Overcoming HVAC challenges in your facility

ABB

CONSULTING - SPECIFYING engineer®

According to U.S. Energy—Energy Information Administration **Annual Energy Outlook 2022**, commercial buildings consume 13.6 quads of electricity (35% of electricity consumed in the U.S.) and generate 826 million metric tons of carbon dioxide emissions (16% of all U.S. carbon dioxide emissions).

In commercial and industrial buildings, heating, ventilation and air conditioning (HVAC) systems often need repair or replacement and the correct system must be specified and installed. To compound that challenge, HVAC systems can use about 35% of the energy load. That means selecting the right HVAC system is of high importance, both to consulting engineers and facility owners.

According to a **2022 research study** conducted by *Consulting-Specifying Engineer, Plant Engineering* and *Control Engineering*, HVAC systems within survey respondents' facilities are commonly challenged with aging equipment that needs updating or replacing (43%), meeting energy efficiency/sustainability goals (33%) and maintenance issues (29%). In looking at these top two challenges, engineers and facility personnel can address them by incorporating newer, more energy-efficient motors and drives into the HVAC system. See Figure 1 for more information.

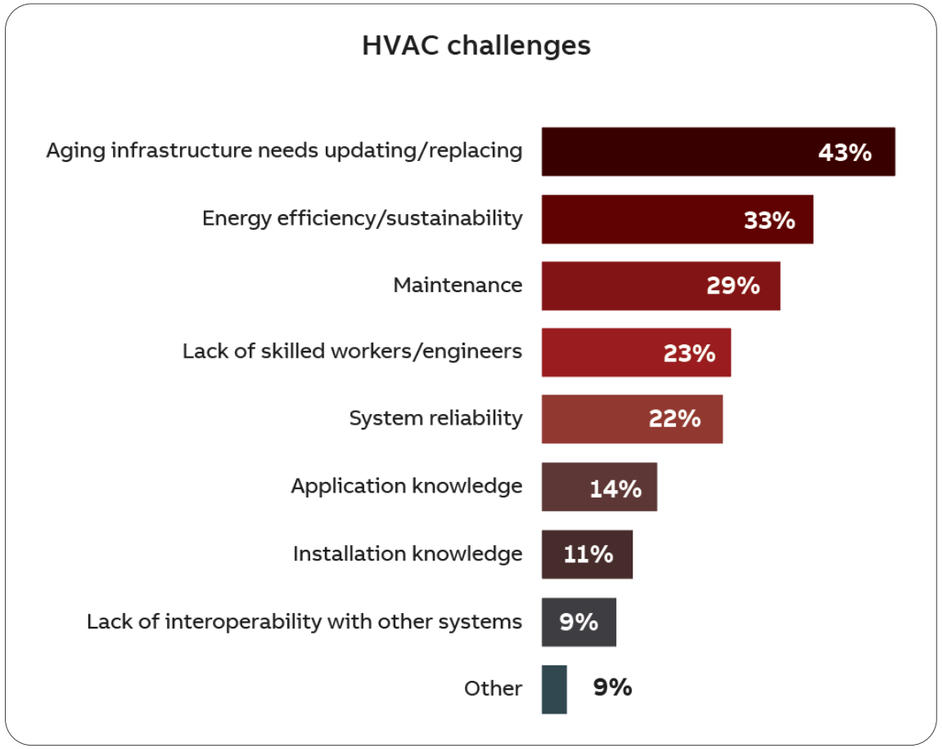

Figure 1: When asked to select the top two HVAC challenges face, feedback varied. Aging infrastructure and energy efficiency were top priorities. Courtesy: Motors & Drives in HVAC Applications study, April 2022

According to Tim Skell, VFD HVAC Application Engineering Manager, ABB, New Berlin, Wisconsin, there are three reasons consulting engineers are driven to help building owners reduce energy consumption.

"First thing building owners want to look at is reducing the utility bill from the dollars and cents standpoint," said Skell. "You've got kWh, or total kilowatt hours, which is your total energy consumption that's directly related to your bill. There are also other charges tied to your bill, topics that are different from your total energy consumption, that can also have a very big impact on an energy/utility bill.

"One is peak demand charges. This is a charge for using a lot of electricity, usually during peak hours, such as the middle of the day. Once a user is aware of this, they can shift some of that energy usage to different parts of the day.

"Also, there are penalties for your power factor. If I have poor power factor, I get a charge, a penalty on my utility bill. However, if I have good power factor, I may actually be given a rebate or a credit on my utility bill. It's simply dollars and cents on your utility bill. You want to reduce your utility bill and there are several different ways you could look at doing that — it isn't just about reducing the total kWh. Having a smart automation system supported by products that support energy sav-

ings, such as variable frequency drives (VFDs) and efficient motors, help bring down that utility bill.

