

WHITE PAPER

The future is energy-efficient, the future is data-driven



Data, insights and expertise can improve the energy efficiency of electrical rotating equipment today

By 2050, global energy usage is projected to increase by almost 50% compared to 2020. This includes an increase in energy consumption in the industrial sector.¹ At the time of writing, in the first quarter of 2022, the cost of energy – oil, gas and electricity – is particularly high, which has led to significant extra energy costs for companies, and prices are expected to increase.



As a result, global players, including businesses and governments, are looking for ways to achieve and enable sustainable growth, and new regulations mandate improved energy efficiency and a reduction in emissions. One of the most promising ways to achieve these goals is through the adoption of energy-efficient technologies – reducing energy consumption will benefit companies in terms of profitability and sustainability.

At the moment, about 70 percent of the electricity consumed by industry is used by electrical motors and there are over 300 million industrial motor-driven systems in operation.² Therefore, improving the efficiency of electrical motor systems can play a significant role in helping the world reduce CO₂ emissions towards “net-zero” and reduce waste. The measures needed to do this are practical, realistic and effective, and they can reduce energy costs for industry, too. In fact, it’s estimated that if all 300 million motor systems were replaced with higher efficiency equipment, we could reduce global electricity consumption by up to 10%.³

Thanks to the Internet of Things and digitalization, new types of digital services now offer even more opportunities to reduce energy consumption. Using connected digital solutions, these services provide new data insights into energy use which, combined with expertise, enable better decisions about energy efficiency. With remote connections and services, the status of equipment and even whole processes can be checked at any time, from anywhere.

In addition, new flexible business models are emerging that offer the potential for continuous energy optimization services. For example, a trusted partner, like ABB Motion, can share the responsibility for gradually improving the energy efficiency of equipment over time, while maximizing the value customers get from their assets.

Energy efficiency in industry

In industries and regions which have a large and aging installed base there are clearly good opportunities to improve energy efficiency by modernizing the existing electric motor systems. This is the case in the US, for example, where over 60% of industrial motors are over 10 years old.⁴

However, despite the potential benefits of modernization and digital services, there are sometimes barriers that prevent companies from investing. Some of these barriers are listed below.

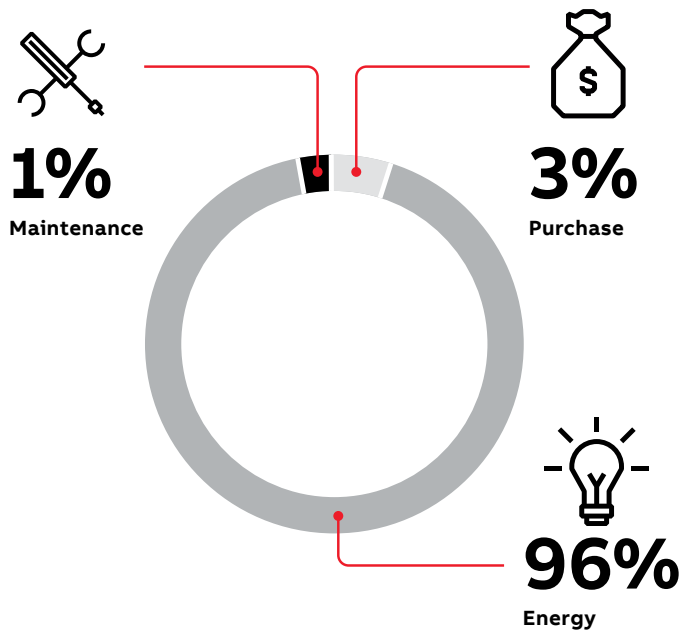
Cost: Companies often find it difficult to justify the up-front expenses. However, the costs, savings and benefits should be evaluated for the whole life cycle. In most cases, the majority of the cost of a motor system comes from the energy used to run the motor throughout its working life, and energy efficiency measures can pay back in just a few years. See the figure **Total cost of ownership for motor systems**.

Downtime: Companies want to avoid the downtime associated with modernization work. However, modernization also improves the reliability and performance of the equipment, meaning that in the long run, total downtime will be reduced.

Digital skills: Companies often feel that they do not have the required in-house skills to make use of digital technologies. This is where service partners are valuable: they can provide both the technology and the skills needed to improve the efficiency of a company's operations.

