Managing Energy Costs in Microbreweries

Microbreweries are highly energy-intensive businesses that can greatly benefit from energy-saving strategies. Facilities managers from brewpubs like Titletown and Deschutes—as well as those from larger craft breweries like New Belgium, Stone, and Sierra Nevada—can all attest to the fact that "tapping" into energy savings can boost your bottom line and, if desired, help your brewery to attain a greener image. Nearly all of the measures described below will pay for themselves within three years, with many having simple payback periods of only a few months. In cases where utility incentives also apply, these actions can be even more cost-effective.

How Breweries Use Energy

The brewing process involves mixing, or "mashing," malted barley (and other grains, if appropriate) with high-temperature water, draining the resulting liquid, or wort, off of the grains, boiling it while adding hops and (optionally) other spices, cooling the wort, adding yeast, and letting it ferment at a temperature suited to the strain of yeast employed. Once the wort has fermented, bottles are cleaned and filled with the resulting beer, then packaged for delivery. Depending on the brewery, beer may be cellared or kept in cold storage before distribution.

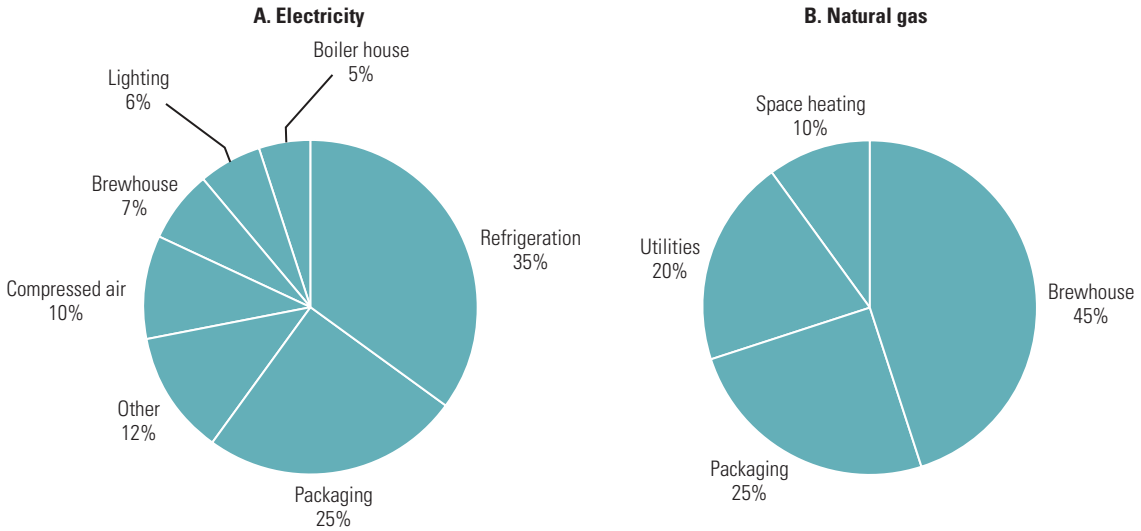
The exact mix of electrical and thermal energy used in different processes will vary from brewery to brewery depending on such factors as equipment used, packaging employed, and the size, age, layout, and location of the brewery. However, most electricity generally goes toward packaging and refrigeration, whereas most thermal energy (from natural gas or coal) goes toward the actual brewing process (**Figure 1**). Because microbreweries can consume as much as twice the energy per barrel of finished product as large macrobreweries and typically have narrow profit margins, energy-efficiency measures can be a particularly effective way to save money and thereby increase profits.

First Steps Toward Energy Savings

Even without actually reducing energy consumption, breweries may be able to immediately lower their electric bill by changing the times when energy-intensive processes (like wort

FIGURE 1: Energy consumption in breweries (all sizes)

Data from the U.S. Environmental Protection Agency (EPA) show that refrigeration, packaging, and compressed air consume 70 percent of U.S. breweries' electricity use (A), whereas the brewhouse dominates natural gas and coal use at 45 percent (B).



boiling) take place. Because breweries are typically charged higher electricity rates during times of peak load and may be penalized for having poor power factor, it's possible to reduce bills by as much as 20 percent through load shifting, load shedding, and power factor correction. Contact your utility to learn more about your energy rate and find out how to reduce peak demand surcharges.

