Prioritizing Energy Projects

When it comes to saving energy in your facility, your imagination may be limitless, but your budget likely is not

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Editor's note: In September, the author will present "Practical Energy Benchmarking for Commercial, Institutional, and Light-Industrial Facilities" during HPAC Engineering*'s seventh annual Engineering Green Buildings Conference and Expo. For more information, go to* www.egbconference.com.

Sustainability, green energy, and LEED certification are the topics of the day for building owners and managers. With so many conservation opportunities, how does one determine which projects to pursue on a limited budget?

To this observer, there is far too much emphasis on supply-side issues, such as rate structure and regulation, supply and price variability, futures speculation, and contract negotiations. Let your company's policymakers handle those high-profile political issues. Concentrate your efforts on demand-side optimization.

Determining which projects will produce the "biggest bang for the buck" can consume scarce resource time, but is crucial to having a sound energy-conservation plan that produces effective savings the boss will appreciate.

The first order of business is to analyze one or two years' worth of energy costs and use. Because financial types may not be readily able to compare a kilowatt-hour of electricity to a therm of gas, energy data need to be converted on a "unit-cost" basis for comparison.

Which forms of energy are likely to escalate in price over the next three to five years? If you do not have access to local energy-price forecasts, go to the Website of the U.S. Energy Information Administration (*www.eia.doe.gov*).

Table 1 provides data for comparing energy use and cost on an equal basis. Site energy should be compiled into one energy-measurement standard. British thermal units per year is recommended.

Thermal energy is measured in British thermal units (Btu)
1 Btu = the heat required to increase the temperature of 1 lb of water 1°F (at 68°F)
1 million Btu = 1 MMBtu
1,000 Btu per hour (Btuh) = 1 MBH
Electrical energy is measured in kilowatts (kw)
1 kw = 3,414 Btu
1 million kilowatt-hours (kwh) = 3.414 MMBtu
1 therm (gas) = 100,000 Btu
Natural gas = 1,010 to 1,040 Btu per cubic foot
Propane = 2,500 Btu per cubic foot = 91,500 Btu per gallon
Kerosene = 130,000 to 134,000 Btu per gallon
No. 2 fuel oil = 138,000 to 140,000 Btu per gallon
No. 6 fuel oil = 148,000 to 152,000 Btu per gallon

TABLE 1. Useful energy-conversion data.

Table 2 shows how to compare the various sources of energy on an equal basis.

Electricity is three to five times more expensive than natural gas and expected to remain so. In some regions, the price of electricity is expected to continue rising at a rate of 4 to 8 percent a year because of commercial and residential growth and the Communication Age explosion. Meanwhile, the Henry Hub natural-gas-price

For engineering accounting purposes, energy costs normally are expressed in dollars per million British thermal units (MMBtu)
With natural gas costing 60 cents per therm: $0.60 per therm ÷ 102.0 Btu per therm = $5.90 per MMBtu
With No. 2 fuel oil costing $2.20 per gallon: $2.20 per gallon ÷ 140,000 Btu per gallon = $15.70 per MMBtu
With electricity costing 7 cents per kilowatt-hour (kwh): $0.07 per kwh ÷ 3,414 Btu per kwh = $20.50 per MMBtu
With electricity costing 12 cents per kilowatt-hour: $0.12 per kwh ÷ 3,414 Btu per kwh = $35.15 per MMBtu

TABLE 2. Energy-supply-cost comparison.

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forecast through 2011 is a relatively stable $4 to $6.

Many facilities use more thermal energy (gas and oil) than electrical energy over the course of a year, but the annual cost is much less. For the facility in Figure 1, electrical projects surely would be more likely to yield greater overall savings and a higher annual rate of return.

Table 3 is a generic list of potential sources of electrical- and thermal-energy savings in a typical facility. The challenge is to conduct a brief assessment and identify several good opportunities.

Table 4 contains examples of cost-savings calculations for an electrical project and a thermal project. Each item identified for a facility should be analyzed in a similar manner.

Some electrical projects (e.g., replacing perfectly good lighting and smoothly running motors) may seem time-consuming and result in lower overall savings. If your power cost is 4 to 6 cents, electrical projects will not yield a good return on investment. Conversely, if your power cost is 10 to 12 cents, any type of electrical project will be extremely attractive. Moreover, thermal projects also can produce exceptional savings. You just need to perform the audits and associated analysis.

