SLASH HVAC COSTS

WITH TESLA TECHNOLOGY

AND VARIABLE SPEED MOTORS

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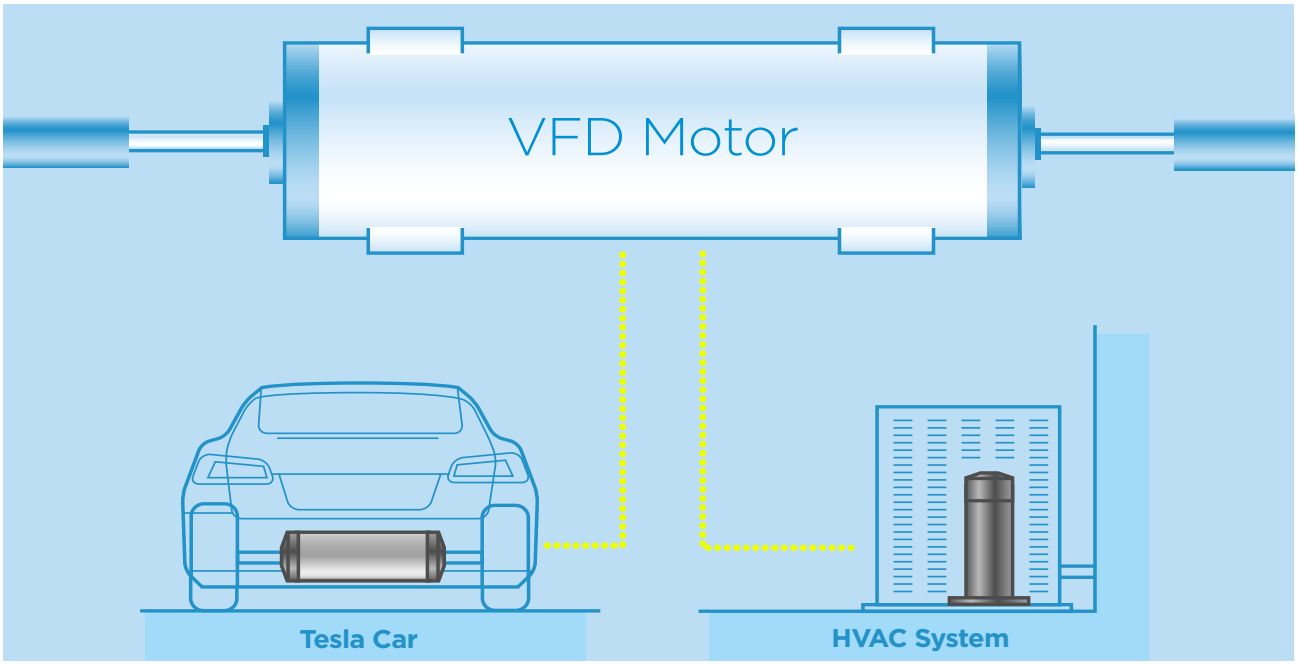
with Tesla Technology and Variable Speed Motors

Open an electric motor from the late 19th century, as designed by a pioneer like Thomas Edison or Nikolai Tesla. What will you find? Copper coils, permanent magnets and electric brushes. Open the motor that drives your air conditioner compressor today and what will you find? Copper coils, permanent magnets and electric brushes, which conduct electricity from a stationary source to a moving component. For motors, the brush energizes these electromagnets on the rotor.

The alternating-current induction motor is a brilliant design. It's reliable, highly capable and easy and inexpensive to manufacture. It's also inflexible, hard to start, and not very energy efficient. Over one hundred years of domination as a vital component in our industries has been a very good run for this device. But it seems to be coming to an end.

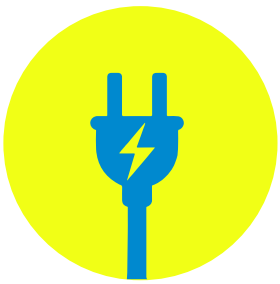
What will replace it, then?

