03
Leading technology

LEADING TECHNOLOGY

Transforming society and industry to achieve a more productive and sustainable future

ABB provides solutions and technologies that are enabling society to preserve resources, become cleaner, more efficient, resilient and flexible

ABB's history stretches back to the late 19th century, when electricity was first harnessed to serve the needs of manufacturing, mobility and infrastructure. Since then, we have continued to advance the technologies that improve people's lives and drive economic prosperity.

Today, we take pride in developing clean and efficient solutions for our customers that enable them to reduce their ecological footprint. Our extensive portfolio of products and services enables them to be more energy-efficient while conserving natural resources.

According to the International Energy Agency, industry generates about 24 percent of global greenhouse gas (GHG) emissions – not just from burning fossil fuels, but also from chemical processes, waste management and other production-related activities. With respect to cleaner and more efficient infrastructure, existing technologies can be used to optimize water and waste treatment, energy services and other resources of critical importance to cities. The transport sector is also poised to be revolutionized by new developments in e-mobility, non-emitting vehicles and energy storage. Many of the advanced solutions required to make our cities and industries cleaner and more efficient have already been developed.

For buildings, transport and industry, among other sectors, reducing emissions and the responsible use of resources are now firmly at the top of the agenda. In addressing these new priorities, sustainable operations and products increasingly represent a competitive advantage in and of themselves. Consequently, demand is strong for products, services and solutions that increase energy efficiency and reduce consumption of non-renewable resources.

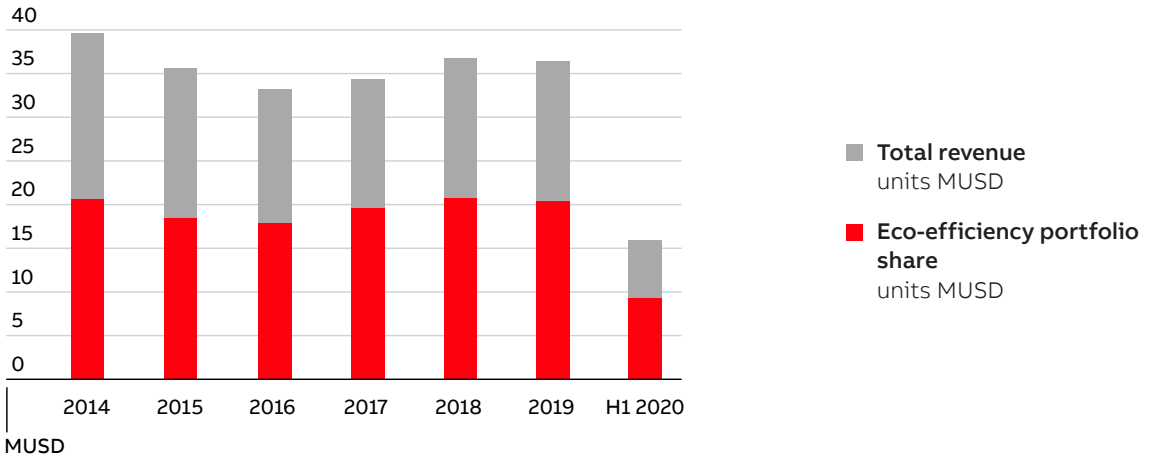
Many of ABB's technologies meet these demands. In this chapter, we have highlighted some of the key technologies that contributed in 2020 to progress toward the achievement of the targets associated with the Sustainable Development Goals (SDGs) established by the United Nations in 2016 to serve as a shared blueprint for achieving peace and prosperity throughout the world.

While ABB's activities can be linked to all of the SDGs, our products, services and solutions contribute directly to SDGs 6 (clean water and sanitation), 7 (affordable and clean energy), 8 (decent work and economic growth), 9 (industry, innovation and infrastructure), 11 (sustainable cities and communities), 12 (responsible consumption and production) and 17 (partnerships for the goals). Technological innovation will play a critical role in meeting these needs – improving people's living standards while reducing their impact on the environment. That is why we believe ABB's Purpose is aligned with the global effort to achieve the SDGs by 2030.

The ABB Sustainability Report's chapter on leading technology this year spotlights the latest contributions to sustainability made by our four Business Areas: Electrification, Process Automation, Motion, and Robotics & Discrete Automation. In concluding the sustainability reporting cycle that we began in 2013, each Business Area lays out lessons learned from the pursuit of our 2020 target – which was to expand our eco-efficiency portfolio to account for 60 percent of ABB's total revenue.

