
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 final 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.



Global players, including businesses and governments, are looking for ways to achieve and enable sustainable growth. Among the key findings of an Energy Efficiency survey commissioned by ABB in 2022 was that 54 percent of the companies were already investing in energy efficiency measures, and 40 percent planned to make energy efficiency improvements that year.

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 2018.² This was equivalent to the total electricity generated in 2018 in those countries by wind and solar facilities.

The aforementioned rising energy prices were one of the main drivers for this focus on energy efficiency. With an average of 23 percent of annual operating costs attributable to energy usage, ninety percent of respondents indicated

that higher energy costs are a threat to profitability. In addition to the cost element, new regulations mandate improved energy efficiency and a reduction in emissions. 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.³ Reducing energy consumption benefits companies in terms of both 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.⁴ 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%.⁵

Thanks to the Internet of Things and digitalization, new types of digital services now offer even more opportunities to reduce energy consumption. With remote connections and services, the status of equipment and even whole processes can be checked at any time, from anywhere, enabling better decisions about energy efficiency. 51 percent of survey respondents are planning to use energy efficiency appraisals to improve their operations.

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

Energy efficiency in industry

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. Half of the 2022 survey respondents cited cost as the biggest single factor in inhibiting the uptake of energy efficiency measures. However, the costs, savings and benefits should be evaluated for the whole life cycle. In most cases, the majority of the cost of an electrical motor driven system comes from 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: 37 percent of companies in the ABB Energy Efficiency Survey were particularly concerned with the downtime associated with modernization work.

Digital skills: Companies often feel that they do not have the required in-house skills to make use of digital technologies. The potential lack of in-house skills as well as workforce resistance to new technology is more evident in some countries, with survey respondents from India, China, and Brazil showing particular concern in this area. 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.

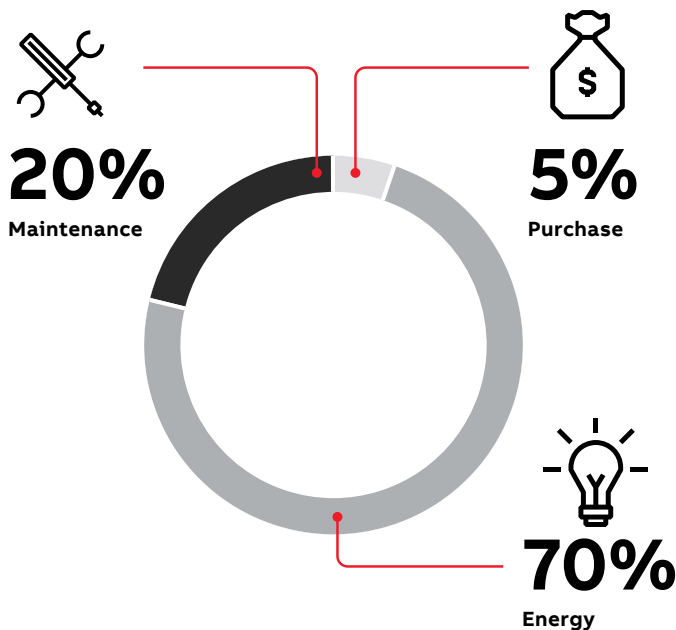
For a company with plants that are already in operation, the starting point for improving energy efficiency is to do an appraisal and assess the state of the installed equipment to identify inefficiencies and opportunities. And for brand new, green-field operations, the focus should be on choosing and 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).

Digital transformation enables sustainable operations

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 2022 study published by ABB showed that:⁶