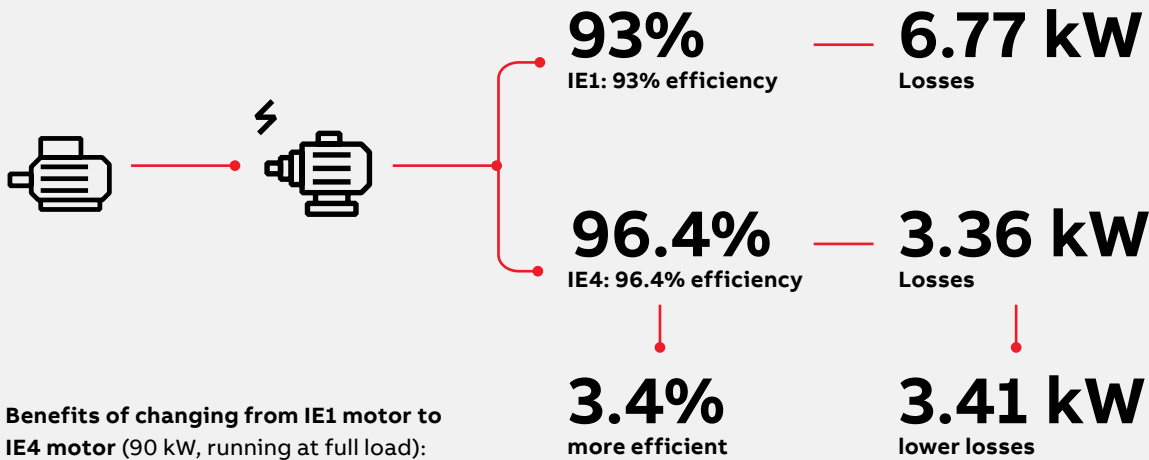
For a company with plants that are already in operation, the starting point for improving energy efficiency is to do an appraisal and assess the state of the installed equipment to identify inefficiencies and opportunities. And for brand

Total cost of ownership for motor systems



new, green-field operations, the focus should be on choosing and installing energy-efficient solutions from the start. In both cases, the latest developments in digital services and connected equipment also offer further opportunities to continuously improve energy efficiency now and in the future. In recognition of this, regulators and organizations around the world are setting and implementing minimum efficiency performance standards (MEPS).

Replacing an old motor (IE1, 90 kW, running at full load) with a more efficient motor (IE4, 90 kW, running at full load) can significantly reduce losses and energy costs.⁵



If electricity costs 0.1 kWh, then the savings can be **2,688 EUR/year**.

Sustainable operations through energy efficiency - a study with the University of St. Gallen

The issue of climate change has undeniably shaped the political and economic landscape in recent years. The global trend is moving towards taking more action to mitigate global warming, as we are now, according to the UN Emissions Gap Report released in October 2021, heading towards a global temperature rise of 2.7°C by the end of this century. In particular, the inevitable problems linked with climate change have brought the topics of sustainability and energy efficiency to people’s attention.

In order to make decisions towards sustainable operations, and to be able to shape desirable, human centered solutions, it is important to understand the pains and needs of the people concerned.

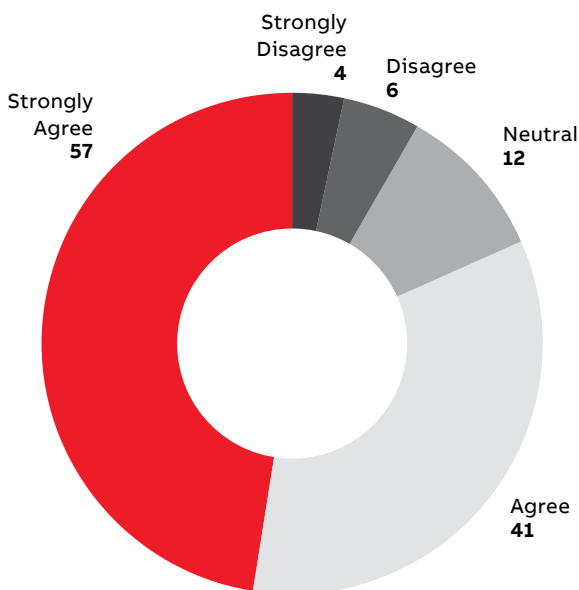
A well proven tool to reveal these types of insights are empathy interviews. In partnership with the University of St. Gallen, a study was conducted with interviewees from various industries around the world. The data from the interviews was further enriched with an online survey.