We completed the final measurement of our progress towards achieving this target in mid-2020. Including the contributions of our Power Grids business, our eco-efficiency portfolio at mid-year accounted for 58 percent of ABB's total revenue. This continued our trend of overall increases in revenues from our eco-efficiency portfolio, achieving a strong result which was very close to target. This target will not be carried forward as such or updated for our next sustainability reporting cycle. For these reasons, we did not re-baseline our 2013 data or recalculate our progress towards the target without the contributions of Power Grids. Our future targets, linked to the impact our products and solutions have for our customers, will bring an even higher level of ambition in how we support customers to deliver positive impact on environment.

Eco-efficiency portfolio development



Underpinning many of the technologies presented by our Business Areas in this report is our comprehensive digital offering, ABB Ability™, which enhances gains in efficiency. For example, solutions under the ABB Ability™ brand collect and analyze data and provide our customers with insights into their processes and equipment in order to increase the safety, productivity and energy efficiency of their operations. Even as it helps our customers optimize their business performance, ABB Ability™ also enables them to reduce their consumption of energy, water and other vital resources, while minimizing their impacts on air quality and the environment.

RESOURCE-EFFICIENT AND ENVIRONMENTALLY SOUND SOLUTIONS IN

Electrification

In ABB's Electrification Business Area, we recognize that new solutions are needed to manage the pressures being placed on our environment. Our aim is to help make a safe, smart and sustainable world possible with technologies that reduce energy consumption, eliminate emissions in industry, infrastructure and transport, and improve quality of life.

Mission to Zero

We are committed to showing the world that the energy transition can be achieved sustainably through our digital energy-management solutions. The necessary steps are outlined in "Mission to Zero," the carbon-neutral and energy self-sufficient blueprint we introduced in 2019 for industry, homes and cities. To demonstrate our confidence, we are using our own facilities as test beds for our comprehensive zero-emission concept.

ABB's flagship Busch-Jaeger site in Lüdenscheid, Germany, is our first carbon-neutral and energy-self-sufficient production site in the world. The ABB technology it relies on, which has our scalable energy management system OPTIMAX® at its core, generates enough climate-neutral solar power to cover 100 percent of the factory's power requirements on sunny days and has reduced the site's CO_2e emissions by some 680 tons per year. For Lüdenscheid, we developed a zero-emission solution that is scalable, flexible and suitable for a wide range of applications. We are now rolling out our Mission to Zero concept at other Electrification sites and will share our learnings with customers and key stakeholders.

