
WHITE PAPER

Data-driven decision making to improve energy efficiency



Digital solutions for more energy efficient electrical rotating equipment

In industries that rely on motors and drives, energy consumption is a big part of their operating costs, with about 70% of the energy being consumed by electric motors.¹ Since a significant number of these motor systems are old and inefficient, they provide a good starting point for companies that want to improve their energy efficiency and reduce energy costs.



Globally, there are about 300 million motor-driven systems currently in use and this number is likely to increase. Therefore, improving motor system efficiency is of growing importance. Indeed, it is estimated that if all the motor systems currently in use were replaced with higher-efficiency equipment, global energy consumption could be reduced by up to 10%.²

One way to improve efficiency is to modernize older and less energy efficient equipment with newer, more efficient solutions. However, modernization is only one step in the improvement process. Digital solutions offer new capabilities that enable energy efficiency to be continuously optimized. To take advantage of these digital solutions, the equipment and processes must be connected to the Internet of Things (IoT). This enables real energy use data to be gathered, monitored, and analyzed. Using the insights gained, service experts – either from the customer or their service partner – can then identify inefficiencies and opportunities and make recommendations for continuous improvement.

This white paper discusses some of the available digital solutions and some of the possibilities they offer for gaining constant energy efficiency, as well as enabling new outcome-based business models.

Studying industry trends towards energy efficiency

To evaluate future market needs and industry attitudes towards energy efficiency, ABB has conducted a study in partnership with the University of St. Gallen in Switzerland.³ The study covers companies in different industry segments and in different geographical areas. While the results so far are preliminary, some findings seem quite clear. For example, the majority of participants believe that sustainability is gaining importance and is becoming a crucial topic for business. And 80% stated that sustainability is an important factor for their customers' customers. In addition, the majority of people interviewed agreed that transformation to more efficient systems is needed and they identified some use cases that had the most chance of success. These included product upgrades, monitoring and energy management systems.³

However, the participants also highlighted a gap between willingness to act and actual action. Part of the reason for this was due to a focus on return on investment rather than on longer-term, life-cycle benefits. Another reason for inaction is that finding the right decision makers can be difficult, especially when decisions have to take both sustainability and business goals into account. Furthermore, some respondents noted that energy efficiency investment decisions were often based on intuition, rather than hard data. In practice, digital connectivity is a prerequisite for continuously gathering this kind of energy data from electrical rotating equipment like powertrains. The results so far indicate that people agree that monitoring and tracking energy efficiency is important to their operations, while modernizing equipment is a viable option for companies.



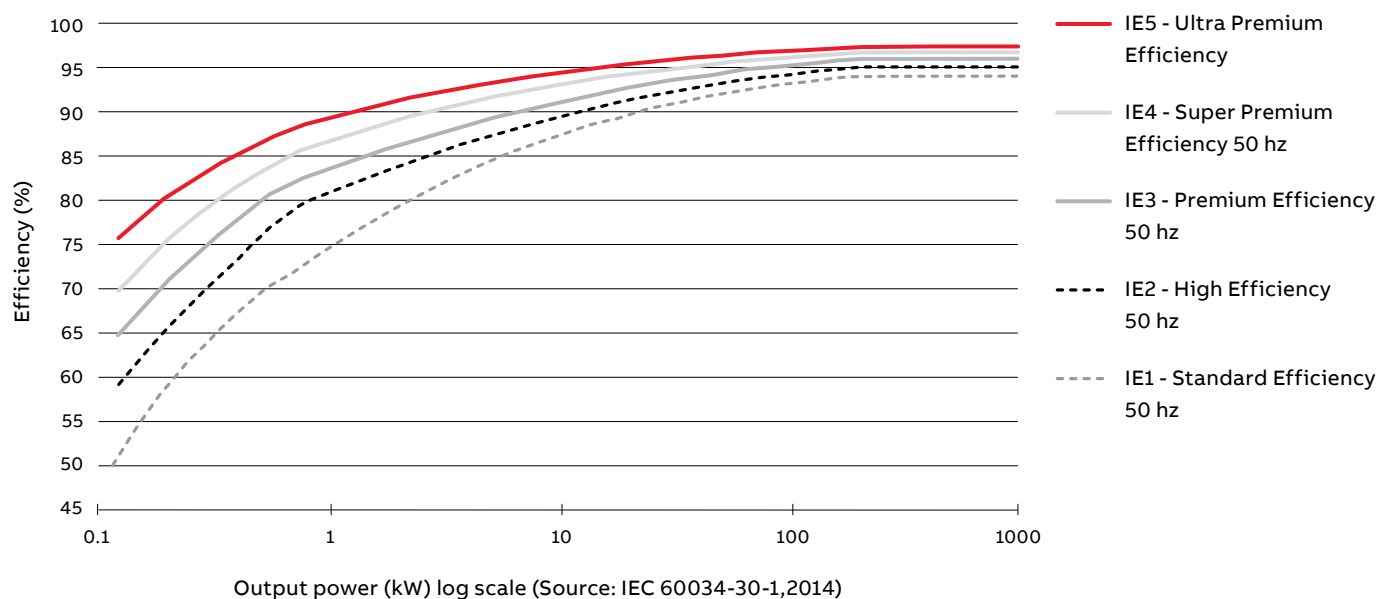
Read the Interim Report: Sustainable operations through energy efficiency [here](#).

