



Variable Speed Drives: Reducing the energy costs of commercial HVAC systems

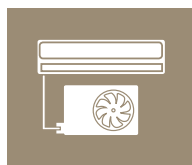
Factsheet



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Using Variable Speed Drives (VSDs) to reduce the cost of heating, ventilation and air conditioning (HVAC) systems in commercial buildings



By virtue of their energy intensiveness, heating, ventilation and air conditioning (HVAC) systems account for a large percentage of companies' energy costs. Continued misuse can dramatically impact on the effectiveness of companies' energy-saving projects and initiatives, which are mostly driven by the need to reduce operating costs.

HVAC systems are responsible for 26% of the electricity consumed in the commercial sector, with motors that drive compressors, pumps and fans in these systems accounting for more than 98% of that energy.

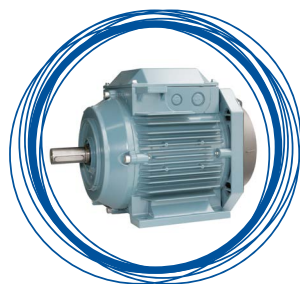
- Variable Speed Drives (VSDs), when applied to HVAC systems, can provide energy savings of between 20 and 40%, while also enhancing operation and comfort.

VSDs are potentially the most underutilised tools for optimising the energy efficiency of electrical equipment. Using them in suitable applications such as HVAC systems can save energy, cut operating costs and extend the lifespan of equipment.

VSDs explained

A VSD, also known as a Variable Frequency Drive or Adjustable Speed Drive, is a device that can adjust electricity supply and regulates and adapts motor speed to match the actual demand required by the system or application it is driving, resulting in a reduction in energy consumption.

VSDs offer a high degree of motor control, accurately varying motor speed according to demand whilst adjusting torque accordingly – all within the specifications of a particular manufacturer.



VSDs come in different sizes and are typically encased in boxes as small as a milk carton or as big as a cupboard. Sizes range from 0.18kW through to several MW. They are available as stand-alone devices and are connected to motors' electrical supply. On some smaller motor designs – usually under 15kW – VSDs may be built onto motors and are available as integrated motor drives.

A basic VSD can be used for simple applications, such as controlling a pump or a fan where variable loads are required. It can also be interfaced with a transducer, such as a pressure or flow rate sensor, and programmed to maintain a particular setting. More advanced VSDs can be used for precise speed and torque control in complex applications like materials forming and can be interfaced with a computing system to provide real time operating data on the status and performance of a motor.



VSDs can be used in a wide variety of applications including most kinds of ventilation systems, air extraction systems, cooling systems and combustion-air control systems for boilers.

Variable Speed Drives can vary the output of your HVAC system to meet your building's needs throughout the day. This will help you save energy and money.

Taking the load off HVAC systems in commercial buildings

VSDs are ideal for equipment with varying load conditions such as HVAC systems.

- Even in the most energy-efficient HVAC systems, VSDs can help to further reduce energy usage by closely matching the speed of the motors that drive the systems with actual demand.
- When HVAC systems require less cooling or heating than the maximum load that it was sized for, VSDs allow the compressors, blowers and condenser fans (in the case of a screw in compressor) to operate at a lower speed and, therefore, use less electricity.

There is a broad range of Variable Speed Drives available specifically engineered for heating, ventilation and air conditioning applications, which can be integrated into a variety of building management systems to improve flexibility and optimise energy efficiency.

- In ventilation systems for large buildings, VSDs on fans save energy by allowing the volume of air moved to match the system's demand.
- Variable Speed Drives are also used on pumps and other equipment.



- When linked by remote control, a VSD can be used to switch off motors or to lower the speed of motors to decrease the flow rate during Eskom's peak hours of demand for electricity.

VSDs are particularly suitable for electronic control systems such as Programmable Logic Controllers (PLCs) and Personal Computers (PCs).

- These systems are typically used in complex building climate control systems.
- By responding to inputs from various sensors in the building and adjusting the speed of relevant motors, the process can be kept at optimal speed and wastage is minimised.

VSDs are one of the most cost effective methods to increase efficiency and reduce the costs of HVAC systems – they cut power usage and prevent energy wastage by precisely matching motor speed with cooling demand.