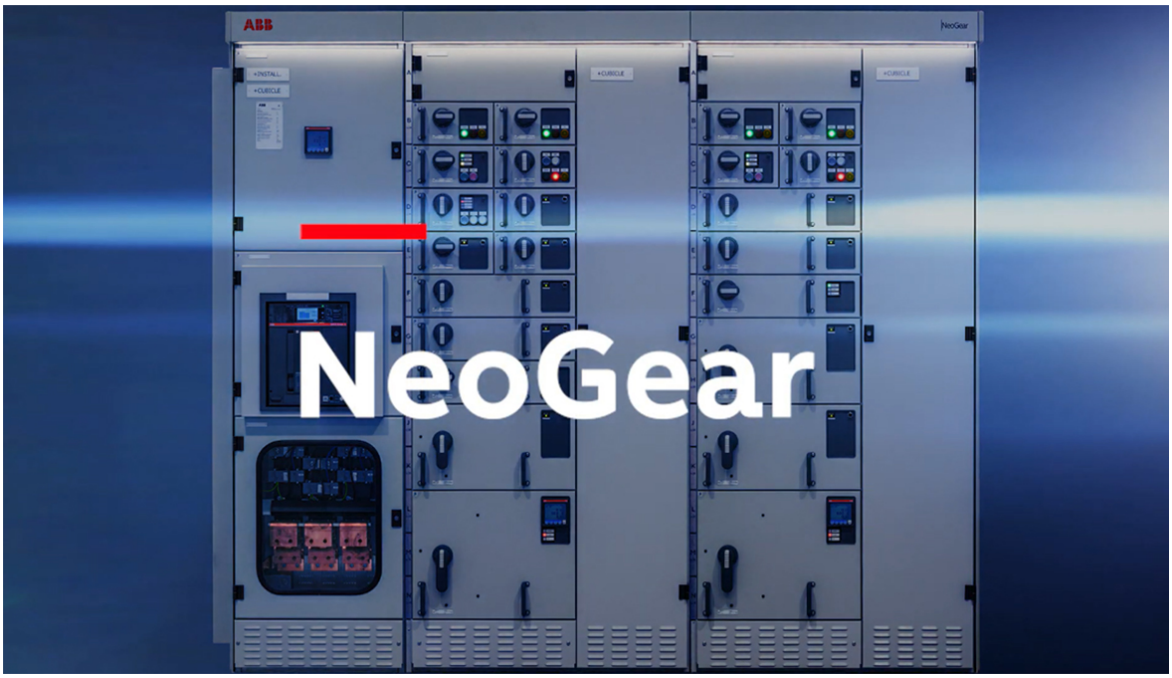
Solutions to reduce power losses

According to the International Energy Agency (IEA), the hypothetical implementation of all of the currently available energy-efficient technologies would deliver 40 percent of the emissions reductions needed to meet the requirements of the Paris Agreement. ABB is a leader in the development of energy-efficient technologies that enable the achievement of global climate targets.

Energy-efficient solutions for data centers

By 2030, hyperscale data centers are projected to account for 15 to 30 percent of total electricity demand in some smaller countries. Our MegaFlex DPA™ uninterruptible power supply (UPS) is designed for exactly this kind of challenge. Compact, flexible, safe and easy to install, it enables data center operators to track energy consumption precisely. Its default operating mode enables efficiency of up to 97.4 percent, with an ECO option to attain 99 percent efficiency. This solution is designed to work with the rest of ABB's power infrastructure products to ensure a continuous flow of clean power to a data center. MegaFlex DPA was awarded the Solar Impulse Foundation's "Efficient Solution" label, an important recognition from an external agency of our work to reduce power losses.

Energy-efficient solutions for switchgear



Watch the video at https://youtu.be/o0u8CDYXWsU

Industry is under constant pressure to reduce injuries, energy consumption and overall costs. To meet these needs, we developed the first real innovation in low-voltage switchgear since the 1980s. NeoGear's bus plate system is fully protected against arc

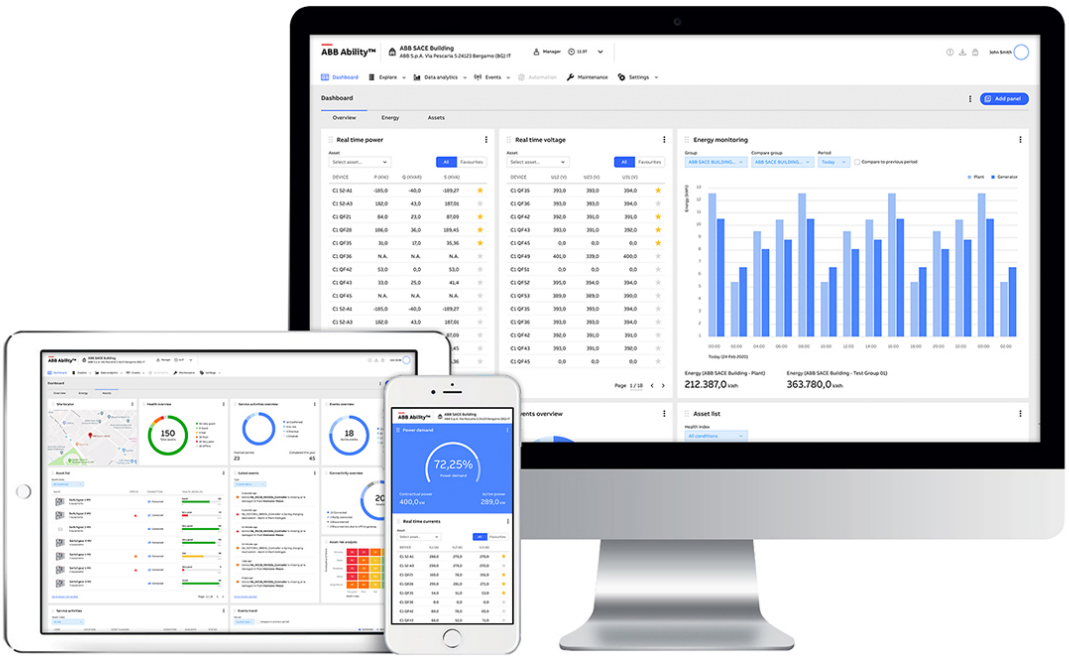
ignition, so it is substantially safer than any previous switchgear system. Furthermore, NeoGear needs less copper, emits 20 percent less heat, requires less energy for cooling, and takes up to 25 percent less space. Underpinned by our ABB Ability™ platform for better energy management, condition monitoring and predictive maintenance, it can reduce operational costs by up to 30 percent. NeoGear is superior to any other switchgear solution, and we are confident it will ultimately replace conventional switchgear almost entirely.

