



*The Hidden Nightmare Lurking in Your Commercial Building*

# GENIUS WASTED

— *THE* —

## ECONOMIZER STORY



# GENIUS WASTED:

## The Economizer Story

*The Hidden Nightmare Lurking in Your Commercial Building*



As you walk into your home after a long day at work, you find the air inside to be hot and stuffy. So you open your windows and let cool outside air in. Problem solved.

Offices get hot and stuffy, too. But most commercial building windows can't be opened. That's a shame, because many times fresh air is all your workplace needs to be comfortable.

The State of California found a genius way to bring that fresh air into the building with a simple equipment change: require outside air intakes on commercial air conditioners. Close the intakes on hot days, but open them on cooler days to draw in outside air and cut run time. So, 25 years ago, the "economizer" was born.

Sounds great, doesn't it?

One study reveals that only one in four economizers functions correctly. What does this mean for your business?



Unfortunately, it was born only to become quickly neglected. Customers didn't understand it, couldn't remember to activate it, and wanted to pay as little as possible for the devices. Manufacturers obliged by cutting corners on the design and using lesser-quality components to lower the cost. The result? Outside air economizers frequently fail within a year or two. If they fail while open, they can draw hot outside air in during those triple-digit days, forcing the cooling equipment to work even harder than usual to maintain temperature. Energy "savings" becomes energy wasted. A genius idea becomes genius wasted.

## Welcome to the Economizer Story.

Back in 1845, engineer Edward Green created a set of vertically cast iron tubes he had connected above and below a basin of water through which the exhaust from a steam engine's boiler passed. This rudimentary exchange device saved fuel and boosted the efficiency of the engine itself. Once patented, "Green's Economizers" became the basis for modern-day feedwater heaters and the generators of today's combined cycle power plants.



A 1940's 'Green's Economizer' in a boiler house in Launceston, Tasmania. Image courtesy of [Wriekhathaar](#)

Economizers descended from Mr. Green's popular invention are used in today's commercial HVAC systems. In fact, they are **mandated by law** in all California buildings (meeting certain size requirements) under a regulation known as Title 24. Theoretically, this is a good thing, as modern economizers are designed to save energy by using the air outside a building to cool the air inside. Along with reducing utility costs, their design is supposed to improve indoor air quality too.

What's not to like about that?

# Economizers: The Big Misnomer for Many Business Owners

## Here's the deal.

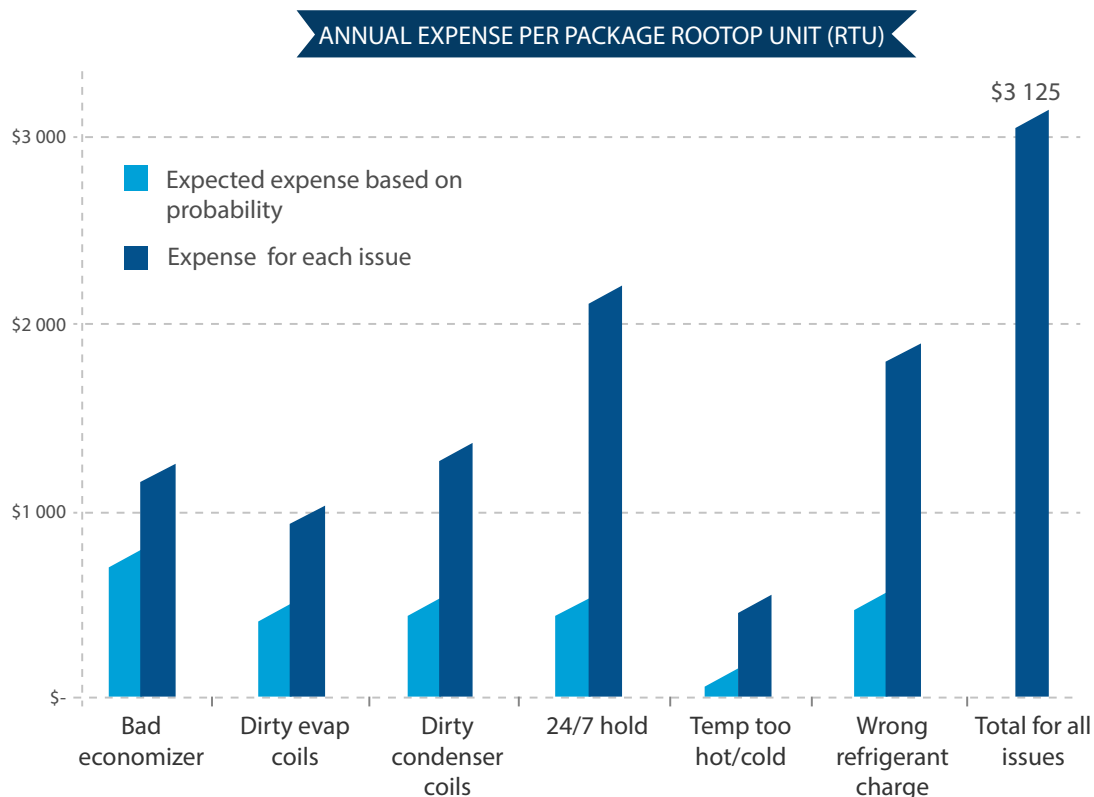
The reality is that many economizers are likely not to function properly. In fact, according to a recent California utility survey, hundreds of those in use across the state may not work at all. The economizers surveyed were found to have wiring or sensor problems, rusted or broken linkage issues, or even to have been disconnected long ago. Given that most building owners have no idea they even exist, let alone how they're supposed to function, this should not come as a big surprise. Even more distressful, however, is the fact that an inefficient or broken economizer not only doesn't save you energy but also may be costing you far more in utility costs.