To actually start reducing energy consumption, the first step that a microbrewery should take is to perform an energy audit. This generally entails the examination of existing equipment and systems (and measuring actual energy consumption) to verify that they are working as intended and to identify areas for improvement. Energy audits typically result in a list of straightforward and cost-effective measures that can save energy and improve system performance while also providing baseline data, which can be used to assess the effectiveness of larger improvements. Your utility can help you learn more about performing an audit and may be able to provide an audit service free of charge.

Improve Equipment Efficiency

There are many systems that offer substantial energy-saving potential in breweries, including boilers, refrigeration and cooling systems, compressed-air systems, motors, and packaging systems.

Boilers and Steam

Boiling wort is the single most energy-intensive step in brewing, and fuels for boilers alone can account for 25 to 35 percent of a brewery's overall energy bill. There are several ways to cut energy use in the boiling process.

Identify leaks. Steam and condensate leaks directly result in energy waste, but they are generally straightforward to detect and seal.

Insulate effectively. Steam and condensate return lines and components are often poorly insulated. Ensure that a sufficient level of insulation is in place to minimize heat loss and save energy.

Adjust steam pressure. Higher pressures than necessary can result in leakage and steam losses, whereas pressures that are too low can yield significant heat loss during distribution and end use. Check steam pressure regularly to ensure that it is just high enough to meet the maximum equipment requirements.

Add heat recovery. Heat recovery is a great way to reduce energy waste and can be accomplished at several points in the brewing process, though the need for additional piping and heat exchangers may result in high initial costs. One of the most effective options is to recover heat from the steam released from the brew kettle (where wort is boiled) using spray condensers or heat exchangers. These systems can recover as much as 60 percent of the energy required for wort boiling, which can be used to preheat new incoming wort, produce hot water for cleaning, or in a variety of other applications. New Belgium uses this technique to generate and store hot water in a large tank, which is then used to heat wort from 76° to 90° Celsius (C) before it is boiled.

Another approach is to capture waste heat from the mash or hot water tanks, which can help to reduce the amount of energy consumed in the mashing process. Heat can also be recovered from the wort cooling step; this may be particularly cost-effective because the warm water essentially just needs to be rerouted.

Lastly, adding heat recovery to a keg washer system can reduce cleaning energy by 40 percent and recover 85 percent of the heat required to warm incoming water.

Refrigeration and Cooling

Refrigeration plants commonly use over 20 percent more energy than they actually need. Because refrigeration represents around 35 percent of a brewery's electricity bill, these systems present a significant opportunity for energy savings.

Optimize setpoints. A 1° Fahrenheit (F) increase in evaporating temperature, or a 1°F decrease in condensing temperature, can reduce energy consumption by 1 to 2 percent. Evaporation temperatures, in particular, are often set lower than necessary.

Insulate chilled water or coolant pipes. As with other areas, insulation is a great way to reduce energy waste and realize savings.

Manage auxiliary loads. Poor control of auxiliary loads (including inadequate insulation of cold storage areas, air infiltration, open doors, etc.) can increase energy costs by more than 20 percent. The initial audit should identify major cooling loads and ways to reduce them.

Properly sequence compressors. Compressors operate most efficiently at full load. In a system with multiple compressors, the most efficient operation occurs when you sequence compressors based on their loads and respective efficiencies, and when you ensure that only one compressor operates at part-load.

Install destratification fans in cellars. Destratification ceiling fans can help to maintain a consistent air temperature throughout a cellar, resulting in lower cooling requirements.

Compressed Air

Although compressed air is often viewed essentially as a free resource, these systems account for nearly 10 percent of overall electricity consumption and are often poorly designed or maintained.

Match your supply to your load. Generate compressed air at the pressure required—halving pressure can result in energy savings of more than 50 percent. Additionally, sequence your machines to ensure that, when the demand is at less than full capacity, one or more compressors are entirely shut off (instead of having several operating inefficiently at part load).

Check for leaks. Leaks are a major source of energy loss and can effectively double the cost of compressed air. Because leaks also result in lower pressure at the end point, they can cause operators to set pressure levels higher than would otherwise be necessary. A leak detector can provide long-lasting benefits and can pay for itself in less than six months.

Switch off compressors. Turn compressors off when production is down, and consider making piping changes to enable shutting off of supply to production areas when there's no need for compressed air.

Review operations. Look for areas where an alternative technology could replace compressed-air use.

Motors

Motors are widely used in fan and pumping applications, and they are a good target for efficiency improvements.