- 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

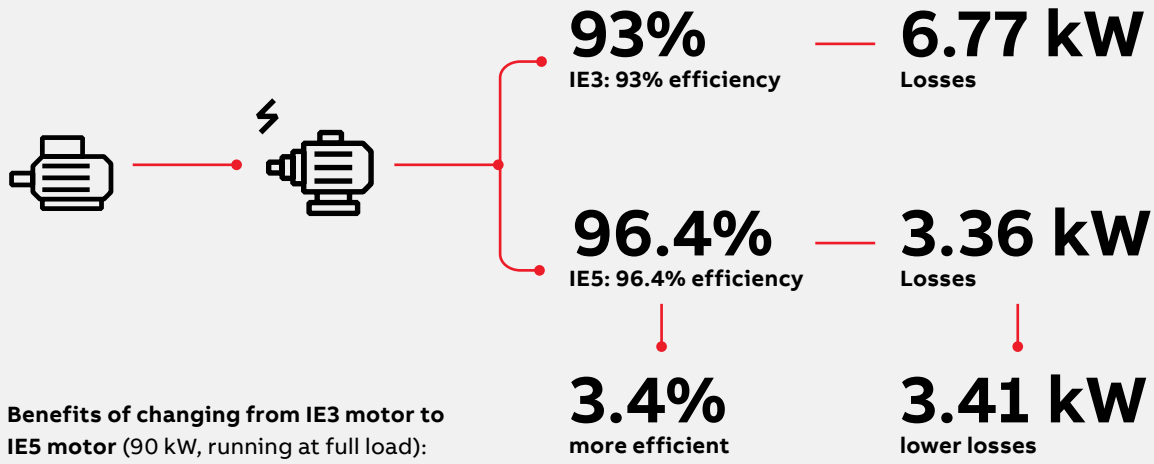
Total cost of ownership for motor systems



Did you know?

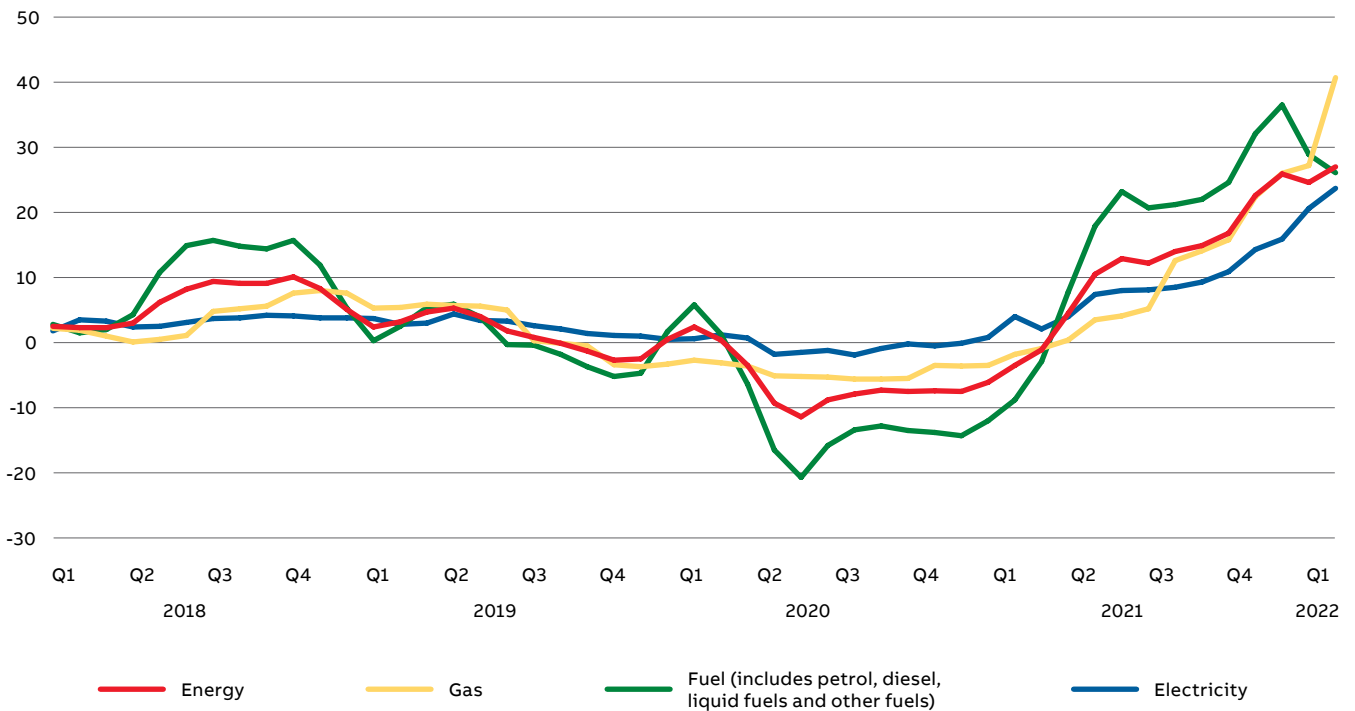
- While there is a lot of interest in sustainability, many companies may not know that the technology needed to help them to meet their energy efficiency goals and reduce their energy costs is already available.
- **The technology exists to reduce motor system energy demand by 20% to 30%.⁷**
- **The IEA estimates that industry accounts for more than 40% of global greenhouse gas emissions.⁸**
- **More than 1/2 of the world’s electricity is consumed by just 4 applications:⁹**
 - 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 2030.¹⁰**
 - That’s the same amount of energy that Mexico uses in a year.¹¹
- **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.¹²**