## You read that right.



A poorly functioning economizer not only actively wastes energy in your building but also forces the rest of your HVAC equipment to work harder and less efficiently.

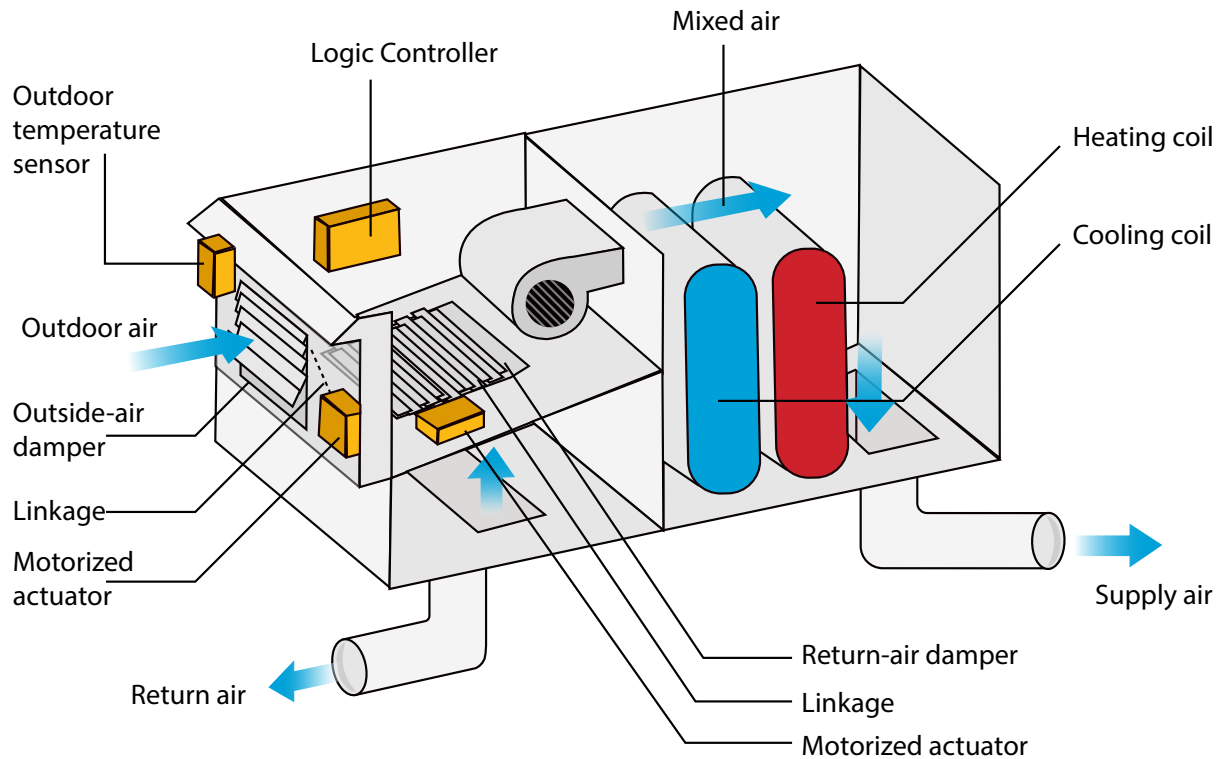
Many building owners are currently paying more every day for a part of their HVAC system that doesn't work properly, may never have worked well, and what's more, will ramp up their energy bills now and into the future. Your economizer could be a clear energy liability unless you inspect, restore and maintain its functionality.