Well, there's a new sheriff in town. As of July 1, all new HVAC air handlers sold in the USA must have a VFD (Variable Frequency Drive) motor. These also go by the name of ECM (Electronically Commutated) motors. These are direct current (not alternating) devices that are digitally controlled. They will also help you save money and conserve energy. Ironically, the new Tesla cars, named after the famous inventor, are all driven by these new VFD motors.

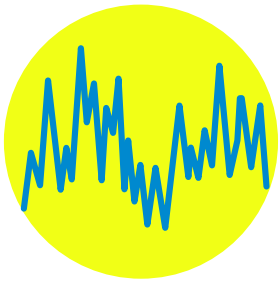


First, let's talk utility bills.

As you may know, SCE bases its electric charges on two factors. The first is your usage. The second is the time of your peak demand: that one moment during the month where you are drawing the most energy from their grid. The usage factor pays for fuel, the second factor pays for building out the grid. Grids need to match peak power, so the peak charge helps pay for this.



ENERGY CHARGES
Total amount of energy used



DEMAND CHARGES
Highest 15-minute peak each month

A VFD system addresses both, cutting both fuel and peak consumption, twice. Because of their design, these drives use less electricity overall. They also slowly ramp up speed. An old fashioned, traditional motor spikes power use at startup as it overcomes the inertia of the rotor. This is called Locked Rotor Amps, or LRA. Then it reduces to normal running load amps (also known as RLA). Unlike a conventional system, a VFD motor gradually ramps up, eliminating the LRA spike as it slowly approaches RLA. The electrical brushes of conventional motors aren't needed with VFD drive motors, either, since they use permanent magnets.

More and more, SCE is relying on demand charges rather than fuel charges overall. This is related to the different dynamics of wind and solar generation vs. the traditional standbys of coal, methane or nuclear energy. Wind and solar don't consume fuel. Good news! But they do generate their power erratically, as dictated not by man but by Mother Nature, which makes or stops the wind and makes or stops (night/cloud cover) solar at irregular times. This unpredictability puts a huge strain on the grid as an unexpected gust spikes wind power or a cloud front crashes solar.

In response, Southern California Edison has raised the demand part of the bill in order to collect the revenue needed to rebuild the grid, and cope with the electric spikes and crashes that define the intermittent nature of renewables. In contrast, VFDs move this burden away from those who install them. They make SCE's job easier, in effect, by cutting spikes and providing continuous, predictable power demands.

So how does it work?

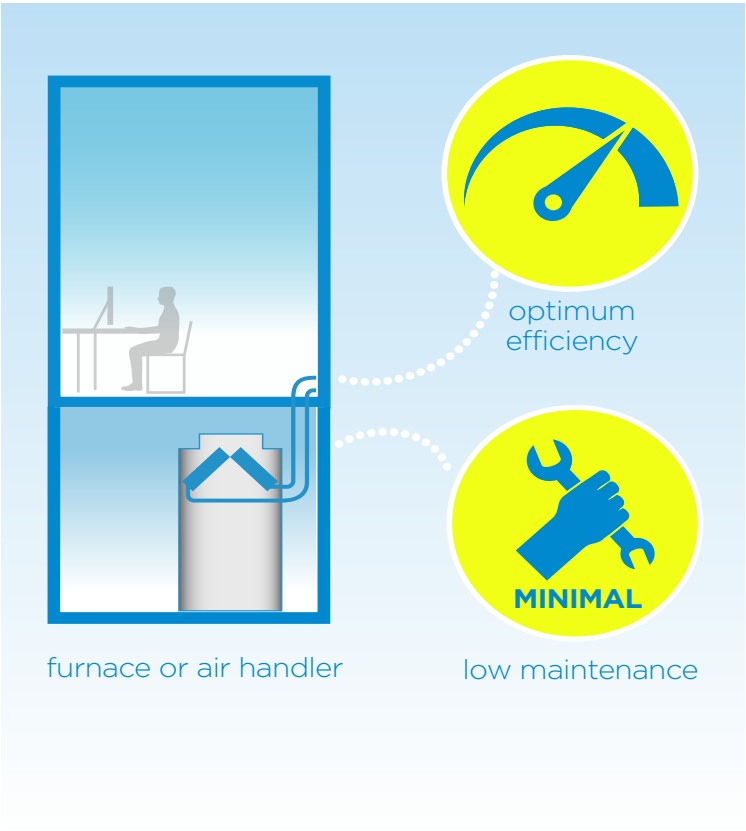
A VFD can be located inside a furnace or an air handler, and as an electronically commutated motor (also known as an ECM), it utilizes a magnet rotor and a built-in inverter. For those reasons, it can operate far more effectively than a typical air handler blower motor.