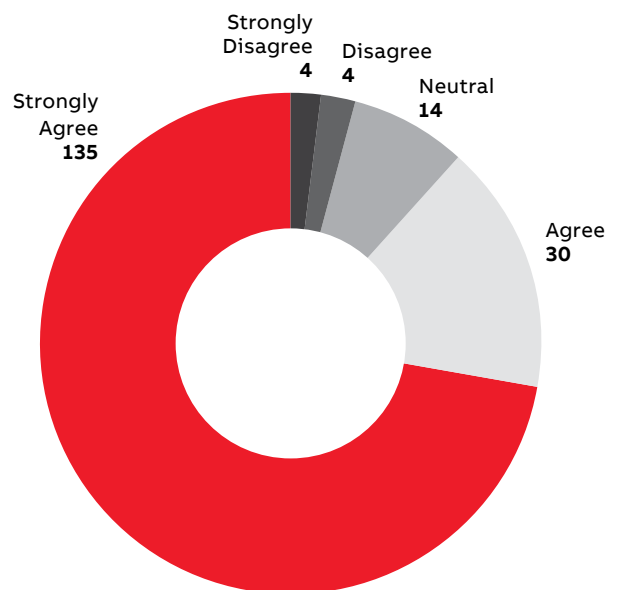
“If you look at young people today, the first questions they have are: “Is the company sustainable?” and “How much does the company respect the environment?”

Maintenance and Energy Manager, South America

Sustainability will become the most important business driver in the future. ⁶



Sustainability is something that personally drives me. ⁶



The importance of energy efficiency related topics has increased within the last two years.⁶

	COUNT	PERCENT	
1 Strongly Disagree (1)	1	0.53%	
2 (2)	5	2.66%	
3 Neutral (3)	8	4.26%	
4 (4)	34	18.09%	
5 Strongly agree (5)	139	73.94%	
I don't know (6)	1	0.53%	



“We could do 100 projects more that would pay off, but we just lack good people. So hard to find good people nowadays!”

Chief Technical Officer and Head of R&D, South Asia



“Sustainability is more than a requirement to fulfil, it is a necessity to survive.”

Senior Project Manager, Metals, Northern Europe

Outcome-based contracts could be a viable option for us to modernize our operations.⁶

	COUNT	PERCENT	
1 Strongly Disagree (1)	1	1.15%	
2 (2)	0	0.00%	
3 Neutral (3)	17	19.54%	
4 (4)	23	26.44%	
5 Strongly agree (5)	21	24.14%	
I don't know (6)	25	28.74%	

Putting digitalization into practice

A separate study by ABB of international business and technology leaders on industrial transformation showed that nearly 96 percent of decision-makers believe digitalization is essential to sustainability. However, the study also revealed that only 35 percent of surveyed companies have implemented Industrial IoT solutions at scale – highlighting the potential for industries to progress towards sustainability goals through increased digitalization.⁷

