THE ENERGY OBSERVER

Energy Efficiency Information for the Facility Manager

Quarterly Issue – September 2009

The Economics of Energy Efficiency

The Energy Observer summarizes published material on proven energy technologies and practices, and encourages users to share experiences with generic energy products and services. This quarterly bulletin also identifies informational sources and energy training for facility managers and staff. ***The Energy Observer*** is a service of the **Bureau of Energy Systems, Michigan Department of Energy, Labor & Economic Growth.**

This issue ties fundamental economic concepts to energy use in buildings. A British economist named Lionel Robbins defined economics as "the study of the use and allocation of scarce resources that have alternative uses." In the case of building energy use, those resources are primarily the budget (dollars) used to purchase natural gas, propane, fuel oil, and/or electricity for the facility. Increasing the energy efficiency of a building usually means that fewer dollars are needed to heat, light and cool, and power equipment in the building. The resulting energy cost savings can be used instead for other valued goods and services. However, buying the most energy efficient building equipment doesn't always make economic sense. This issue aims to explain when and when not to choose higher efficiency options; and to assist facility and building managers in making the case for buying appropriate energy efficiency and conservation measures for their facilities.

Opportunity Cost

What is spent on energy use cannot be spent on other goods, and these alternative goods are called *opportunity costs*. While every building requires a certain amount of energy to be habitable and functional, using more energy than necessary to operate inefficient equipment and/or running equipment when it is not needed is forfeiting opportunities for more valued investments in your facility. Neglecting energy waste can put a business at a competitive disadvantage, and put public entities, such as schools and municipalities, at an increased risk of running budget deficits.

Initial Cost

While many organizations would like to reduce their energy costs and become energy efficient, they may see the first cost of the new equipment and decide not to purchase it, with the reasoning that it's too expensive and/or there are insufficient funds in the budget. While various financing methods are offered by energy companies and financial institutions to pay for projects over time, there is another important reason to not allow short-term costs to halt energy efficient upgrades: the payback period.

Payback Periods

When higher efficiency equipment is purchased, it should be done so with the expectation that it will consume less energy and require less maintenance during its operating life. The accumulated energy cost savings will eventually equal, and then exceed, the first cost of purchasing and installing the equipment. The time period for the accumulated savings to equal the initial investment is known as *simple payback*, and it can range from months to decades. The payback period is what makes certain measures more attractive to implement than others. For example, replacing a 60W incandescent bulb that's used 2,080 hours/yr and costs $12.48/yr to operate with a $4, 13W compact fluorescent lamp (CFL) that costs $2.70 a year to operate yields an annual savings of

$9.78. So, despite the higher cost of the CFL vs. the $0.32 incandescent bulb, the CFL pays for itself in $4 / $9.78 = 0.41 years, or a little less than five months. In this case, the difference in energy efficiency between the two technologies, along with the annual usage, generated enough cost savings so that the CFL paid for itself in a short amount of time. Had the 60W incandescent been replaced with a lighting technology that consumed 50W, or the fixture itself was used only 20 hours per year, the payback would have been much longer.

Sometimes a measure provides good energy savings but the cost of implementation is so high that it still takes many years to pay for itself. This is often the case with windows, insulation, and some HVAC components. In addition, measures that reduce time of usage, such as occupancy sensors for lighting and programmable thermostats for heating and cooling, can be an unnecessary expense in buildings where the occupants are diligent about turning off lights and setting back thermostats at night and on weekends. The cost of energy, the price of the new equipment, the hours of use and the amount of energy demanded by the facility are all factors in determining the payback period and thus, the economic feasibility of implementing a project.

Incremental Cost

Sometimes replacing the equipment for energy efficiency alone is not economically viable, since the first cost would have to be factored in and could result in a payback period that exceeds the operating life of the equipment. In those cases, the equipment will be replaced for reasons other than it's inefficiency. For instance, windows may be cracked or broken, or an old steam boiler may not longer be deemed safe by inspectors. Unfortunately, since the energy efficient models of replacement equipment typically cost more, a decision maker may only look at the short-term cost and purchase the cheaper and less efficient replacement model, without taking into account the higher energy costs that will be incurred in the long run. Since the equipment has to be replaced anyway, the additional or *incremental cost* of choosing a higher efficiency model over a standard or lower efficiency model should only be considered when calculating payback. This is usually a fraction of the total cost, and thus typically results in shorter payback periods.

Energy Projects and Audits

When longer-payback measures are implemented at the same time as shorter payback measures in a building energy project, the *aggregate payback,* or the total project cost divided by the total annual savings resulting from it, is often within an acceptable timeframe. In addition, replacing multiple pieces of equipment at once can have decisive advantages over doing it piecemeal. For example, replacing windows and adding insulation to the walls and roof will lower the heating load requirement of the building. Thus, the boiler or furnace can be replaced with not only a higher efficiency model, but possibly a smaller one as well. If the boiler had been replaced without the new insulation and windows, it would have been more efficient but might have been oversized if the insulation and windows were added at a later date.

An *energy audit* by a qualified engineering professional or firm can determine the cost and payback periods for many types of energy projects, as well calculate new heating and cooling load requirements and interactive effects between equipment. Such audits should be considered for large energy projects to best determine the most cost-effective measures and combination of measures.

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