> ***Because of its construction, this kind of ECM is also extremely low maintenance. It breaks down a lot less frequently, and requires far less care than conventional motors.***

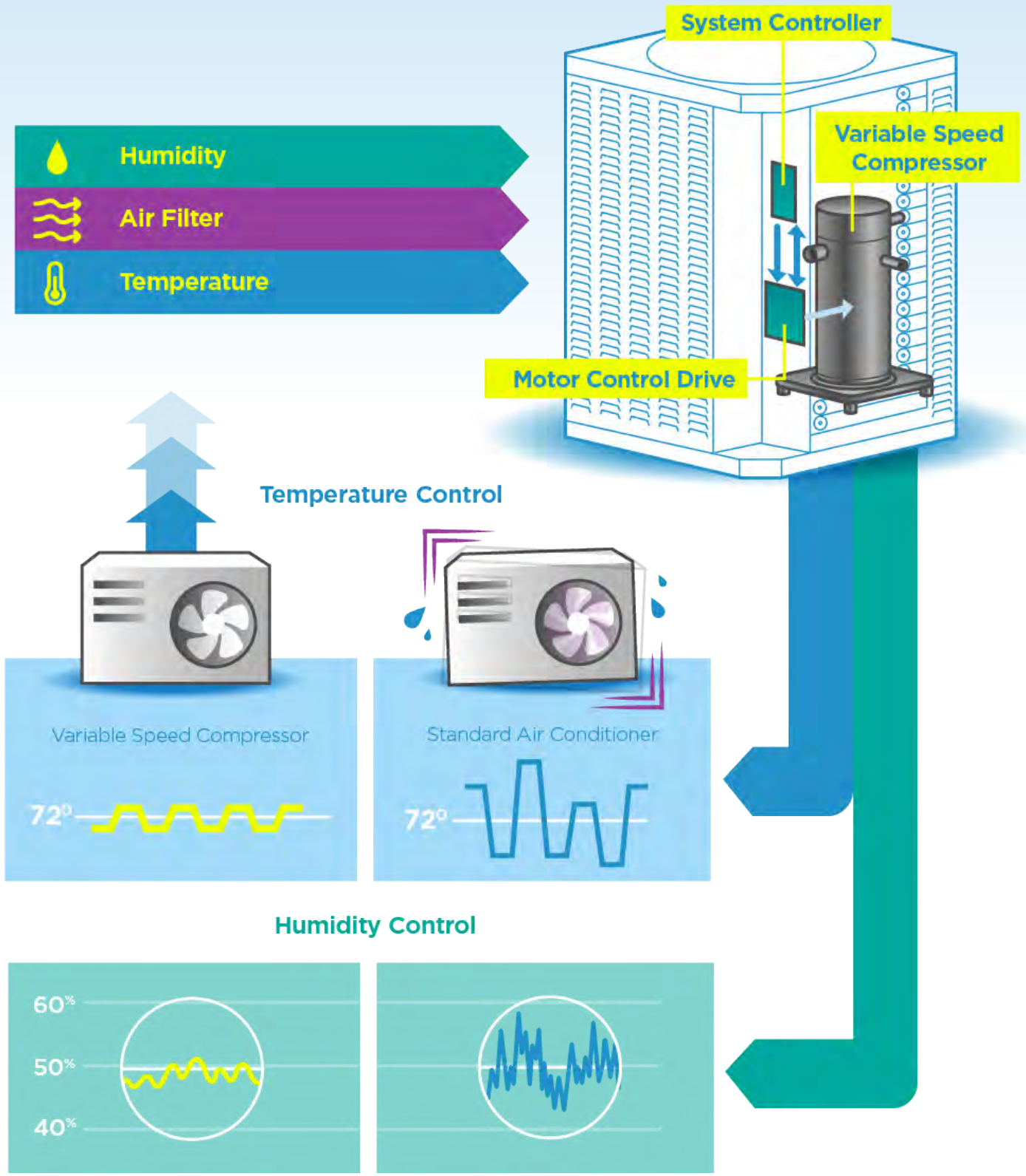
Consider a typical fan motor. It operates at one speed, whether you need it or not. It doesn't adjust to a particular temperature or humidity level. It just runs continuously, costing you money and energy day after day, hour after hour, no matter what the conditions are inside or out.