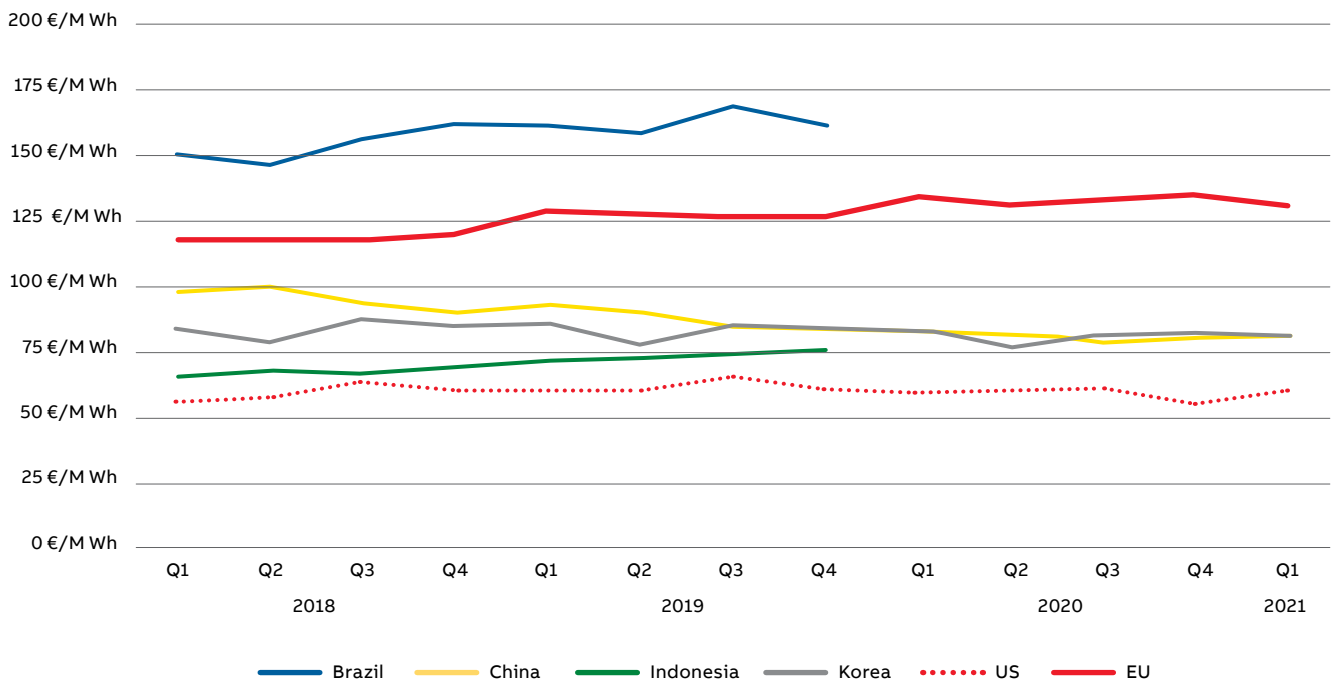
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Did you know?

While there is a lot of interest in sustainability, many companies may not know that the technology needed to help them to meet their energy efficiency goals and reduce their energy costs is already available.

- **The technology exists to reduce motor system energy demand by 20% to 30%.⁸**
- **The IEA estimates that industry accounts for more than 40% of global greenhouse gas emissions.⁹**
- **More than 1/2 of the world's electricity is consumed by just 4 applications:¹⁰**
 - electric motor systems
 - lighting
 - room air conditioners
 - residential refrigerators
- **Using energy-efficient motor systems in developing and emerging economies could save 300 TWh and 200 Mt of CO₂ emissions per year by 2030.¹¹**
 - That's the same amount of energy that Mexico uses in a year.¹²
- **Smart demand response could provide 185 GW of system flexibility globally, the same as the electricity supply capacity of Australia and Italy combined. This could save USD 270 billion of investment.¹³**

Energy prices are expected to increase.



Source: Eurostat, IEA, CEIC, DG ENER computations.
The latest data for Brazil and Indonesia are not available.¹⁴

Making billions of better decisions

Assess potential energy savings

As different countries and markets look for energy saving opportunities, there will be an increasing need for accurate data, which will span countless systems and business processes. With the right expertise and advanced analytics, this data can be brought together to give companies the knowledge and visibility they need to make better decisions about the energy efficiency of their motor systems. It can include data about motors, drives, entire powertrains and other connected equipment, as well as the equipment age and condition, its power consumption and performance, and the demands of the application, including load characteristics.

In practice, there are several ways to gather and assess data. Companies with connected equipment can perform self-assessments using tools provided by expert partners, like ABB, to calculate how much energy and money they could save by modernizing their drives and motors. For more in-depth assessments, expert partners can perform

audits and inspections on-site, and they can gather and monitor data remotely and online from equipment through secure cloud services.

Once enough relevant data has been gathered, then it can be analyzed and assessed, and used to develop the best long-term strategy for modernization, maintenance, energy savings and reductions in CO₂ emissions. Continuous monitoring can also be used to follow the performance of motor systems and to identify areas with the potential for improvements in energy efficiency. However, analytical expertise and knowledge of motor systems is required to put the results into context and turn them into actionable information. Since businesses often do not have people with this kind of expertise inhouse, they are likely to need the help of an expert partner. This is why ABB Motion Services offers a range of services specifically designed to help businesses improve the energy efficiency of their operations.