Replacing an old motor (IE3, 90 kW, running at full load) with a more efficient motor (IE5, 90 kW, running at full load) can significantly reduce losses and energy costs.³



If electricity costs 0.1 kWh, then the savings can be 6,600 EUR/year.

Evolution of EU energy prices in the last 5 years.



Source: Eurostat.¹³

Making billions of better decisions

Assess potential energy savings

The ABB Energy Efficiency Survey tells us that different countries and markets are looking for energy saving opportunities. Fully 97 percent of the companies surveyed said they are engaged in or planning energy efficiency investments.

Due to these efforts, there will be an increasing need for accurate data which spans countless systems and business processes. With the right expertise and advanced analytics, this data 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. This is vital, for example, for the 70 percent of companies that intend to improve energy efficiency in their processes and operations.

In practice, there are several ways to gather and assess data. Companies without connected equipment can conduct offline appraisals and obtain a one-off assessment. In the case of connected equipment, online analyses offer more constant energy efficiency and cost savings. In this case, tools provided by expert partners like ABB can gather data constantly to calculate how much energy and money can be saved.

Once enough relevant data has been gathered, it can be analyzed, assessed, and used to develop the best long-term strategy for maintenance, modernization, energy savings and reductions in CO₂ emissions. 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 solutions specifically designed to help businesses improve the energy efficiency of their operations.



ABB Energy Appraisals

An ABB Energy Appraisal gives a detailed insight into how motor-driven applications perform, helping to make better decisions on ways to save energy, lower CO₂ emissions and boost a company's overall energy efficiency. This process can be done online or offline, i.e., when equipment is connected or not connected.

The offline process involves a one-time on-site visit by an ABB engineer to gather data from installed motors and drives, generators, pumps, and other applications. 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. Once recommendations have been implemented, the savings can also be tracked and verified against the original predictions.

See the bigger picture

The online process uses remote connections to collect data from connected assets of 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. With this data, 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. These 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 savings. These audits are becoming increasingly popular among companies that aim to increase their energy efficiency. An average of 51 percent of 2022 survey respondents confirmed they are conducting such audits to identify critical areas for improvement. In China, this number increased to 71 percent.

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, data and analytics together to give companies the insights they need to make the right decisions at the right time.

Another benefit of ABB energy appraisals - both offline and online - is that they help companies look beyond process silos. In the past, motor systems have often been viewed and optimized as individual processes. Today's 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. Online appraisals that fully utilize the power of collected data provide constant savings in terms of costs and energy.

[Read more >](#)



—
51% of decision-makers plan to use energy efficiency audits to identify key areas for improvement.⁶

Implementing change

Energy-efficient solutions and services

Once the optimum areas to make energy savings and reduce CO₂ emissions 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.

