CALCULATION GUIDE

Maximizing Free Economizer Cooling

The steps and example below will walk you through a process for estimating the potential energy cost savings from maximizing free economizer cooling.

Key Variables

The following are variables typically used in valuing maximizing free economizer cooling:

Building space: square feet

Cooling capacity: tons

Electricity usage: kilowatts (kW) and kilowatt-hours (kWh)

Energy costs and savings: dollars ($)

Step 1: Review Current Building Space and Cooling Capacity

Gather information about your facility's space and HVAC system configuration and operation. You will need to know your building's total square footage as well as the *cooling capacity* of the HVAC system, measured in tons.

You will also need to determine if your HVAC system includes economizers and the state of their repair and operation. Larger buildings typically have multiple air conditioning air handlers and/or packaged HVAC units, so there may be multiple economizers to check to see if they are working optimally.

If you are seeking to optimize economizer operation for a targeted space within a larger facility – whether a section of one floor, an entire floor, or multiple floors, you will need to also determine the square footage of this *targeted space* and identify the HVAC equipment serving it. For simplicity's sake, the following steps will focus on estimating the savings of economizer optimization to serve an entire building.

Let's assume we have a building with multiple commercial HVAC units equipped with economizers for free cooling that we can optimize. Following is key information about our building needed for our calculation:

- *Building square footage = 10,000 sq. ft.*
- *Cooling capacity = Four economizer-equipped HVAC units with a total of 25 tons of cooling capacity:*
    - *One 10-ton unit (economizer is in good repair and optimized)*
    - *Three five-ton units (only one economizer of the three is in good repair and optimized)*

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Your turn:

Building square footage: _____ square feet

Economizer-equipped HVAC cooling:

Number of units: _____

Number Optimized (if known): _____

Total cooling capacity: _____ tons

Step 2: Obtain Energy Usage and Cost Information

Find your facility's electricity costs by reviewing your monthly or annual electricity bill. You will need to know your facility's annual *total electricity usage* (in kWH) and *total electricity cost* (in $). Electricity rates can vary regionally; in the Pacific Northwest, an average cost for electricity for commercial facilities is $0.08/kWh.

Following are the electricity usage and cost figures for our sample building:

- *Annual building electricity usage = 205,100 kWh*
- *Annual electric bill = $16,408 (at an average price of $0.08 per kWh)*

Once you have your building's energy usage and cost data, you will need to determine what percent of that usage is dedicated to mechanical cooling. As this can be challenging to determine or calculate, it may be simpler to use a benchmark or rule of thumb for this *cooling percent of use*. For example, in a typical office building in the Pacific Northwest, mechanical cooling counts for about 10 percent of the building's total energy usage (see chart).

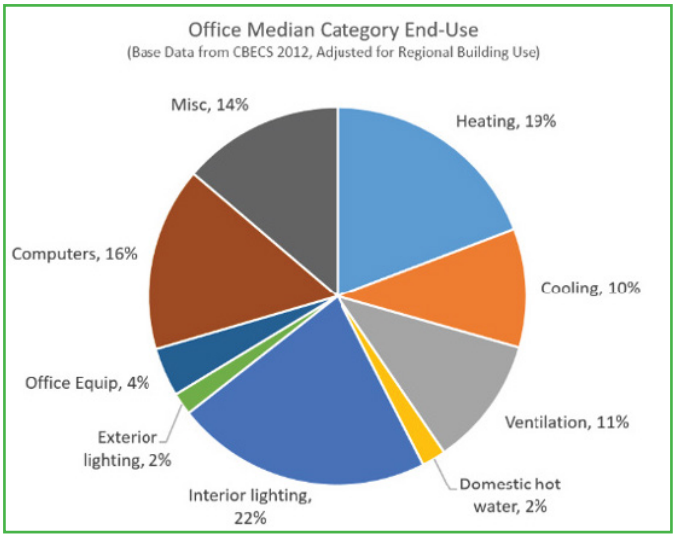

Image source: Strategic Energy Group

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Another figure you will need is *economizer savings*. This is the percent reduction of energy usage and costs that can be achieved through optimized operations of economizers. Since economizer specifications and performance can vary, it again may be most useful to use a benchmark or rule of thumb. On average, economizers save five to 15 percent of the mechanical cooling energy used, so we will assume a potential savings of 10 percent for estimating purposes.

Step 3: Estimate Percent of Cooling Load of Non-Optimized Units

Assuming your facility's HVAC system has multiple units or air handlers and you've determined that one or more have economizers that can be repaired or re-calibrated to operate optimally, you will need to estimate the *percent of the total cooling load* represented by the non-optimized units.

In our example, the total cooling capacity of the sample building's HVAC system is 25 tons, and 10 of those tons are contributed by two non-optimized units, representing 40 percent of the total mechanical cooling load (since *10 / 25 = 40 percent*).

Your turn:

Percent of cooling load provided by units with non-optimized economizers:
_____ tons /_____total cooling tonnage = _____ percent

Step 4: Calculate Estimated Annual Savings

Plug the data collected in the previous steps into the following formula to calculate estimated savings for setting or restoring economizers to optimal operation:

Estimated savings = Total electricity use (kWh) x Cooling percent of use x Percent of cooling by non-optimized units x Economizer savings x Electricity cost ($/kWh)

Here's how this looks for our sample building, based on our previous calculations and benchmarks:

Estimated savings = 205,100 kWh x .10 x .40 x .10 x $0.08/kWh

Estimated savings = $65.63

The savings generated by the sample calculation may seem low but multiplying the savings over greater tonnage will result in bigger savings.

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Your turn:

Total electricity use: _____ kWh

Cooling percent of use: _____ percent (or use benchmark)

Percent of cooling by non-optimized units: _____ percent

Economizer savings: _____ percent (or use benchmark)

Electricity cost: $ _____/kWh

Estimated savings = Total electricity use (kWh) x Cooling percent of use x Percent of cooling by non-optimized units x Economizer savings x Electricity cost ($/kWh)

Estimated savings = _____ kWh x percent
x _____ percent x _____ percent
x $ _____ /kWh

Your estimated savings: $ _____

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Additional Resources

NEEA Resources

Other SEM Hub tutorials. Check out other tutorials on the SEM Hub website that can help you learn and apply SEM at your facility and calculate their estimated savings. In particular, you may wish to view the tutorials on:

- How to Get and Record Energy Data
- How to Perform an Energy Audit
- How to Estimate Costs for Energy Projects
- How to Convert Measurements to Common Units

Toolbox Talk cards. Print-ready talk cards outlining a variety of strategic energy management (SEM) tools, approaches and methods for both industrial and commercial facilities.

Other Resources

Your utility or energy efficiency program provider. Check with utility or program representatives for any assistance, solutions, or incentives they offer for optimizing HVAC equipment, settings, and usage and implementing other O&M best practices that support energy-efficiency goals.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. This association for engineers, architects, contractors, building owners and others concerned with the design, operation and maintenance of HVAC systems in buildings funds research projects, offers continuing education programs and publishes technical standards.

Smart Buildings Center. This Seattle-based regional energy efficiency solutions provider offers education, training and resources for building engineers, managers and operators, including a lending library of measurement and diagnostic tools for energy efficiency and demand-reduction projects.

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