Putting VSDs to work

- Conduct a proper feasibility study before investing in a VSD to ensure that it is the best solution to optimise your HVAC system.
- VSDs can increase harmonics in the electricity supply, which disturb the sine curve of the Alternating Current and cause motors to run warmer than they are designed for, reducing their life expectancy. Harmonics can also decrease the life expectancy of computers and negatively influence the operation and accuracy of electronic measuring devices. The appropriate harmonic filters and chokes must, therefore, be installed along with the VSD to filter out the harmonics and protect your equipment.
- Spend a bit more on quality – VSDs are high tech; mixing low quality with high tech is not recommended.
- Full energy-saving gains will be achieved when harmonic filter protections and components are properly installed and tested.
- Since VSDs are dust sensitive, an appropriate dust filter needs to be installed when operating in dusty conditions – they also need to operate within specified temperature and humidity parameters.
- VSDs must be installed by qualified installers that can back up their product.
- Once installed, a VSD must be properly programmed – setting incorrect parameters will result in poor control and energy wastage.
- Regular maintenance of VSDs – and associated motors – is essential to maintain energy savings; preventive maintenance is always less expensive than correcting faults and having unanticipated breakdowns.
- Opt for a maintenance contract with your supplier to ensure the VSD is kept in an optimal condition.



Important note: If you have a power factor correction capacitor installed, remove it before installing a VSD.

Additional tips to help reduce HVAC system energy costs:

- Where boilers are used check for scale deposits, electrical contacts, heater elements and control instrumentation
- For compressors that are cooling on a regular basis, listen for unusual sounds or vibrations and check for signs of wear
- Regularly lubricate fan bearings and clean fan components
- Regularly replace dirty or blocked air filters and leaky dampers
- Use economiser controls
- Insulate thermal surfaces such as coolant and hot water pipe work
- Inspect ductwork for air leaks
- For cooling equipment, ensure heat exchanger surfaces are clean and reset evaporation and condensation temperatures, particularly under extreme operating conditions
- Take full advantage of various control and heat recovery devices on the ventilation system
- Ensure that electrical equipment is working at the rated voltage
- Establish and follow a regular maintenance programme – make sure that staff are trained accordingly and take advantage of a computer programme to facilitate maintenance scheduling
- When fitting new equipment ask your supplier to conduct a proper needs analysis, replace oversized motors and size new units at optimal efficiency
- Ask an experienced specialist to properly balance your ventilation system
- Reduce HVAC operating hours to reduce electrical, heating and cooling requirements
- Eliminate HVAC usage in unoccupied offices, underutilised communal spaces and empty store rooms
- Minimise direct cooling in unoccupied areas by turning off fan coil units and unit heaters, and closing the vent or air supply diffuser
- Adjust thermostat settings for a change in seasons
- Check the combustion efficiency by measuring carbon dioxide and oxygen concentrations and the temperature of stack gases; make the necessary adjustments
- Close outdoor air dampers
- Install heat recovery ventilators that exchange between 50 and 70% of the energy between the incoming fresh air and the outgoing return (conditioned) air
- Be sure to switch off air-conditioners when leaving the office after a day's work or install timers to switch air-conditioners off to prevent them from running overnight or over weekends.
- Consider installing occupancy sensors, which will switch on HVAC systems based on occupancy and switch them off when rooms are left vacant.



Eskom's Energy Advisors are on standby to assist you.

Eskom's national Advisory Service offers information on manufacturers and suppliers of VSDs. The team can also advise businesses on:

- Reducing energy usage
- Doing walk-through energy assessments to identify energy usage patterns, energy needs, areas of energy wastage and energy-saving opportunities
- Improving the energy efficiency of operations and electrical systems and processes
- Prioritising maintenance as an important contributor to reducing energy usage
- Finding SANAS approved energy savings Measurement & Verification Authorities.

Advisors can also provide information on funding opportunities for energy efficiency projects.

Call 08600 37566, leave your name and number and an Eskom Energy Advisor will contact you. Alternatively, ask for a specific advisor to contact you.

Visit www.eskom.co.za/idm for more information.



Credits:

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