Digital transformation enables sustainability

Around the world, decision-makers in different industrial segments see that digital solutions and the IoT will play a big role in enabling companies to improve the sustainability of their operations. A recent study published by ABB, showed that:⁷

- 94% agreed the Industrial IoT “enables better decisions, improving overall sustainability”
- 57% indicated the IoT has had a “significant positive effect” on operational decision-making
- 38% of digitally mature companies experienced top-line growth due to sustainability practices

ABB Ability™ Life Cycle Assessments for motors and drives

ABB offers life cycle assessment services for both motors and drives. An ABB Ability™ Life Cycle Assessment collects a comprehensive overview of the life cycle state and operating conditions of all the motors and/or drives in an entire plant. ABB's experts gather and analyze data, perform criticality studies, and then compile an in-depth Life Cycle Assessment report that details the status of the fleet, as well as providing recommended maintenance and modernization actions. This enables the plant owner to make more informed decisions and plan for actions that will improve reliability and energy efficiency over the whole fleet life cycle.

ABB Energy Appraisal

An ABB Energy Appraisal involves a one-time on-site visit by an ABB engineer to gather data from the installed motors and drives. The information gathered will include load profiles and empirical data about energy consumption and process requirements. The engineer will then analyze the findings to assess potential energy savings and reductions in CO₂ emissions, as well as the estimated payback time for any investments in motors and/or drives. They will also prepare a clear, thorough report and an action plan that will include detailed recommendations for suitable drives and motors, including the correct parameters for optimal energy efficiency. After new equipment is installed, the savings can also be tracked and verified against the original predictions.

ABB Digital Powertrain Energy Appraisal

An ABB Digital Powertrain Energy Appraisal uses remote connections to collect real-time data from ABB Ability™ Smart Sensors installed on the powertrain. The data will be automatically processed to provide data-driven insights that can be used to reduce the power consumption of the company's powertrains. Because the data is available in real-time, the customer can get both instant insights into the energy use of their fleet, as well as accurate assessments of the energy saving potential of individual connected assets, and it can also be used for online condition monitoring. These deeper data insights enable better decision-making, and because the data is gathered over longer periods of time, it can also be used to reveal hidden opportunities to improve energy efficiency.

See the bigger picture in real time

Connected equipment and digital solutions make it much easier to obtain accurate and reliable data, and digitalization will play an increasingly important role in enabling a more sustainable and energy-efficient future. It will bring connected equipment, continuous remote monitoring, real-time data and analytics together to give companies the insights they need to make the right decisions at the right time.

Another benefit of connected equipment and the IoT is that it helps companies look beyond process silos. In the past, motor systems have often been viewed and optimized as individual processes. However, today's digital solutions can overcome this limitation to provide a connected view of whole applications, giving companies deeper insights into the performance and energy efficiency of their operations overall.



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96% of decision-makers believe digitalization is essential to sustainability.⁷