A first step: modernize to improve efficiency

Older motors are a typical source of inefficiency in industrial applications. By modernizing some of their motor systems, most companies and utilities could save energy and money, helping them to meet both their sustainability objectives and their business goals. In general, upgrading a motor to the next IE class, for example from IE3 to IE4, will reduce motor losses by 20%, and adding a variable speed drive to

an existing motor of a pump, fan or compressor, can reduce power consumption by 25%.⁴ Given that in some markets over 60% of industrial motors are more than 10 years old, modernizing equipment offers a lot of scope to improve energy efficiency.⁵ The improvements in energy efficiency will, of course, depend on the processes involved and the age of the equipment in use – the older the equipment, the greater the potential for energy savings.

Motors: Efficiency and age



⁴ Older motors are less efficient than newer motors.⁶

Continuous energy efficiency driven by data

Enabling better decision making based on data

Companies in many industries do regularly modernize their existing equipment or components at the end of their life with solutions optimized for lower energy consumption. However, data about actual energy use and equipment performance is one of the most important requirements for continuously deciding how to improve energy efficiency. You need data to know how efficiently your equipment is running and you need data to see what changes you could make to actually improve efficiency. Today, with the rapidly accelerating capabilities of digital technology, it's easier than ever to gather data from all your equipment and all your processes. However, accumulating raw data is not enough. You need the ability to identify the relevant data and then process it, and you also have to have the expertise to analyze and interpret the results.

In short, you need to look at the right things and ask the right questions before you can get useful, actionable answers. That is when you can find effective ways to improve energy efficiency.

Data gathering in practice

Digitally enabled services are provided remotely via secure IoT connections. This way customers can benefit from

advanced computer processing without having to build or support data storage or computing facilities on their own site.

Specially developed solutions, such as ABB Ability™ Condition Monitoring, are needed to gather data from connected devices. The software connects to the powertrain either through sensors that can be added to motors, generators, bearings and pumps or via sensing functions that are an integral part of the equipment, as with ABB drives.

Once the software is enabled then it can be used to measure and track different parameters like usage patterns, cooling, stress levels, and power consumption. The data gathered can then be processed and analyzed and is available through a dedicated platform.

Use data to see the bigger picture

Data gathering is increasingly being applied to whole processes and process areas, rather than only individual pieces of equipment. For example, it's possible to assess the condition and maintenance needs of an entire powertrain, rather than just the individual motors and drives. With this approach, the same data from the motors and drives is gathered, but it is also assessed and analyzed in the context of the whole system.



ABB Ability™ Condition Monitoring for powertrains is a solution that gathers data from drives, motors, pumps and other electrical components. It combines connectivity and data analytics, and it enables expertise driven assessments that can improve the performance, reliability and efficiency of each component in your powertrain, as well as the powertrain as a whole.



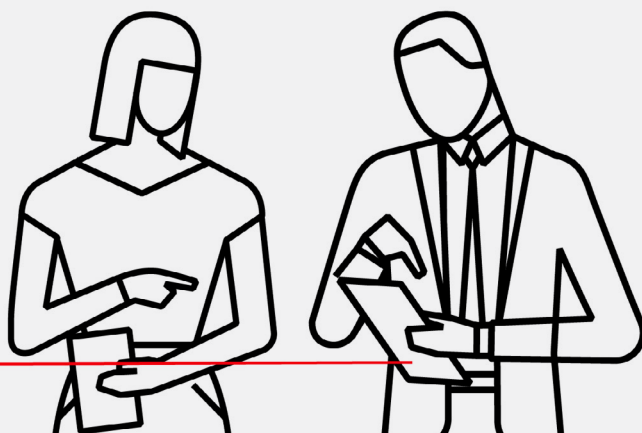
Understanding data requires expertise

To make the most of the data you gather, you also need expertise. If a company does not have the required expertise in-house, then they will need to rely on an expert service provider to help them.