Solutions to optimize energy use

Growing urbanization and digitalization and concerns about climate change are driving the need to think beyond energy-saving measures and shift towards energy optimization. At ABB Electrification, we are facing this challenge head on, helping our customers adapt and thrive with our advanced technologies.

Energy optimization solutions for companies

It has become essential for companies to reduce energy costs and shrink their carbon footprints as their stakeholders become increasingly concerned about sustainability. To meet this need, we developed a suite of ABB Ability™ plant- and enterprise-level applications, called ABB Ability™ Energy Manager. This scalable solution can pull together real-time and historical data from energy providers and a company's commercial and industrial systems to help customers optimize their energy usage, saving up to 30 percent on operational costs. ABB Ability™ Energy Manager enables reduced energy consumption by comparing actual consumption against targets and identifying, in real time, the areas where improvement is required. It can also help companies optimize their energy consumption with planning and scheduling applications that let them get the best pricing for the energy they require.



Energy-optimization solutions for buildings

Buildings consume more than 30 percent of the world's energy and generate nearly 40 percent of annual global GHG emissions. ABB Electrification has developed a wide range of smart solutions for buildings that can significantly reduce their total carbon footprint.

Smart buildings are not new. For decades, architects and developers have been installing separate systems to control lighting, heating and ventilation, among others. What is new, however, is the addition of web-based platforms, such as our range of ABB Ability™ building automation solutions. Our smart building technologies seamlessly integrate all of these systems, providing building managers with a single view of how efficiently a building is operating, so they can make better decisions. And with the right systems, buildings today can make autonomous decisions to adjust lighting, heating, air conditioning and other systems to reflect the time of day, outside weather or any other variable. When fully implemented, our building automation solutions typically deliver up to a 30 percent reduction in energy costs for heating, lighting and appliances.

Emission-free alternatives

The world needs to adopt approaches and technologies that can reduce global GHG emissions. In ABB Electrification, we are committed to providing the world with emission-free solutions that will enable future generations to pursue economic growth without contributing further to climate change.

Emission-free mobility

20,000+
DC chargers sold

~ 24 million
Charging sessions enabled

High double digit
Growth rate

~ 332 GWh
Delivered

Chargers installed in
85+ countries

~ 800+
Employees

Active across the e-mobility value chain, ABB is the world leader in fast-charging solutions, which are increasingly in demand as the world works to shift away from polluting internal combustion engines. We have sold more than 400,000 electric vehicle chargers across more than 85 markets, including those sold through Chargedot, our subsidiary in China. Our DC fast chargers run on the ABB Ability™ Connected Services Platform, which employs Microsoft's Azure cloud services to enhance uptime, scalability and operational efficiencies, as well as to provide real-time remote support services. ABB provides not only EV charging stations, but also critical EV charging infrastructure components, such as substations, energy storage systems and eco-friendly switchgear. These technologies are designed so that EV charging stations, once installed, will be both future-proof and scalable.

For mass transit, ABB offers solutions for the electrification of buses. And for the electrification of railways, we support sustainable mobility with power and automation technologies for customers ranging from train builders to rail operators. We design, engineer and commission solutions to deliver safe, reliable and cost-effective rail freight and passenger transportation solutions. Our product offering includes traction transformers, motors and converters that move vehicles quickly and reliably. It also encompasses leading integrated and collaborative digital solutions with ABB Ability™.

CASE STUDY

ABB fast chargers powering bus fleet in the Netherlands

In 2020, we began working with one of the Netherlands' largest public transport operators, Qbuzz, to supply more than 100 chargers to electrify part of its bus fleet. In helping the Netherlands to meet its commitment that all new buses will be emission free by 2025, we installed 62 100kW high-power charging stations across Qbuzz depots in the northern part of the country. With a voltage range of 150–850VDC, the chargers will be used to charge the fleet overnight.

In the country's southwest, we installed 38 Terra 54 50kW depot fast chargers with a voltage range of 150–920V. We also supplied six HVC-300 Pantograph Down smart

charging solutions for en-route charging, as required in the regional network around the city of Dordrecht. This solution charges a bus for 3 to 6 minutes, depending on the power it needs to finish its route. It can then make it to the end of the line to receive a full charge, without slowing down its schedule.