*The U.S. Department of Energy commissioned multiple studies of more than 4,500 HVAC systems in order to pinpoint their associated maintenance costs. Economizers on average were responsible for more than a third of expenditures over a 12-month period.*

## What Are HVAC Economizers, Anyway?

First, there are two kinds of economizers used for HVAC: waterside and airside (wet bulb and dry bulb). Most systems we service utilize an airside economizer, for reasons that will be explained below. According to the Salt River Project (one of Arizona's largest utility companies), "an HVAC economizer is a dampered vent designed to save energy and give the cooling system a break. Sensors within the economizer compare the outdoor temperature and humidity with that inside the building. If the outside air is cool enough, the damper is opened to bring outside air in, thereby reducing the need for mechanically cooled air. If the outside air is not cool enough, which is indicated by the economizer's sensors, the damper is closed."



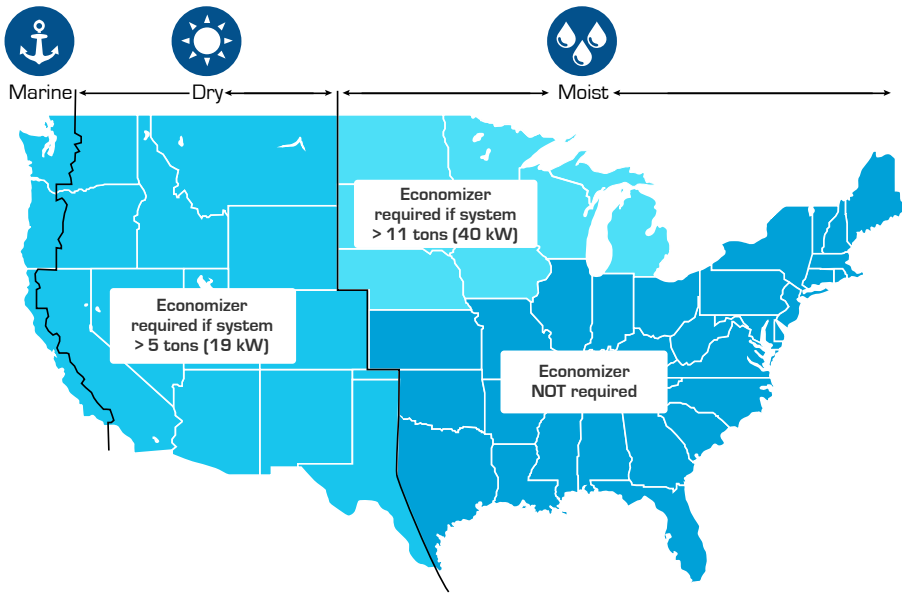
*Components of an air-side economizer*

Wet bulb or waterside economizers are more costly, as they are able to detect not only the temperature of the air, but also its moisture content. Waterside economizers are often used for data centers, as they require a large space for all the physical equipment. These economizers depend upon a water or air-cooled chill water plant to operate, utilizing the evaporative cooling capacity of a cooling tower to produce chilled water for use through a heat exchanger. They also perform best in climates where the temperatures are consistently less than 55 degrees for several months out of the year.

For these reasons, most economizers in California commercial buildings are airside (dry bulb). We'll focus on their strengths and limitations here.