The type of expertise required includes an understanding of the technology involved, for example, of brand agnostic motors, generators, or drives. It also includes an understanding of the type of data the technology can provide, as well as expertise in processing, analyzing, and interpreting the data. And of course, companies and their service partners need to understand their processes and business area, as well as being focused on the objective in sight.

For example, if a service partner provides remote condition-monitoring services for a water treatment plant, they will need an understanding of motors, drives, pumps and valves, knowledge of the water treatment process, and maintenance expertise, as well as expertise in data gathering, processing and analysis. The data by itself is not enough to ensure that the plant equipment stays in good working condition.

With this knowledge in place, service partners like ABB will already know the common issues to pay attention to and which aspects usually have potential for improvement.



Moving towards partnerships

Digitally driven solutions require companies to safely share data with their service providers. This is leading to a re-evaluation of the relationships between service providers, customers, and other businesses. In the future these will be increasingly based on collaborative partnerships in which equipment manufacturers and service partners remove risk and use a high level of connectivity to deliver results.

Using data and expertise to improve performance

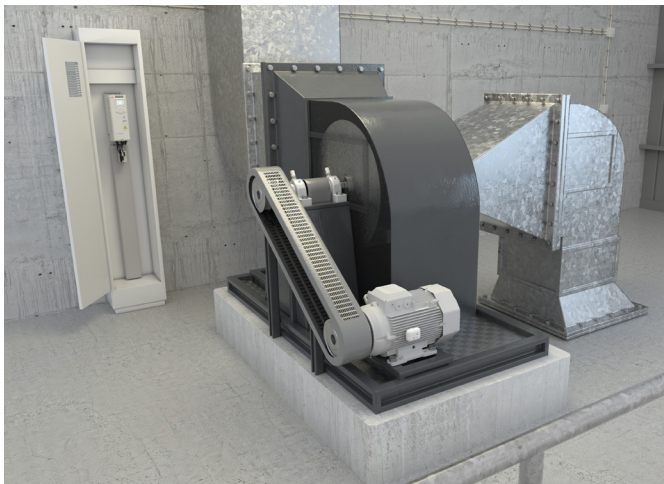
Digitally enabled solutions can be used to provide different types of service, including condition-based maintenance and predictive maintenance.

Continuous monitoring and condition-based maintenance

In condition-based maintenance, data is continuously gathered from equipment and processes to monitor their condition. The data is transmitted securely to the cloud where equipment manufacturers and service partners are authorized to access, process and analyze the data. Using their expertise, the service partner will assess the condition of the equipment, identify maintenance needs and recommend maintenance actions to their customer. This improves equipment reliability and performance and enables better maintenance scheduling, while preventing unnecessary maintenance work and reducing the need for manual inspections. Because the system monitors the equipment continuously, it can also provide alerts and alarms automatically if an unexpected deviation occurs.

Predictive maintenance

Predictive maintenance uses data to identify potential issues before they become a problem, which helps ensure process stability and the maximum available uptime. With predictive maintenance, service experts analyze both real-time and long-term aggregated data. They bring together equipment data like the hours of operation, and process data like parameter settings, and combine it with historical data and trends to predict upcoming maintenance needs. With this longer-term overview, optimum maintenance intervals can be established, deviations in performance can be pinpointed and problems can be prevented. In addition, bottlenecks and opportunities for improvement can also be identified.



Digitally enabled services like ABB Ability™ Condition Monitoring help companies to monitor the condition of their powertrain components.



CUSTOMER CASE



Mokrá improves efficiency with digital monitoring solutions

A cement factory operated by Mokrá in the Czech Republic had difficulties tracking down the source of repeated unplanned outages and they turned to ABB for help. Using ABB Ability™ Condition Monitoring for drives, ABB Motion Services monitored the condition of their variable speed drives continuously. Using the insights gathered from this data, ABB's experts were able to identify the cause of the failures and recommend areas to focus on. This enabled Mokrá to change from schedule-based maintenance to focusing their maintenance actions on the right equipment at the right time. As a result, by using preventive maintenance solutions, they identified potential failures in advance, preventing unplanned shutdowns, and in just 3 months Mokrá obtained over \$210k cost savings and improved the performance and efficiency of the ID fans (smoke fans) without needing to make unplanned investments.