ABB's solutions for industry, cities and infrastructure leverage the latest technologies to deliver unprecedented levels of resource efficiency. Our world is a fragile one, with limited resources. These resources must be used sustainably and in a manner that minimizes the impact of their use on the environment. Intelligent technologies offer the key to protecting the environment while enabling continued economic growth. ABB is committed to developing the products, solutions and services required to make a brighter future possible for future generations.

Emission-free solutions for the power industry

The production and consumption of energy is responsible for roughly two-thirds of global GHG emissions. To enable our power industry customers to reduce their emissions, we have developed AirPlus™, a groundbreaking eco-efficient gas mixture that will enable electric utilities to avoid using sulfur hexafluoride (SF_6) in gas-insulated switchgear (GIS) applications. SF_6 is one of the most potent GHGs – 23,000 times more damaging to the climate than CO_2, with an atmospheric lifetime of 3,200 years, according to the Intergovernmental Panel on Climate Change. While SF_6 has been used as a reliable insulation gas in switchgear for over 50 years, AirPlus is equally reliable – with almost zero global-warming impact and no compromise to the footprint or performance of the switchgear.

While our medium-voltage (MV) GIS uses AirPlus, we have also developed another solution, Dry Air, a natural gas replacement for SF_6 that is suitable for 12kV applications. Both of these SF_6 -free technologies allow our switchgear to be operated at a lower tank pressure.

In 2020, we launched our latest primary GIS, PrimeGear ZX0. Designed for use in MV networks, it builds on ABB's digital monitoring and diagnostic solutions and incorporates our proven SF_6-free switchgear technology. PrimeGear ZX0 is the world's first switchgear designed to enable customers to transition easily from SF_6 to our SF_6-free alternative at any point in the switchgear's lifetime.

Lessons learned

Over the past seven years of ABB's sustainability reporting cycle, we have increasingly learned to appreciate the value of collaborating across functions within our Group, while working closely with customers, suppliers, startups and academia to achieve ABB's sustainability objectives.

We have also determined that small actions, like changing the material we use to manufacture a simple product or part, can have a tremendous impact on the sustainability of our business in mature markets. Similarly, we have recognized the importance of understanding the true drivers of our CO_2 footprint within the product lifecycle.

Based on our experiences over this period, we have also learned that we can make our operations more circular by collaborating with suppliers to find ways to achieve the "closed-loop" recycling of plastic waste from our own manufacturing processes. At the same time, we have determined that we can improve ABB's Scope 3 emissions and the carbon footprint of our solutions by working with our suppliers to reduce their carbon footprints and by focusing on low-carbon logistics.

RESOURCE-EFFICIENT AND ENVIRONMENTALLY SOUND SOLUTIONS IN

Process Automation

In ABB's Process Automation Business Area, we are dedicated to equipping our customers in the process and maritime industries with products, systems and solutions that make their operations safer, smarter and more sustainable. Our offerings are based on ABB's leading technologies – such as distributed control systems, marine propulsion, turbocharging, measurement and analytics – as well as deep domain expertise and industry-specific products. Each solution is supported by a range of remote services for the duration of the asset's lifetime.

Reducing emissions through better marine technologies

Automation, electrification and digitalization are central to the energy transformation in the process and maritime industries. ABB plays a major part in reducing the environmental impact of the shipping industry with leading technologies that include Azipod® electric propulsion, the latest generation of turbochargers continuous emissions monitoring and the electrification of ferry services.

Azipod® is a gearless, steerable propulsion system that deploys an electric motor, placed in a submerged pod extending outside a ship's hull. Azipod® units rotate 360 degrees to increase maneuverability and operating efficiency, with a proven ability to cut fuel consumption by up to 20 percent compared to traditional shaftline propulsion systems. In addition to hardware, we provide fuel-saving software solutions to the marine industry. ABB Ability™ Tekomar XPERT diagnostic software enables large-vessel operators to reduce fuel consumption and manage their fleets more efficiently, collecting data from a wide range of sensors and other indicators in and around a ship's engines and recommending optimal settings for engine operation.

CASE STUDY

Technologies for cutting shipping emissions by 50 percent by 2050

Meeting the International Maritime Organization's goal of halving greenhouse gas emissions from ships by 2050 represents a critical step toward sustainability. ABB continued to work hard in 2020 to help the shipping industry meet it, providing a number of currently available technologies that can reduce fuel consumption and lower emissions, such as hybrid and electric vessel systems.