Implementing change

Energy-efficient solutions and services

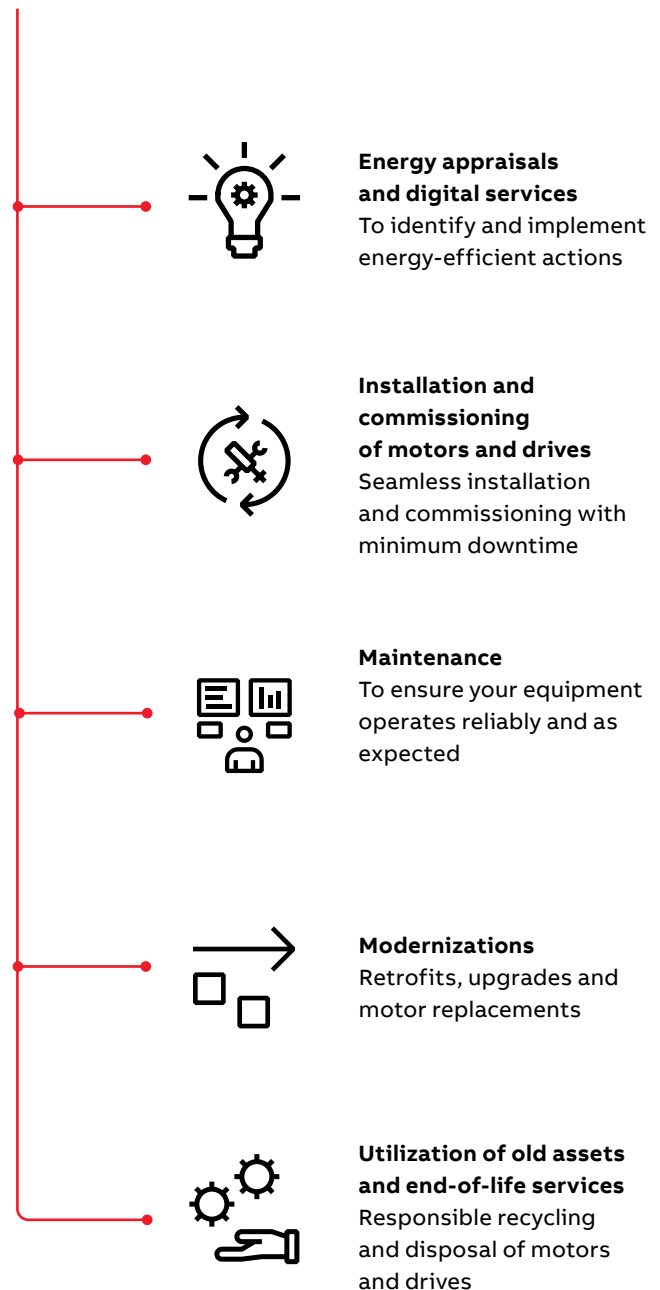
Once the optimum areas to make energy savings and efficiency gains have been identified, then companies can begin to implement energy-efficient solutions. These measures can include adding variable speed drives to existing motors, replacing low efficiency class motors with higher efficiency motors, or other modernizing actions, for example.

The implementation phase should be done together with a reliable partner that has experience in managing this kind of project. They will install and commission new equipment, and use insights from the data to ensure the fastest, most efficient and cost effective results. With good data, modernizations can be implemented at all stages of the equipment life cycle. For example, information about obsolescence and migration paths can be used to plan and schedule retrofits and upgrades to extend equipment operating life and avoid premature scrapping.

Connected digital solutions can also be implemented to provide better data about equipment and processes. With this type of solution, digitally-enabled motors and drives, and even whole powertrains, can be integrated during modernization work and then connected securely to cloud service solutions. These kinds of solutions can then help identify new opportunities for improvement and prioritize investments, as well as predicting upcoming needs.

For example, continuous monitoring can be used to improve maintenance planning, which, in turn, can improve reliability, performance and energy efficiency. Furthermore, expert partners can also analyze data about existing configurations and motor usage to provide solutions that will lead to improved energy efficiency and performance over time.

ABB can help you to implement energy efficiency improvements



Mitigating risks

Flexible business models

Various types of digital services have been available for some time, including condition monitoring, and remote technical support and troubleshooting. Now, however, advances in digital technology, connectivity and processing power are making new types of outcome-based business models possible.

Instead of focusing on one issue, these new flexible business models can be used to guarantee outcomes and help companies mitigate their risks. This means that the customer and their service partner define and agree targets and desired outcomes over time, and then the partner takes responsibility for delivering them. For example, a service partner, like ABB, could take responsibility for ensuring an improved level of energy efficiency.

Digital connectivity is a key component of outcome-based services because it enables the services to be provided continuously and remotely. Using secure, remote connections, the customer's equipment and processes can be monitored 24/7 and advanced data analytics can be used to follow performance, to ensure that agreed KPIs are met and to identify and prevent risks in advance. Flexible business models like these are provided by ABB, including turnkey solutions all delivered through ABB Motion OneCare agreements.

Because outcome-based services involve deeper cooperation between customers and their service partners, companies will need to be more willing to share data than in the past - a shift in mindset that is essential to getting the most from digitalization and remote services. Simply put, data lets service partners provide a better quality of service. The connected technology and service capabilities are already available, so outcomes like constant energy savings and reductions in CO₂ emissions are now within reach.