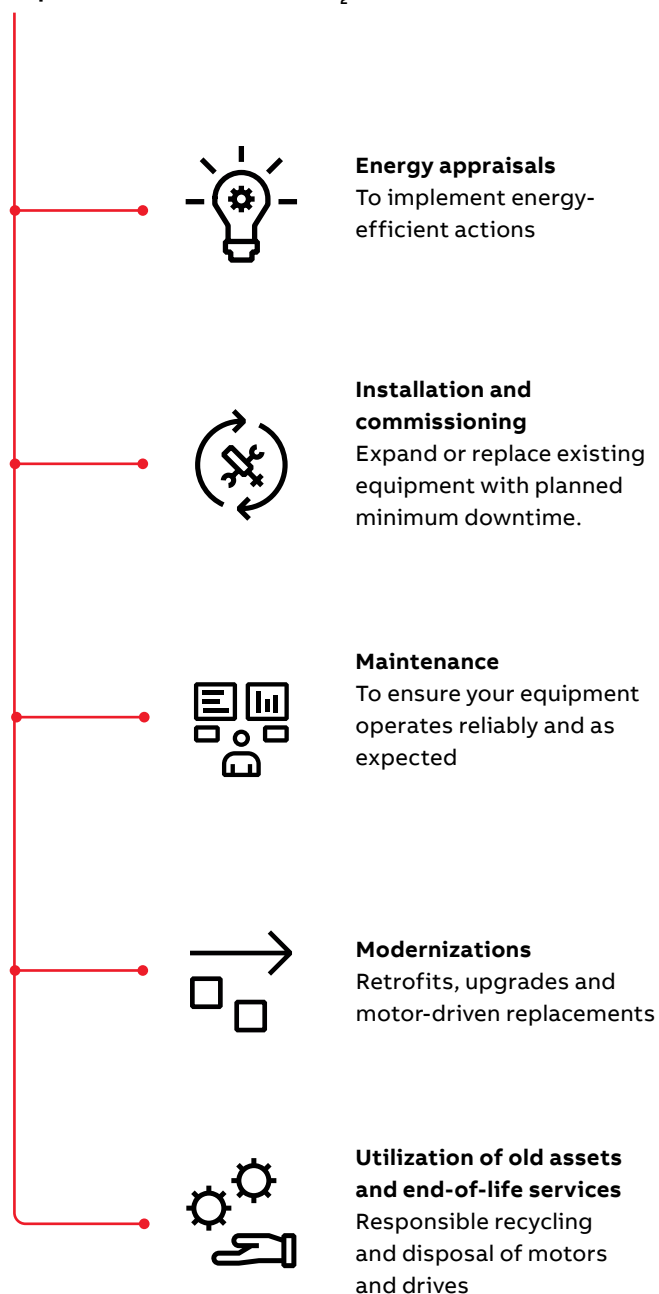
The implementation phase should be done together with a reliable partner that has experience in managing this kind of project, such as ABB. They can upgrade, install or commission new equipment, and use insights from the data to ensure the fastest, most efficient and cost effective results. With good 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. Encouraging and enabling a circular perspective to equipment modernization is a highly beneficial element of this approach. The data - both online and offline - can also inform the best maintenance strategies to employ for maximum reliability of equipment and processes.

Connected digital solutions can provide better data about equipment and processes. When properly integrated, these kinds of solutions can 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 continuous 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 and reduce CO₂ emissions



[Read more >](#)

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. Previously, the adoption of IoT was too low for digitalization to have a major impact. This attitude is being reversed with advances in digital technology, connectivity and processing power.

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 provides us with the data

needed to predict issues before they occur and make better decisions about effective courses of action. 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 these new models. Simply put, data lets service partners provide a better quality of service and reduce the risks to the customer. 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.

[Read more >](#)

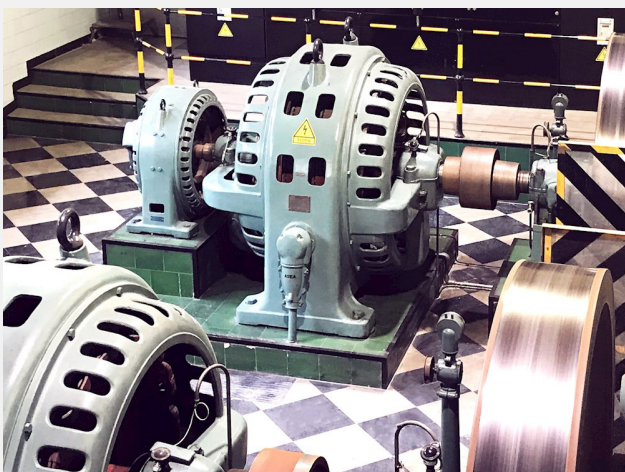
CUSTOMER CASE

WAGGERYD

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, which ABB's experts use to monitor performance and to analyze the mill's status and energy efficiency. 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.