Our technology will be at the heart of P&O Ferries' sustainability program, as it transitions to the zero-emission future envisaged for shipping. Our contribution consists of supplying Guangzhou Shipyard International Ltd with a full scope of integrated solutions for P&O Ferries' two new vessels. The hybrid propulsion solution we are providing will use electric power from 8.8MWh batteries and diesel generators, cutting fuel consumption on P&O Ferries' Dover-Calais route by 40 percent. Equipped with four Azipod® propulsion units per vessel, each rated at 7.5MW, the 230-meter-long vessels will be the largest passenger and freight ferries ever to operate on this route when they enter service in 2023. In addition to Azipod® propulsion and energy storage, the new ships will feature a comprehensive scope of ABB solutions to cover power and propulsion, automation and power management.

We are also partnering with the American shipbuilding company Vigor Fab LLC as the hybrid-electric propulsion and energy storage system provider for the newest additions to the fleet of Washington State Ferries, setting the largest U.S. ferry system on course to zero-emission operations. The new "Olympic Class" ferries, which will have the capacity to carry 144 cars and 1,500 passengers each, herald a new era for the state of Washington as it seeks to shift toward technologies that enable significant reductions in GHG emissions and fuel use.

Upon delivery in 2024, the initial vessel of the class will be the first new build in Washington State Ferries' fleet to feature hybrid-electric propulsion and a high-capacity energy storage system. The new vessels will be able to operate fully on battery power and have the capability to revert to hybrid mode, if required. This landmark project supports the state's goal for 2050 to reduce emissions by 57.5 percent from a 2019 baseline.

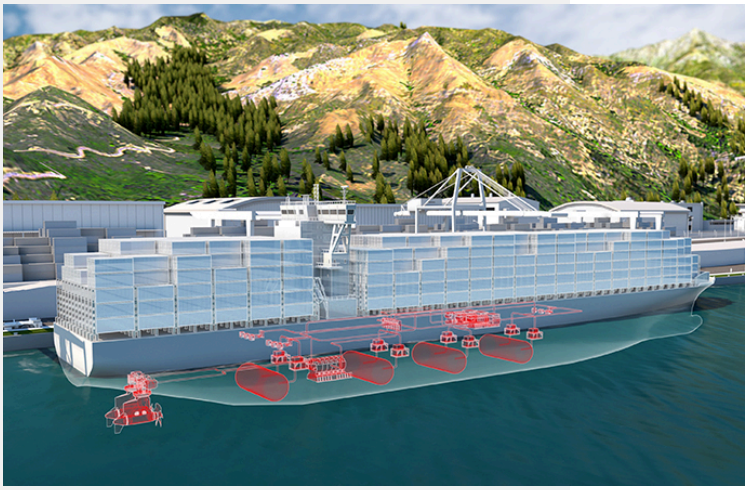
In January 2020, emission limits in International Maritime Organization (IMO) regulations became effective worldwide. To help customers comply, ABB expanded its extensive continuous emission monitoring portfolio with a marine-specific system called CEMcaptain. Our intention is that its measurement and digital capabilities increase on-board safety, provide process optimization, and substantially reduce ownership costs by requiring less maintenance.

We also offer zero-emission technology to the marine industry, and recently equipped a new generation of fully electric ferries that replaced the diesel vessels on the iconic Maid of the Mist tour at Niagara Falls. The two new 28-meter catamaran ferries are powered solely by high-capacity battery packs, making them the first fully electric vessels ever built in the United States.

Our solutions are also used in large, shaftline propulsion ships to increase engine efficiency. Our turbocharging portfolio comprises single- and two-stage turbocharging solutions. The latter is capable of producing high pressures at efficiencies of 75 percent or more, reducing fuel consumption, extending service intervals, and helping customers reduce environmental impact and comply with IMO regulations.

CASE STUDY

ABB brings fuel cell technology closer to powering large ships



With the ever-increasing demand for solutions that enable sustainable, responsible shipping, ABB's Marine & Ports division has made an important step towards powering oceangoing vessels with fuel cell technology.