## Airside Economizers: Frequently Used, Often Misunderstood

Dry bulb or airside economizers do not require a cooling tower and thus are relatively easy and inexpensive to install. However, they only recognize the temperature of the air, making them impractical in more humid environments. As a combination of duct and damper coupled with an automatic control system, they allow outdoor air to enter your building during mild periods, eliminating the need for mechanical cooling and improving indoor air quality with "fresh" outside air.



Moreover, in most commercial buildings in Southern California, there are some indoor areas that need HVAC cooling throughout the year. When it's cooler outside, it makes sense to utilize this cooler air for the inside of your building too, and avoid running the air conditioner. In simple terms, that's the logic behind these systems. And indeed, when they work

properly, they can save up to 10% of your energy costs, essentially paying for itself within five years.

Typically, an airside economizer relies on multiple dampers. These dampers are used for outdoor, return and relief air. During extremely cold weather, the damper for outdoor air will bring in only enough air from the outside for ventilation, mixing it with return air and heating it with your furnace as necessary. When it's only cool outside (sweater weather), mechanical intervention (heating or cooling) theoretically is no longer necessary. In that case, the economizer system will let in enough outside air to mix with the return air to maintain the inside temperature at a comfortable level, and you can avoid having to pay for any mechanical conditioning at all.

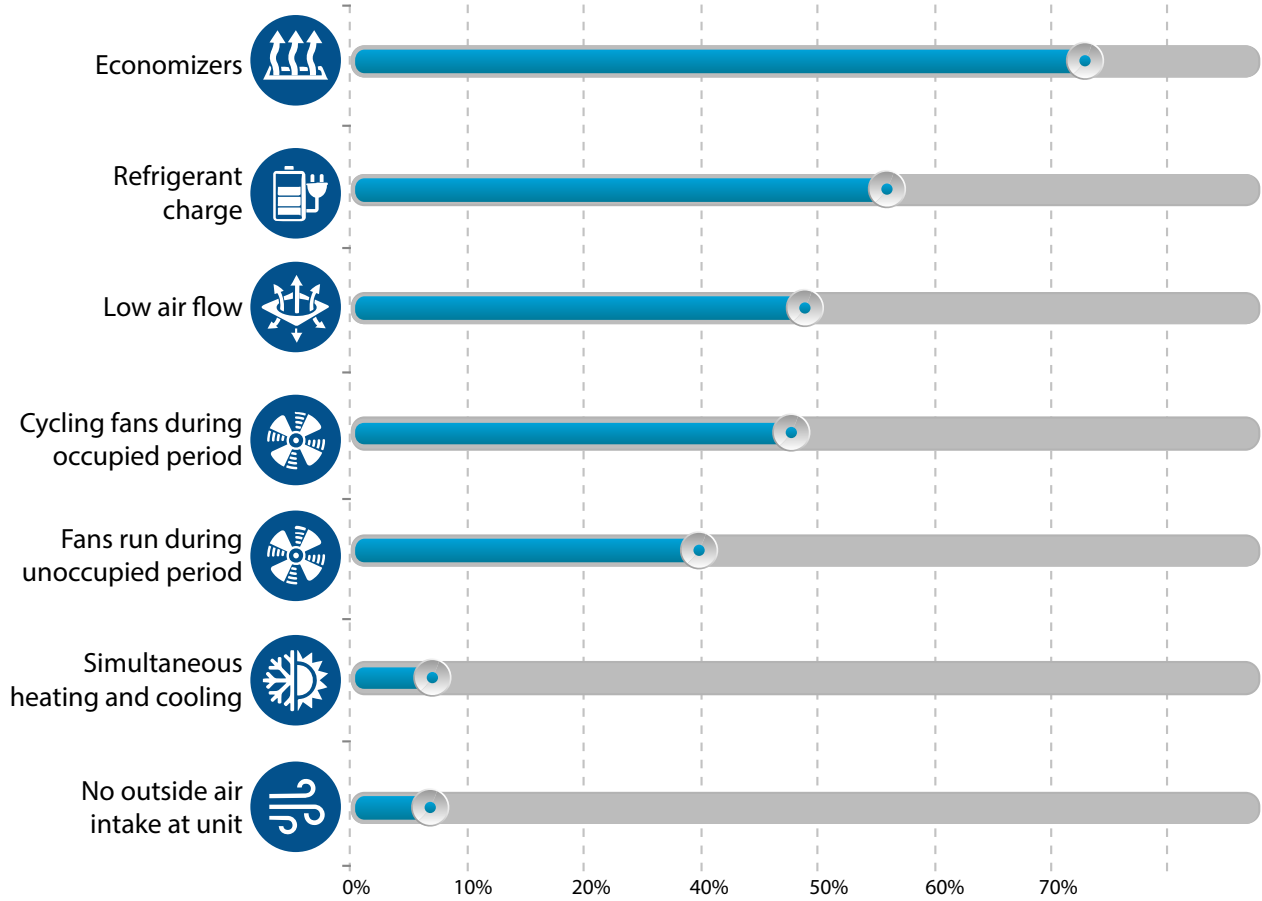
In contrast, when it's warmer outside, the economizer is supposed to stop working and simply close its dampers, leaving only enough open for proper ventilation. After all, you don't want to bring warm air into a building you're trying to keep cool. That's the way it's designed, though the reality can sometimes be different.