“The next thing you can take a look at is the older equipment that you have that has been in place for many years. When you have older equipment that’s less efficient, it’s obviously consuming more energy than equipment made more recently. And while there may not be an appetite to change out the equipment just for the sake of sustainability, if you start peeling back a couple layers of the onion, you then see that you’ve got higher maintenance costs and equipment being down more often with that older equipment. If you replace that older equipment with newer equipment, more efficient versions, you will reduce those maintenance costs and extra downtime while also getting the increased energy savings of the newer equipment, which helps with the payback period,” said Skell.

“Then lastly, even if sustainability is not high on the list today, there is a very good chance it will be in the future. It makes sense to start looking at various energy-saving projects now so you can secure those funds later on.”

Aging HVAC equipment

Waiting for equipment to fail is not a strategy for facility personnel. It is important to know the average age of the installed base, as well as expected lifetime. When specifying equipment, mechanical engineers typically account for this in the total cost of ownership, payback periods, life cycle cost and a variety of other calculations. This allows for planned obsolescence, enabling a facility manager to plan upgrades or replacements with the least impact to production and the budget.

A leading cause of unscheduled downtime within industrial facilities remains aging equipment, followed by mechanical failure, operator error and lack of proper training. According to the results of an unrelated ***Plant Engineering* research study**, more than half of facilities are planning to upgrade their equipment to decrease unscheduled downtime.

While supply chain and funding continue to be a challenge, preparing for an equipment upgrade is often top-of-mind. For consulting engineers, this must be done while designing a new or retrofitting an existing building. For the plant manager, upgrades dictate when HVAC equipment is replaced.

Two things to consider are drop-in replacements, to save time and budget in the installation process; and new technologies that can offer smaller footprints and significant savings from energy consumption.

Skell further explained drop-in replacements and how simple it is to integrate them. “If a user is reading information over BACnet with the building automation system (BAS) from the old drive and they swapped in the new drive to replace it, the new drive would just immediately talk to the BAS assuming the new drive has the same object list,” said Skell.

If a VFD is already in place, having a drop-in replacement reduces the overall installation cost and complexity because there is no need to reach out to the controls contractor and have them remap it.

Energy efficiency

To improve energy efficiency and ultimately reduce overall costs, investment in a highly efficient solution is an option. In the “Motors & Drives in HVAC Applications” research study, reducing energy consumption in HVAC and plumbing applications is an important goal for 89% of respondents, their facilities and their clients, with cost savings being the top motive. The key reasons to reduce energy consumption are:

- Cost savings (54%).
- Environmental impact (20%).
- Meet environmental, social, governance targets (20%).

On the same note, 40% of the survey respondents were “very willing” to invest in a highly efficient motor and drive solution to reduce energy consumption.

Many companies have sustainability goals based on reducing their energy consumption. This can seem overwhelming to add to a facility modernization project. However, maximizing the efficiency of the components, such as adding a VFD to a motor and incorporating new technologies designed to meet higher efficiency ratings into the plan, will allow for more efficient operations.

There are many reasons to reduce energy consumption, even if sustainability is not high on the target list. The majority of respondents and their clients are willing to invest in highly efficient motor and drive solutions to reduce energy consumption, but the top barriers preventing them at this time are upfront cost and potential payback period.

Mark Gmitro, Global Product Manager, Variable Speed AC Motors, ABB, Greenville, South Carolina, explained how incentives and rebates can reduce this upfront cost.

“I believe there’s a perception in the market that there isn’t as much return on investment for upgrading to higher efficiency motors than there once was, but that’s not the case. Additionally, it may not be understood that there are still incentives available from the utilities and/or from the government to do energy upgrades. Consulting engineers can make the end customer aware that energy incentive rebates are available and can help offset initial upfront cost,” said Gmitro.

“Even beyond rebates, it is worth calculating the electricity savings potential over the lifetime of the system. Let’s say that an installed unit is estimated to last at least 10 years and you look at what an average savings is. We had one customer who upgraded just a simple 7.5 horsepower motor, which is not even a very powerful motor in an HVAC application. The customer measured a 1.5-year return on the purchase of

SUCCESS STORY

Real-world results prove performance and ROI

ACG Films and Foils is a leading Indian multi-national corporation manufacturing a wide range of barrier packaging - including capsules, films and foils - for the pharmaceutical industry.

Founded in Mumbai in 1964 by brothers Ajit and Jasjit Singh, ACG Films and Foils now has offices in India, Croatia, Argentina and Brazil, among others, and prioritizes sustainability and energy savings through green building initiatives and the use of modern equipment.