Tabulating everything in an Excel spreadsheet (using next year's energy-supply and project-implementation costs) can be an easy method of comparing economic benefits and presenting projects to management for approval. Additionally, it makes you much better prepared to have an honest discussion with equipment suppliers.

When purchasing products, use life-cycle analysis, rather than simply go with the lowest-cost option. One caution: Government stimulus programs have drawn a few nefarious characters into the green-energy movement. Some were selling automobiles and real estate just last year. Check the fine print about performance guarantee before buying.

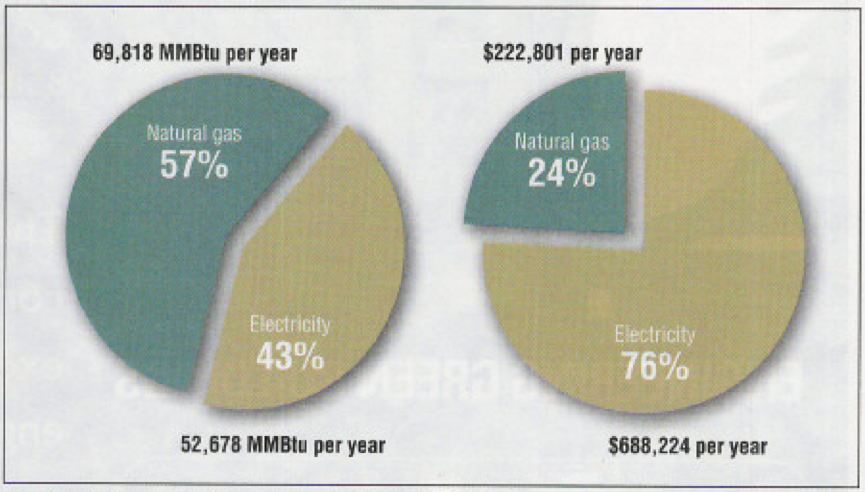

FIGURE 1. A Chicago office building's energy use, 2008.

ELECTRICAL	
• Lighting and sensors • Data center • Security equipment • Infrared space heaters • Vending equipment • Electric hot-water units • Setback thermostats • Transformers and motors • Hand tools • Rolling stock (trucks) • Air leaks • Variable-speed drives on pumps and fans • Welders • Heat treating	• Office equipment • Doors and elevators • Shredders and compactors • Kitchen appliances • Washers, dryers, and ovens • Air conditioning • Refrigerators and freezers • Control systems • Machine drives • Compressed-air equipment • Vacuum pumps/blowers • Excess ventilation • Autoclaves • Acrylic reflective paint
THERMAL	
• Steam boilers • Gas and oil heaters • Compressed-air heat recovery • Furnace and air-handling-unit (AHU) filters • Doors and windows • Setback thermostats • Duct insulation • Cascade cooling water • Oil-fired processes • Feedwater heating • Condensate loss • Exhaust fans	• Thermocompressors on low-pressure steam • Pipe insulation • Gas hot-water heaters • Building enclosures • Attic insulation • AHU heat and air-conditioning controls • Water thermal loss • Gas-fired processes • Combustion efficiency • Steam leaks • Process-exhaust heat recovery • Electronic controls

TABLE 3. Sources of potential energy savings in a typical facility.

Assume 250 8-ft, two-bulb Type T12 fluorescent-light fixtures in a facility can be shut off as employees leave. If electricity is 8 cents per kilowatt-hour, what is the annual savings?
250 units × 148 w × 12 hr × 320 days = 142,000 kwh
142,000 kwh × 3,414 Btu per kwh = 485 MMBtu per year
142,000 kwh × $ 0.08 per kwh = **$11,360 per year**
Assume a 3-in. steam valve has a cracked body and is leaking 800 PPH. If boiler fuel is $6 per million British thermal units, what is the annual loss?
800 PPH × 1,200 Btu per lb = 0.96 MMBtuh = 8,410 MMBtu per year
800 lb per hr × 1,200 Btu per lb × (1.0 ÷ 0.8 eff.) × 24 hr × 365 days × $6 per MMBtu
0.8 × 1.2 ÷ 0.8 × 24 × 365 × $6 = **$63,070 per year**

TABLE 4. Economic analysis.