CUSTOMER CASE



Source: Denka

Denka extends motor lifetime and reduces maintenance costs

ABB provided condition monitoring solutions for motors and pumps to Japanese company, Denka, at their chemical plant in Singapore. The plant is one of the world's largest styrenic resin production facilities and it uses hundreds of motors to operate pumps, compressors, blowers and pelletizers. Under the service agreement, ABB provides expertise and manages equipment failure risk, and conducts or advises on preventive maintenance and repairs using a reliability index and urgency level. For example, ABB continuously monitors key parameters of process-critical motors, pumps and bearings. Using insights from this data, ABB was quickly able to identify deviations in several processes, leading to corrective action well-ahead of potential failures. Over the longer term, the condition monitoring service reduced electric motor failures by 80% over 2 years.⁷

With ABB's condition monitoring service, Denka reduced electric motor failures by 80% over 2 years.⁷

Using data and expertise to continuously optimize energy efficiency

The majority of digitally enabled solutions currently focus on ensuring process and equipment reliability and performance. However, they can also be adapted to continuously optimize energy efficiency. As with condition-based maintenance services, energy efficiency services are also provided remotely.

It should also be noted that improving the reliability and performance of equipment by itself can already measurably improve energy efficiency. A customer in Australia has reported that ABB condition monitoring for motors and drives has been demonstrated to increase their energy efficiency by around 10% by creating better loading profiles based on energy consumption patterns and rationalizing the installed base of motors and drives.⁸

In services that focus on energy efficiency, data about energy use is continuously gathered from connected motors and drives, and other electrical components. Service experts can look deeper into the data to pinpoint critical areas for improvement and to calculate potential energy savings. Using this information, they can then advise on the different options available and recommend the most effective course of action to improve energy efficiency. For example, motor systems and drives, or adding variable speed drives. And, once any changes are made, continuous monitoring enables them to follow up and verify the efficiency gains, and to ensure that all motor systems continue to run as efficiently as possible in the long term.

With outcome-based business models, companies can focus on reaching their goals rather than overcoming the hurdles on the way.

New service models for guaranteed outcomes

Digitally enabled solutions can also be used to increase transparency and to achieve broader goals, rather than just focusing on individual issues. For example, leading companies like ABB offer outcome-based business models that combine big data with continuous-monitoring and expertise, whether provided on site or remotely.

With traditional services, equipment manufacturers and service partners focus on responding to needs and finding solutions. In contrast, with outcome-based business models, the focus is shifted to avoiding risk – this becomes the service partner's responsibility – and the customer and their service partner work together to define and achieve critical outcomes over time. For example, a customer might pay their service provider to ensure a guaranteed level of production availability or continuous energy efficiency. The service provider will then take responsibility for monitoring the customer's equipment remotely and take proactive maintenance actions to ensure the agreed outcome. Similarly, in the future, a customer might pay their service provider to improve their energy efficiency and optimize their energy use.

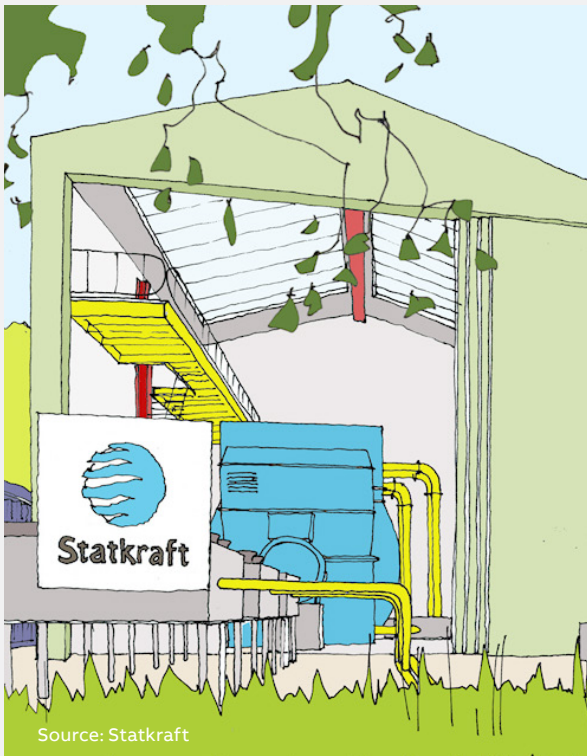
Because outcome-based services rely on remote access, digital connectivity is essential – it provides the infrastructure that makes it possible to deliver continuous results and the desired outcomes. This also means that customers will need to change their mindset and be more willing to share data with their service partners. However, service partners have the best knowhow about the equipment they supply, so it makes sense to let them take responsibility for optimizing its performance throughout its life cycle.