A variable speed motor doesn't work that way. In contrast, it constantly evaluates the information coming from the rest of your HVAC equipment, reacting to changing environmental and practical conditions with adjustments to speed and therefore indoor temperature. Whether it's picking up that the system has a dirty air filter or that it's a really hot day outside, the variable motor will modify its rate of speed accordingly.

Furthermore, it does so gradually. Unlike the conventional HVAC motor that suddenly makes the system blast cool or hot air into the room to lower or raise temperature, a system powered with a variable speed motor modifies its rate more slowly over time. As you might imagine, this reduces wear and tear on all its components, as well as creating a more carefully modulated indoor temperature.



How It Works

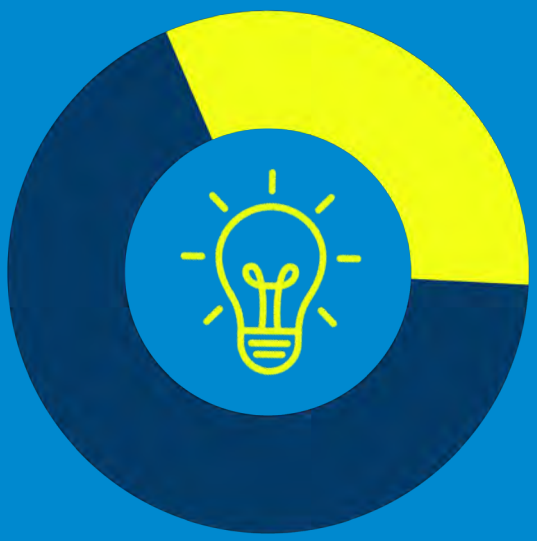

System Controller
Variable Speed Compressor
Motor Control Drive
Humidity
Air Filter
Temperature
Temperature Control
Variable Speed Compressor
72°
Standard Air Conditioner
72°
Humidity Control
60%
50%
40%

The best news?

A furnace powered by a variable speed motor uses two thirds less electricity than a conventional model. You read that right. Using 66% less energy translates into significant savings at the end of every month, even during the winter, when utility costs are typically quite high for the average commercial building owner. Why? A system utilizing a variable speed blower typically runs at a lower speed, just about continuously throughout the day and night. It doesn't need to ramp up or wind down, since it's practically nonstop. For that reason, it never has to work as hard as conventional HVAC units, which must power up or power down multiple times in a 24 hour period.

> *Using 66% less energy translates into significant savings at the end of every month*