Variable-frequency drives (VFDs). VFDs match motor output to real-time load, and they can result in savings as high as 45 percent depending on the application. They can also improve power factor, potentially resulting in fewer utility surcharges.

Downsize your motors. Motors are often more powerful than necessary, producing needlessly high energy consumption and peak power draw. If possible, consider replacing motors with smaller units.

Upgrade to high efficiency. When considering whether to repair or replace aging motors, keep in mind that new, more-efficient units can save significant amounts of energy and yield short simple payback periods.

Packaging

Packaging comprises everything from bottle filling to palletizing, and it is a major source of energy consumption in most breweries. As a result, the implementation of efficiency measures related to packaging can be a great way to cut costs.

Optimize line efficiency. In addition to reducing the number of shifts required, increasing line efficiency can greatly impact energy use by helping to eliminate losses when the line is idle.

Run conveyors only when necessary. This simple step can save money by reducing energy consumption and demand while also conserving lubricants and water. Although this can be done manually, automation controls can make this easier.

Other Ways to Save Energy

In addition to the measures mentioned above, there are some other effective energy-saving strategies to be aware of.

High Gravity Brewing

Because most of the brewing process uses essentially the same amount of energy regardless of beer strength, one

effective strategy is to produce, ferment, and process more-concentrated wort, diluting the beer to normal strength just before bottling. This approach can greatly reduce per-barrel energy consumption while simultaneously increasing the output capacity of the brewery and improving consistency. While some macrobreweries may dilute their product by as much as 40 to 60 percent, diluting by as little as 3 to 5 percent will still yield benefits without a noticeable flavor impact.

Brew Batches Back to Back

A large amount of energy goes into just preparing brew equipment (like boilers) for use. By brewing multiple batches back to back, instead of spreading out the process over several days, you can minimize this wasted energy use while simultaneously reducing your peak load consumption.

Restaurants

A number of microbreweries also operate as part of a brew pub. In these cases, there are even more opportunities for reducing energy consumption. Ask your utility for information on energy-saving measures specific to restaurants, including efficient cooking equipment, vent hoods, and refrigeration.

HVAC

As in all buildings, HVAC represents a consistent source of energy consumption and can be made to operate more efficiently.

Change HVAC settings. During closed hours, turn temperature settings down in heating seasons and up in cooling seasons. You can automate these settings with programmable thermostats. Additionally, make sure that HVAC settings in stockrooms, offices, and other peripheral spaces are at minimum settings.

Maintain your HVAC system. Making sure that your HVAC system is regularly cleaned and serviced can help to prevent costly heating and cooling bills. If your system uses an economizer, have a licensed technician check, clean, calibrate, and lubricate it about once a year, as economizer failure can increase heating and cooling costs by up to 50 percent.

Lighting

Improving the efficiency of your lighting systems can be straightforward and inexpensive, and it is an easy way to save energy.

Fluorescent lamps. If your facility uses T12 fluorescent lamps, relamping with modern T8 lamps and electronic ballasts can reduce your lighting energy consumption by 35 percent or more. Adding specular reflectors and new lenses can increase these savings and yield short simple payback periods.

Install occupancy sensors. Areas that are not consistently occupied—such as storage rooms, restrooms, back offices, and walk-in refrigerators—are ideal places for occupancy sensors. They can save 30 to 75 percent in lighting-energy consumption, and they typically yield simple payback periods of one to three years.

The Bottom Line

All of the measures discussed above represent good investments. Not only will they save you money and pay for themselves quickly, but they can also help your brewery establish a greener image that could lead to improved sales.

Resources

Brewers Association of Canada, "Energy Efficiency Opportunities in the Canadian Brewing Industry," http://oee.nrcan.gc.ca/industrial/technical-info/benchmarking/benchmarking_guides.cfm#b. This guide, a joint project of the Brewers Association of Canada, Natural Resources Canada, and the CIPEC Brewers Sector Task Force, contains valuable energy-saving information for both large and small breweries.

Lawrence Berkeley National Laboratory, "Energy Efficiency Improvement and Cost Saving Opportunities for Breweries: An Energy Star Guide for Energy and Plant Managers" (PDF), http://www.energystar.gov/index.cfm?c=industry.bus_industry_info_center#brewing. Energy Star's guide to efficiency improvements in breweries covers a wide range of efficiency options, including both process-related and technology related measures.