As India’s first end-to-end packaging solutions provider for capsules and tablets (manufacturing packaging films from raw material through to the finished

the new motor, so it was approximately $520 a year in electricity cost savings. If that new motor lasts 10 years, after that first 1.5 years, they are coming out ahead. I would think any facility manager is going to be interested in looking at saving more than $4,000 over the lifetime of a motor. Most facilities run more than one motor, so extrapolating the savings potential across all of the applications makes the case for upgrading even more cost-effective."

Because the cost of implementing efficient products is often the perceived barrier, the payback period of using efficient motors with a VFD is highlighted.

Paying for new, retrofit equipment

Data from the "**Motors & Drives in HVAC Applications**" research study show an average return on investment or payback period of 29 months is required to consider removing functional yet low-efficiency HVAC equipment and replacing with new, high-efficiency equipment. A similar payback period of 30 months is expected when selecting high-efficiency HVAC equipment with a higher upfront cost over equipment with an average efficiency and lower initial cost. See Figure 2 for more details.

A very slight payback period increase is acceptable for the building's complete HVAC system, especially if the full system is being replaced.

There are several funding options for upgrading equipment. In many cases, utility rebates and incentives will offset much of the cost.

One-quarter of respondents have current or upcoming projects that could benefit from government funding, such as **Buy American**, **Buy America**, **CARES Act** and the **Infrastructure Investment and Jobs Act.**

Purchasing or specifying motors and drives that are compliant with Buy American or Buy America is very important, according to 26% of respondents; 22% responded it was moderately important.

product), ACG is responsible for meeting all regulations throughout the manufacturing process, including, safety, protection, suitability, compatibility, quality control and stability of the packaging materials. These operations require machinery capable of achieving a repeatable, high rate of precision quickly and efficiently.

While investigating replacement options for the company's existing IE3-rated motors, Mr. S.R. Shivshankar, CEO of ACG, discovered ABB's Baldor-Reliance EC Titanium motor through a LinkedIn post and advised his team to contact the local ABB sales office. The sales team conducted a virtual presentation and product demonstration session with representatives from ACG.

A 7.5 Hp, 1,800 RPM rating EC Titanium motor was chosen and bench tested against one of ACG's current IE3 motors to evaluate energy savings and payback time. The results were overwhelmingly positive. EC Titanium achieved an average unit consumption of 45.1 kWh per day over the seven-day test time, compared to 57.69 kWh for the existing motor. This reduction in energy consumption achieved by replacing one IE3 motor with EC Titanium would result in a monthly energy consumption cost of $155.04, compared to $198.38 for the IE3 motor – a savings of $43.30 per month or $520 per year, per unit. This cost savings would realize a complete return on investment in less than two years.

Decision makers at ACG were impressed with EC Titanium's superior performance and energy savings. The company purchased a 10 Hp EC Titanium motor for further testing, and discussion is now underway for the purchase of an additional eight 10 Hp and five 7.5 Hp EC Titanium units. Additionally, ACG is working internally to allocate a budget for replacing all IE2 and IE3 motors in the company's Shirwal, Maharashtra, India, plant with EC Titanium motors.

Induction motor (IE3)	EC Titanium motor (IE5+)	Difference
Average unit consumption per day (seven-day test duration): 57.69 kWh	Average unit consumption per day (seven-day test duration): 45.1 kWh	12.59 kWh
Estimated monthly energy cost per unit: $198.38	Estimated monthly energy cost per unit: $155.04	$43.30 per month per unit
Energy reduction: 20% Annual savings: $520 per unit Estimated return on investment: 18-24 months		

With a variety of government funding available depending on the project, industry sector and scope of equipment, such as Buy American, Buy America, CARES Act, Infrastructure Investment and Jobs Act, etc. it is important to partner with a manufacturer that not only supplies products that meet the demands of the HVAC industry but also understands the requirements that must be met to be eligible for funding.

Integrated products

In addition to reducing the footprint and energy consumption of a product, a newer technology offers better integration and controls. Syncing the motors, drives and overall HVAC system with the BAS allows for sophisticated controls. This, in turn, provides the consulting engineer, commissioning professional and building owner with a variety of data to help them make educated decisions.

The correct technology allows the specifier to meet all the clients needs when incorporating new technology into a system. From the building owner's perspective, long-term reliability allows for little to no system downtime, dramatically improving performance and resident comfort.