## Economizer Design Vs. Energy Usage Realities

As you might imagine, the economizer depends heavily on two things in order to operate correctly: the quality of its temperature sensors to read the outdoor and indoor temps correctly, and the ability of its multiple dampers to conduct airflow with proper size and modulation for the building they are supposed to regulate. Furthermore, they must be installed appropriately; their particular size and design precisely calibrated for the size and energy demands of your building.

What could go wrong? Well, as the case may be, quite a bit.

## TYPICAL PROBLEMS WITH ROOFTOP UNITS



Source: New Buildings institute - PIER

According to another recent study, only one in four economizers functions correctly, with the other three either completely nonfunctional, or worse, wasting huge amounts of energy through dampers open at the wrong times, sensors providing incorrect information, or overall poor system performance.

In another survey focusing on California's Central Valley, broken economizers have been estimated to cost the region 50% more energy than the area's commercial buildings would otherwise use. That translates into millions of dollars in wasted utility costs, a money burden borne by business owners across the state. Rather than an effective energy saving device, economizers can be an expensive drain on your budget if left unmaintained.

Let's review some of the more common problems, starting with component issues.



## ECONOMIZER FAILURE RATES

5-10%

- High/low limit setpoints incorrect, set by occupants/operating staff
- OA sensor (db, enthalpy) miscalibration

10-20%

- Actuator/linkage broken, misaligned, or loose, due to occupant/operation staff action
- Min Outside Air is not set correctly: too high
- High/low limit setpoints incorrect, set by factory
- Dampers mechanically forced open
- OA Sensor (db, enthalpy) malfunction
- OA Sensor (db, enthalpy) drift

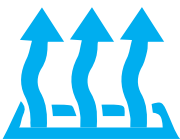
20-30%

- Actuator/linkage broken, misaligned, or loose, due to normal wear and tear or lack of lubrication
- High/low limit setpoints incorrect, set by installing contractor
- Range/action setup incorrectly
- Min Outside Air is not set correctly: too low

30-40%

- Economizer is disabled and dampers are closed

source: [American Council for an Energy Efficient Economy](#)



### Broken/Jammed Damper

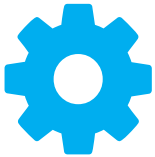
Most building owners underestimate how quickly their economizer's dampers will deteriorate with exposure to outside air and its accompanying pollution. Salt air, industrial waste, automotive contaminants, and even airplane exhaust can corrode the dampers, especially those made out of less expensive galvanized steel or aluminum, freezing them into place or reducing their range of motion to near zero.

Once these are jammed, as you can imagine, it becomes impossible for the system to function appropriately. Your HVAC system must work harder to overcome the dampers either left wide open, or closed shut at the wrong times. Hot air pouring into your building during the summer months, and cold air rushing inside during the winter months are just two possible scenarios affecting the rest of your heating and cooling system.