CUSTOMER CASE



SCA's Munksund paper mill produces 400,000 tonnes of packaging annually. The papermaking process uses a lot of energy, and most of it is consumed by their installed base of more than 2,400 electric motors. Together with ABB, SCA Munksund implemented digital solutions to improve their energy efficiency and reduce emissions. This included data from monitoring the condition of their assets. When combined with expert data analysis, this lets them follow real-time indicators like usage patterns and power consumption, as well as long-term trends in performance. The end result is that they will be able to save energy and costs and ensure as energy efficient operation as possible.

CUSTOMER CASE



Source: Statkraft

ABB has signed a 10-year service contract with Statkraft, Europe's largest generator of renewable energy. This turnkey contract includes the design, manufacture, and installation of two high-inertia synchronous condenser systems for the Lister Drive Greener Grid project in the UK.

As part of their service, ABB will ensure around-the-clock availability for the condenser system. With this outcome-based service, Statkraft will get a guaranteed level of uptime, together with maintenance from ABB. ABB will continuously monitor the equipment and take proactive maintenance actions to ensure that breakdowns never occur.

Conclusion

Worldwide energy consumption is projected to grow by almost 50% by 2050.⁹ As a result, global and local regulations are constantly being tightened to drive companies towards more energy efficient operations.

As discussed in this white paper, digital solutions and services that enable continuous energy efficiency are already available. These use continuous monitoring to gather data from equipment and processes to ensure that they run as efficiently as possible, to support decision making and to identify areas for improvement. Continuous monitoring is also essential to more advanced digital services that focus on delivering outcomes based on specific KPIs. With outcome-based business models,

companies can improve and develop their operations and work towards long-term goals, and avoid risks, rather than simply maintaining performance as it currently is.

ABB is leading the way in digital solutions for energy efficiency for motors, generators and drives, and we offer digitally enabled services that are accessible to almost any business. This enables them to adopt these powerful new technologies in small steps, as they digitalize their business. In the future, digital, outcome-based business models are expected to be a normal part of business life, and at ABB, we have the expertise and the technology to make the transformation to a digital and energy efficient future easier than ever before.

- (1) Fong, J.; F. Ferreira; A.M. Silva; and A.T. De Almeida, "IEC61800-9 System Standards as a Tool to Boost the Efficiency of Electric Motor Driven Systems Worldwide," *Inventions*, 2020, 5, 20, <https://www.mdpi.com/2411-5134/5/2/20/htm>
- (2) Waide, P. and C.U. Brunner, "Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems," International Energy Agency working paper, Paris, 2011 page 13, 17, 118.
- (3) ABB Smart Lab and University of St. Gallen, Sustainable operations through energy efficiency, Interim Report, 2021
- (4) For an example of the calculations involved, see "Program Insights: Variable frequency drives," Consortium for Energy Efficiency, 2019, <https://www.cee1.org/content/variable-frequency-drives>.
- (5) Lawrence Berkeley National Laboratory, U.S. industrial and commercial motor system market assessment report, Volume 1: characteristics of the installed base, January 2021, Page 67, permalink: <https://escholarship.org/uc/item/42f631k3>
- (6) Electric Motor Systems: targeting and implementing efficiency improvements, Maarten van Werkhoven, Low Carbon Economy Webinar, European Copper Institute, 8 October 2015, slide 29, <https://www.slideshare.net/sustenergy/electric-motor-systems-targeting-and-implementing-efficiency-improvements>
- (7) Based on ABB measurements and customer experience
- (8) Based on ABB customer experience
- (9) U.S. Energy Information Administration, International Energy Outlook 2019 (IEO2019), page 24, <https://www.eia.gov/outlooks/ieo/pdf/ieo2019.pdf>



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