ABB Motion OneCare agreement

With ABB Motion OneCare, ABB partners with customers to plan, coordinate and execute equipment maintenance according to the specific criticality and needs. Each service agreement is tailored to meet the customer's long-term objectives using expert knowledge, standardized processes, and advanced technologies.

CUSTOMER CASE

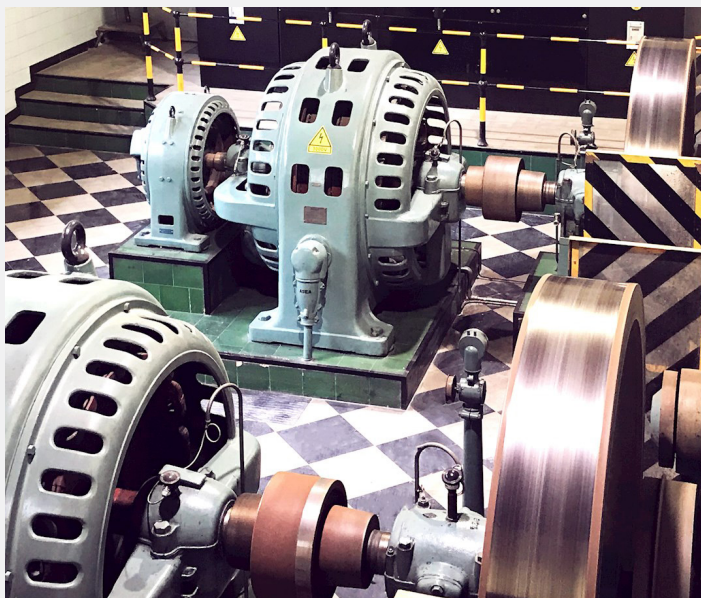
Digitization enables higher uptime and better energy efficiency



The Waggeryd Cell AB pulp mill in Sweden has used digitalization to continuously improve the energy efficiency of their operations. The mill installed 146 ABB Ability™ Smart Sensors to gather accurate data from electric motors, pumps and other equipment. ABB's experts use this data to monitor performance and to analyze the mill's status and energy efficiency, and to prevent disturbances in advance. As part of the service, ABB also provides energy reports, and these have enabled the mill to identify and deal with inefficiencies, for example, by replacing wrongly dimensioned motors. The result is that Waggeryd Cell AB has been able to reduce the risk of unplanned downtime and improve their energy efficiency.

CUSTOMER CASE

Modernization services enable improved power output



Spanish company FIL-GENESIS turned to ABB Motion Services to improve the efficiency of their hydro-power plant. First, ABB's experts assessed the installed base and technical data from the previous 10 years. Then, using the insights gained, they identified the most effective modernization options, together with the estimated payback time. As a result, FIL-GENESIS added an ACS880 variable speed drive to the plant turbine together with specialised Hydropack control software. The modernization led to a 25% improvement in power output. Because the river flow rate varies, the modernized system showed the significantly improved performance at low flow rates, compared to the previously fixed speed of turbine operation.

Conclusion

Although energy demand is predicted to grow, new energy efficiency standards and regulations are having a positive effect on global energy consumption. For example, in an IEA analysis of nine large countries and regions, including China, the European Union and the United States, it was found that efficiency standards had successfully helped to save about 1,500 TWh of electricity in 2018.¹⁵ This was equivalent to the



total electricity generated in 2018 in those countries by wind and solar facilities. Furthermore, about 85% of companies say they are now adopting IoT initiatives.¹⁶ On average, the amount of connected equipment is growing by 33% every year and it's estimated that almost \$7 trillion will be spent on digital transformation between 2020 and 2023.^{17,178} As the adoption of digital technology accelerates, new types of services will proliferate to enable companies to make better use of data, which will further enable them to improve the energy efficiency of their operations.

ABB's range of digitally enabled solutions and life cycle services can help companies to continuously optimise the energy efficiency of their electrical rotating equipment, and we also offer flexible business models that can help them reduce electrical energy consumption and CO₂ emissions.

As digitalization continues to progress, data-driven services will make it easier for companies to achieve their energy efficiency goals and outcome-based business models will become more common.

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