use would be maximized. What would the incremental NPV of Taylor's savings be under this scenario? It would be useful to take a look at NPV under a range of possible rate hikes from 0% to 7% to get a better idea of just how good deal this might be.

4. What are the financial and environmental implications of selling the old lighting system? By selling it, does Graphic Design perpetuate the use of inefficient equipment?

The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 734-764-1412
• Fax: 734-647-5841
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materialsand conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

Your Input is Welcome!
We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education*.

We're Online!
The NPPC provides information on its programs and educational materials through the Internet's Worldwide Web; our URL is:
http://www.umich.edu/~nppcpub/
Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!