[Read the full article](#)

CUSTOMER CASE

FIL-GENESIS

Spanish company FIL-GENESIS turned to ABB Motion Services to improve the efficiency of their hydro-power plant, leading to a 25% improvement in power output. ABB's experts assessed the installed base and technical data from the previous 10 year and, using the insights gained, 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 modernized system showed significantly improved performance at low flow rates, compared to the previously fixed speed of turbine operation.

[Read the full article](#)

CUSTOMER CASE

CERN

CERN is the world's leading laboratory for particle physics, providing a unique range of particle-accelerator facilities. To provide innovative ways to reduce energy consumption in the cooling and ventilation systems, smart sensors are used to collect data. The resulting digital energy appraisal report from ABB will identify motors with high consumption and indicate where, how, and how much energy can be saved. Furthermore, the results and best practices that emerge from this unique partnership will help illustrate how industries and large-scale research facilities can use digital solutions to become more energy efficient.

[Read the full article](#)

Conclusion

Despite the recent and predicted future rises in fuel prices, solutions do exist that enable cost- and energy efficiency. Embracing the possibilities of digitalization and energy audits, companies are able to reduce costs and engage in a circular economy. This approach is only becoming more popular.

About 85% of companies say they are now adopting IoT initiatives.¹⁴ 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.^{15,16} 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 mitigate risks associated with adopting electrical energy and CO₂ emission reduction measures.

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.



- (1) International Energy Outlook 2021, U.S. Energy Information Administration's (EIA), page 12; <https://www.eia.gov/outlooks/ieo/>
- (2) IEA, Energy Efficiency 2021, page 17; <https://www.iea.org/reports/energy-efficiency-2021>
- (3) 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>
- (4) 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/html>
- (5) 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.
- (6) ABB "Billions of Better Decisions" survey, August 2021; <https://stories.ability.abb.com/better-decisions/introduction/>
- (7) Electric Motor Systems Annex EMSA, <https://www.iea-4e.org/emsa/>
- (8) IEA (2021), Greenhouse Gas Emissions from Energy: Overview, IEA, Paris, <https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview/emissions-by-sector#abstract>
- (9) Accelerating the Global Adoption of ENERGY-EFFICIENT ELECTRIC MOTORS AND MOTOR SYSTEMS, UN Environment, U4E Policy Guide, 2017, page 4; <https://united4efficiency.org/wp-content/uploads/2017/09/U4E-MotorGuide-201709-Final.pdf>
- (10) 300TWh, 200 Mt, Accelerating the Global Adoption of ENERGY-EFFICIENT ELECTRIC MOTORS AND MOTOR SYSTEMS, UN Environment, U4E Policy Guide, 2017, page 15; <https://united4efficiency.org/wp-content/uploads/2017/09/U4E-MotorGuide-201709-Final.pdf>
- (11) IEA, Mexico Electricity Final consumption, <https://www.iea.org/countries/mexico>
- (12) IEA, Promoting digital demand-driven electricity networks, <https://www.iea.org/areas-of-work/promoting-digital-demand-driven-electricity-networks>
- (13) Eurostat, Evolution of energy prices in the last 5 years (EU), <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220225-2>
- (14) <https://stories.ability.abb.com/better-decisions/the-industrial-iot/>
- (15) IEA, Energy Efficiency 2021, page 18; <https://www.iea.org/reports/energy-efficiency-2021>
- (16) <https://stories.ability.abb.com/better-decisions/introduction/>



—
ABB Motion
solutions.abb/motionservices