In 2020, we signed a memorandum of understanding with hydrogen technologies specialist Hydrogène de France (HDF) to closely collaborate on the assembly and production of a fuel cell power plant for marine applications. This builds on an existing collaboration announced in 2018 with Ballard Power Systems, the leading global provider of proton exchange membrane fuel cell solutions. Our goal is to optimize fuel cell manufacturing capabilities to produce a megawatt-scale power plant for marine vessels. The new system will be based on the megawatt-scale fuel cell power plant jointly

developed by ABB and Ballard, and will be manufactured at HDF's new facility in Bordeaux, France.

With shipping responsible for about 2.5 percent of the world's total GHG emissions, there is increased pressure for the maritime industry to transition to more sustainable power sources. The International Maritime Organization, a United Nations agency responsible for regulating shipping, has set a global target to cut annual emissions by at least 50 percent by 2050 from 2008 levels.

Fuel cells turn chemical energy from hydrogen into electricity through an electrochemical reaction. By using renewables to produce the hydrogen, it is possible to create an entire energy chain based on clean technologies. ABB is proud to be working with HDF on a solution that could enable the global shipping industry to meet the emissions reduction target set by the International Maritime Organization (IMO).

Improving environmental performance with smarter industrial processes

ABB's automated control solutions are designed to increase output while reducing energy usage and waste of raw materials. Our suite of ABB Ability™ solutions and services uses sensors, network connectivity and data analytics to provide a real-time view into operations, enabling predictive maintenance, improved safety and better environmental performance.

This includes our first cloud application for original equipment manufacturers (OEMs), the ABB Ability™ Asset Performance Monitor. Launched in 2020, it collects data on production rates, energy consumption and temperature, and provides a continuous overview of an OEM's entire installed base, enabling more informed business decisions. Data is displayed on a digital dashboard, giving OEMs the necessary insights to initiate machine upgrades and advanced services. State-of-the-art security standards and transfer protocols ensure data integrity. This is just one of the many flexible, scalable and secure solutions that we offer to facilitate the shift to smart industrial processes. Digitalizing production processes increases system reliability and throughput, reduces raw material and energy use, and improves product quality.

With these goals in mind, ABB Process Automation has been deeply involved in laying the groundwork for an all-electric mine concept, developing several solutions focused specifically on the electrification, automation and digitalization of mines. One example is the ABB Ability™ Ventilation Optimizer, a modular system that maximizes the efficiency of mining ventilation systems. While maintaining proper air quality in a mine, this solution delivers energy savings of up to 50 percent per year.

CASE STUDY

Pilot project for the electrification of mining transport in Sweden

ABB has designed, delivered and commissioned electrical infrastructure capable of powering several electric mine trucks at Boliden AB's Aitik mine, Sweden's largest open-pit copper mine. The lane is ~700 meters and is expected to save ~830 m^3 diesel per year. This infrastructure will ultimately enable Boliden to carry up to 70 million tons of rock every year at the mine, and reduce its greenhouse gas emissions from transportation by up to 80 per cent along those routes where the technology can be implemented.

Given that demand for copper is expected to continue to rise, driven by increased production of electric vehicles and the widespread use of renewable energy, ABB's electrification project at Aitik is a significant milestone. By enabling Boliden to increase productivity and safety at the site, we are helping the mining company to meet the high demand for copper in a sustainable manner.

To execute this project, we provided a digital substation, including a 4.8MW rectifier, connected to the ABB Ability™ System 800xA control system. This solution is our first-ever application for heavy-duty trucks in the mining industry. Our rectifier will efficiently convert alternating current to direct current, ensuring maximum availability and productivity. The substation will incorporate digital communications utilizing fiber optic cables to replace traditional copper cables, significantly reducing costs. It will also ensure safety, as systems are monitored digitally without requiring manual intervention.

The project is based on the ABB Ability™ MineOptimize offering, which provides mine operators with a suite of digitally connected solutions, products and collaborative services. The MineOptimize connected solutions at Aitik will send early alerts when the equipment needs servicing, provide remote assistance with real-time guidance, and offer remote monitoring to ensure optimal performance. The project is supported by the Swedish Energy Agency and is being executed by a number of collaborating parties.