## Broken/Jammed Linkage

Assuming your dampers are functioning properly, the next potential problem lies in the connectors between them and the actuator. Frequently these connectors are inadvertently disconnected by a well-meaning handyman trying to get the system working. The linkage can also accumulate grime or debris, resulting in a poor connection and subsequently decreased economizer function. Simple corrosion is also common.



## Broken Actuators

Driven by compressed air or electricity, actuators stop working if their power source is discontinued. A power outage, or simply broken pneumatic tubing, will result in their failure, and thus the failure of the whole economizer. Actuators can also come loose, which disrupts functioning too.



## Broken/Inaccurate Outside Temperature Sensors

Naturally, these sensors must work correctly in order to direct the movement of the dampers. Otherwise, as mentioned above, you get wide-open dampers letting hot air inside on summer days, or closed dampers on fall or spring days when the cooler air outside could be used instead of the air conditioner to lower the temperatures inside.

Unless you've recently replaced your economizer, most sensors run on technology at least 5-10 years old. Regardless of their make or model, these are prone to malfunction and breakage. As you might suspect, so go the sensors, so goes the rest of the system. Once they stop working, so does your economizer.



## Improper Settings, Faulty Installations

If this weren't enough to discourage you, consider that the wrong setting for an economizer controller can also affect indoor temperatures and how hard your HVAC system will have to work to adjust. Dials set with temperatures too high or too low result in improper function, as can poorly managed building air pressure. Faulty installation can also doom the system.

# SOLUTIONS



## Solutions and Strategies for Successful Economizer Use

It's easy to despair. But guess what? There are practical answers for boosting the longevity and improving the function of your system. In fact, the “bad rap” economizers have received with the press and the industry have resulted in recent advances in economizer technology and component manufacturing. In other words, there are things you can do to minimize equipment failure, and maximize their efficiency.

For those considering a brand new economizer to replace their broken unit, here are real changes to insist upon:

### Good Damper Construction

Time and again, stainless steel dampers have proven to outlast and outdo their less expensive galvanized steel and aluminum counterparts. Stainless resists corrosion far more effectively, too. While these dampers are more expensive, they also obviate the need for costly replacement down the line. If you're in an area with a lot of pollution or salt air exposure, these types of dampers are a “must have.” Furthermore, dampers constructed with internal linkages and ball bearings, or nylon bushings to enhance their rotation may be in order. Avoid damper gears made from materials likely to jam up the blades.

## The Right Actuators

Consider a direct-drive actuator instead of a linked one. Direct-drive actuators are made with fewer parts that could break or malfunction, and are also a cinch to install! The good news? Many economizer manufacturers have made these more practical components standard to their newer units. Nevertheless, it's important to ask about it before purchase, just to be sure.

## Get an Exhaust Fan, Stat!

Without a return or exhaust fan, no economizer can work properly. Instead, excess air will leak out of your building in a variety of places since it's not being directed and drawn out through the proper ducts. This translates into unwanted indoor temperature variations and other issues.

## Installation, Placement and Integration Issues

When it comes to selecting, installing, and managing your economizer, it's essential to use a qualified, reliable HVAC professional for the job. Even with the right equipment, the wrong location for an outdoor air intake, the incorrect choice of unit for the size and design of your building, and inappropriate settings for your economizer controls can make or break its performance before you even start using it.

## Call In An Expert for an Assessment

If you're trying to avoid replacement altogether, it is imperative to have your economizer evaluated by someone trained to know what to look for, and how to fix it or make adjustments. Damper position, economizer control settings and even your energy consumption data analysis play an important role in determining how well even the best made system will operate. Regular diagnostics will also help you evaluate its service and ways to improve your investment.



Economizers can help you save energy. They can also hurt your bottom line as a hidden and expensive drain on your utility budget throughout the year. With new legislation and an overall emphasis on efficient resource management, they aren't going away any time soon. Take a few moments to understand how your unit works, and whether or not it can be fixed or enhanced, or should be replaced altogether.

While a hassle in the short run, we promise the long term benefits will make your efforts worthwhile. After all, they are called "economizers." With a little effort and attention, you can turn that nightmare story into a happy ending. We can turn that wasted genius back to a genius idea.



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