As equipment upgrades or replacements are needed in a facility, it is also important to consider the tools and processes available that can monitor equipment or prescribed maintenance practices based on need, not a schedule. Incorporating remote condition monitoring, predictive maintenance and other practices into an operation allows maintenance to be scheduled and reduces unexpected downtime.

To improve energy efficiency and to save money, Gmitro explained, there are now designs that integrate the VFD into the motor, creating a single package. Integration provides a fixed speed-application with the benefits of going to variable speed. And, if there is not panel space or somewhere to put a drive, you can simply drop in a new motor with the same frame size that has a drive integrated into it.

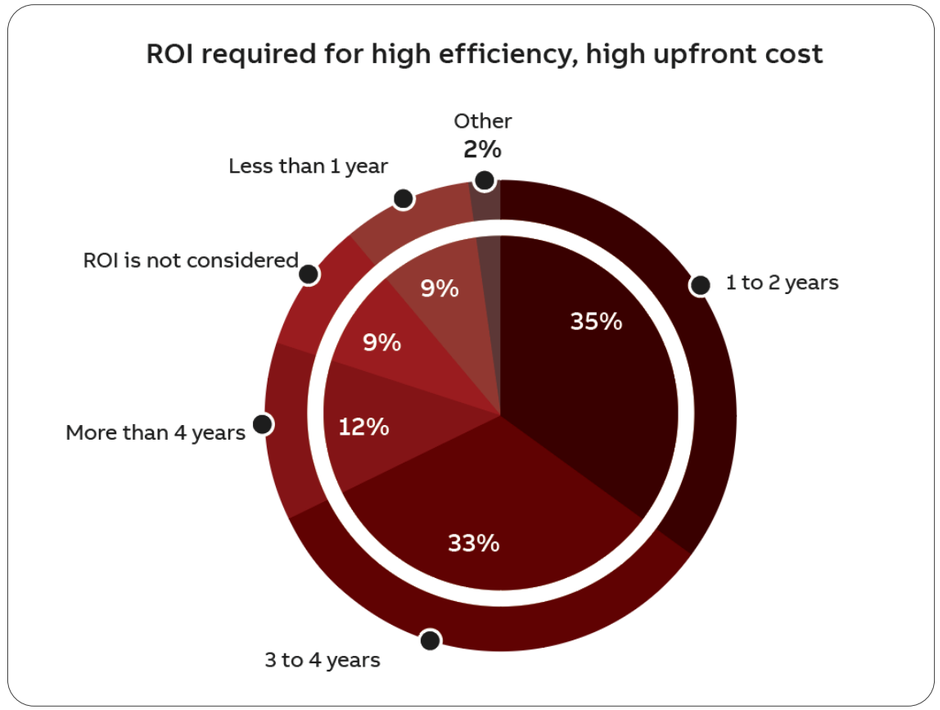

Figure 2: Payback for high-efficiency HVAC equipment was only one month longer than low-efficiency HVAC equipment. Courtesy: Motors & Drives in HVAC Applications study, April 2022

"Now you've got both variable speed and high-efficiency capability and with a drop-in replacement," said Gmitro.

Selecting solutions

There are many reasons behind selecting the right motors and drives for your HVAC applications. When survey respondents were asked, the No. 1 reason was "reliability or quality of product," at 79% and 77%, respectively. Interoperability/integration was second on both lists of important factors.

ABB's motors and drives are based on advanced technologies and designed for a variety of industries and applications. ABB offers a broad portfolio of ABB and Baldor-Reliance® motors and drives created specifically for the demands of HVAC environments. For more information, review the links below:

- ABB Energy Efficiency Movement webpage
- ABB in HVAC
- Accelerating Ambition: How global industry is speeding up investment in energy efficiency
- Achieving the Paris Agreement
- EC Titanium and ACH580 Drive Flyer
- Energy efficiency of smart buildings
- HVAC Interactive Brochure
- Improving end-to-end system efficiency
- Join the Energy efficiency movement
- Webcast: How to specify HVAC motors, drives to meet energy goals
- Whitepaper: Selecting the Right Motor for your HVAC application
- Whitepaper: Variable Speed Drives in HVAC

Join the Energy Efficiency Movement now

Survey methodology

The research study "**Motors & Drives in HVAC Applications**" was conducted by *Consulting-Specifying Engineer, Control Engineering* and *Plant Engineering* to identify the buying and specifying habits of engineering professionals involving HVAC systems. Data collection occurred March 30 to April 18, 2022, with 431 respondents completing the study.

For more information, visit ABB

Mark Gmitro
Global Product Manager, Variable Speed AC Motors
ABB
Greenville, South Carolina

Tim Skell
VFD HVAC Application Engineering Manager
ABB
New Berlin, Wisconsin