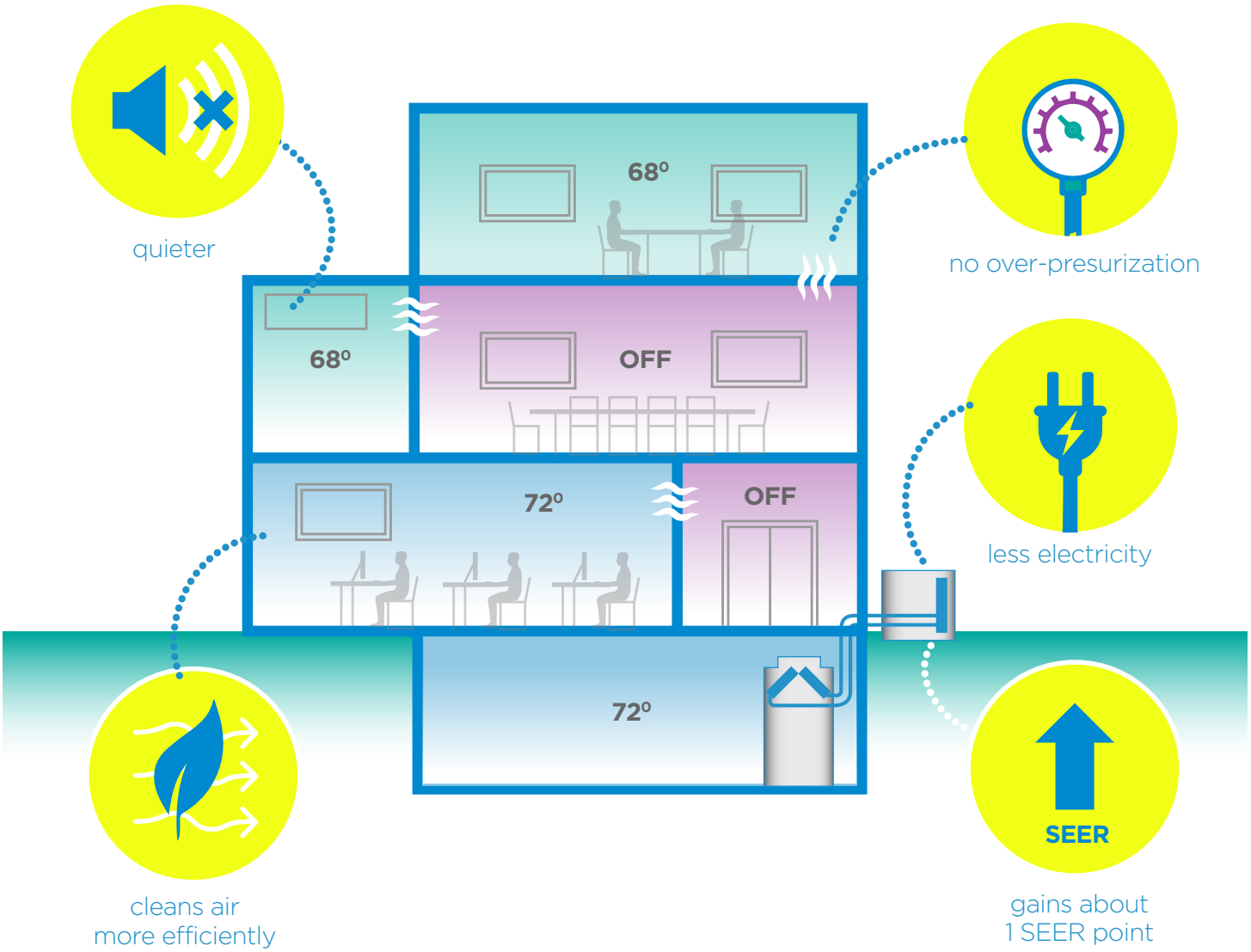
The news is equally positive on the AC side. When used for cooling, an HVAC system equipped with a variable speed motor gains about 1 SEER point. That's a Seasonal Energy Efficiency Ratio, in case you were wondering. It refers to the ratio of cooling output with an air conditioner throughout a cooling season (i.e. summertime), divided by the Watt-Hours of energy it consumes. As you might imagine, the higher the SEER, the more energy efficient the product, and the less expensive a system is to operate.



A variable speed motor uses two thirds less electricity than a conventional model

Variable speed motors are perfect for zoned systems as well, allowing for further customization of those areas you heat and cool within your commercial building.

With temperature zoning, multiple thermostats are connected to dampers inside the ductwork, so you can seal off the ducts linked to areas of your building where heating or cooling is not needed. In a conventional zoned system, shutting off only some of the ducts can mean over-pressurization of the remaining open ones. As a result, you may need more ductwork to relieve this problem. A variable speed motor mitigates this issue, reducing overall air velocities and ensuring your registers are always quiet, too. Humidity can be better controlled with a variable speed motor system for the same reason.



Finally, as if saving big bucks on operation weren't a big enough plus, a system equipped with a variable speed motor is also able to clean the air in your building more effectively than conventional HVAC. Using the fan in operation 24/7, the variable motor allows the system to slowly circulate air through the filters, letting them trap more irritants and debris. By running practically continuously, air is constantly being cleaned.

So what does this mean for the average commercial building owner?

If you've been following the tax cuts now available for United States business owners, it's never been more financially advantageous to install or upgrade your HVAC equipment from the perspective of the IRS. While a variable speed motor system does cost more to install than a typical system, it has been shown to pay for itself within 4-5 years, enhancing the long-term value for your property asset as well.

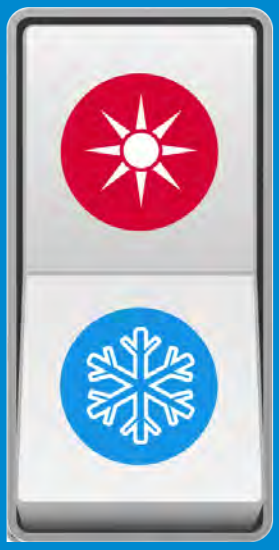
A variable speed motor system has been shown to pay for itself within 4-5 years

When does this kind of system make sense to purchase?

If you've just received new, long-term leases, it may not be worth it at this time. However, if your building is near termination of a lease, or has just gone vacant and is now on the leasing market, a variable motor system installation makes excellent sense. For the reasons described above, it makes the building far more attractive to tenants looking to renew, or new ones looking for a building that costs far less to operate than ones with older HVAC systems.

As with any infrastructure change, talk to a licensed HVAC professional about how best to go about incorporating this technology into your heating and air conditioning. Your air ducts must be properly evaluated. It's critical to ensure there are no excessive leaks and drafts to undermine the efficiency of the variable motor.

There is one option for commercial building owners not yet ready to make the leap. For those unwilling or unprepared to invest the money into a variable speed motor HVAC system, consider one driven by a multi-speed motor instead.



Unlike the conventional single motor HVAC equipment with its one-size-fits all, single speed option, a multi-speed motor offers two operating systems. While not as advanced as a variable speed option, the multi-speed motor provides at least one speed for heat, and one for cooling. Like a ceiling fan you can adjust to high, medium or low speeds, depending on the temperature, these products offer more energy efficiency and flexibility over air flow. Price-wise, HVAC systems equipped with multi-speed motors are also significantly less expensive than their variable-speed counterparts.

As HVAC technology becomes more advanced, we hope every new heating and air conditioning system will someday be super efficient. In the meantime, however, older models continue to operate within many commercial buildings. While frugality is a virtue across many areas of business management, when it comes to heating and air conditioning, your old system could be costing you far more money in the short and long term than necessary.

Like an old gas-guzzling car, that antiquated HVAC system that you rely upon may be eating up monies better spent on other aspects of your business operation.

Talk to your licensed HVAC consultant. Get information specific to your building, and your business. As utility costs continue to explode with no sign of lessening, you may find that variable speed motor-driven systems are an HVAC option that makes real sense for your business and your building.

Few would deny that Nikolai Tesla and Thomas Edison have made enormous contributions to the field of electric power generation. But were they alive today, we would bet they both would insist on a brand new, VFD system to heat and cool their offices. Would they drive the new Tesla cars? We kind of like the idea of Thomas Edison tooling around in a conventional minivan, but we'll let you decide that question yourselves.

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Robert Helbing, PE, is President of Air-Tro Heating and Air Conditioning Company. He is a Caltech-degreed aeronautical engineer (yes – a rocket scientist!), as well as a 4th generation contractor and 3rd generation engineer. He is a past-president of the Institute of Heating and Air Conditioning Industries (IHACI); Air Conditioning Contractors of America (ACCA) Contractor of the Year, 2011; and a 15-year member of Excellence Alliance Industries, a membership organization committed to the development and improvement of HVACR companies nationwide. Bob is also a founding member and past committee chair for the Western HVAC Performance Alliance, a council of stakeholders in the Energy industry which includes utilities, regulators, manufacturers and contractors. He currently serves on two committees for the WHPA: Commercial Quality Installation and the Existing Buildings Energy Efficiency. He can be reached at 626.357.3535 and bobhelbing@airtro.com.

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