ABB has been deeply involved in laying the groundwork for an all-electric mine concept and provides numerous solutions involving electrification, automation and digitalization – three key elements that are transforming the mining sector. Boliden is already partnering with ABB to develop automated solutions that can keep mine production running around the clock while improving safety. Building on our 90-year relationship, we have worked

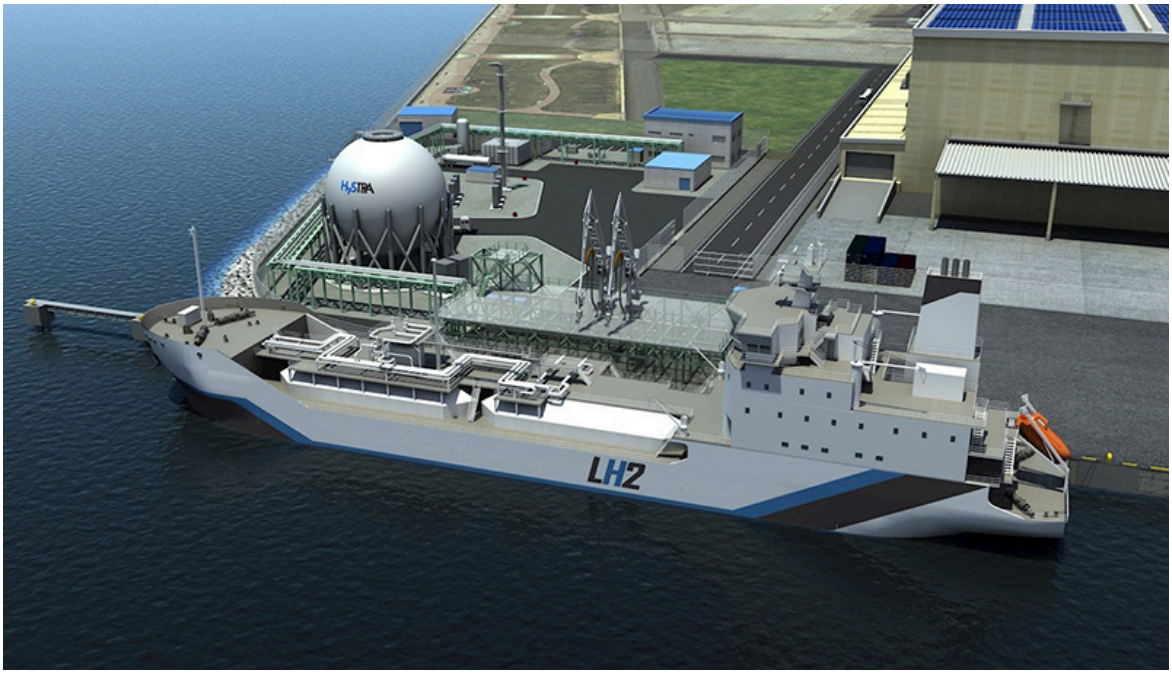
together to achieve unprecedented levels of automation and control, both below and above ground, to optimize mine performance.

Driving the energy transition

ABB Process Automation is developing technologies to facilitate the energy transition for our industrial customers. As a member of the European Clean Hydrogen Alliance, ABB is helping to scale up the hydrogen value chain across Europe. Hydrogen has several uses, from storing renewable energy to fueling heavy transport, and as a feedstock in energy-intensive processes. Most importantly, hydrogen only emits water and heat when used as a fuel, releasing no carbon. In fact, if hydrogen is produced from renewable sources, the whole hydrogen value chain is carbon-free. Hydrogen thereby serves as an excellent complement to electricity and offers a solution to decarbonizing industrial processes and economic sectors where reducing carbon emissions is both urgent and difficult to achieve. Hydrogen is crucial to achieving the objectives of the European Green Deal and ensuring Europe's transition to clean energy.

To help hasten the energy transition, we are working with Hydrogen Optimized on the development of large-scale, environmentally friendly hydrogen production systems. In 2020, the two companies signed an MOU to make green hydrogen a financially viable option for our customers. We have also been cooperating with ABB's Electrification Business Area on the transformation of ABB's Busch-Jaeger production site in Lüdenscheid, Germany, into an example of how the energy transition can be successfully accomplished with currently available technology. We are exploring the possibility of using hydrogen as a clean source of energy at the site, which already has a solar plant that generates enough power on sunny days to meet all of its power requirements.

In the Asia–Pacific region, ABB is supporting the Hydrogen Energy Supply Chain (HESC) project. HESC aims to safely and efficiently produce hydrogen in Australia and transport it to Japan, in one of the world's first efforts to commercialize hydrogen liquefication and transportation. The project is poised to position Australia as a leader in hydrogen production, and with the world's fifth-largest energy consumption, yet low fossil fuel resources, Japan considers hydrogen key to meeting future energy requirements. ABB won orders in both countries: an electrification and instrumentation contract in Australia, and an automation contract in Japan from Kawasaki Heavy Industries.

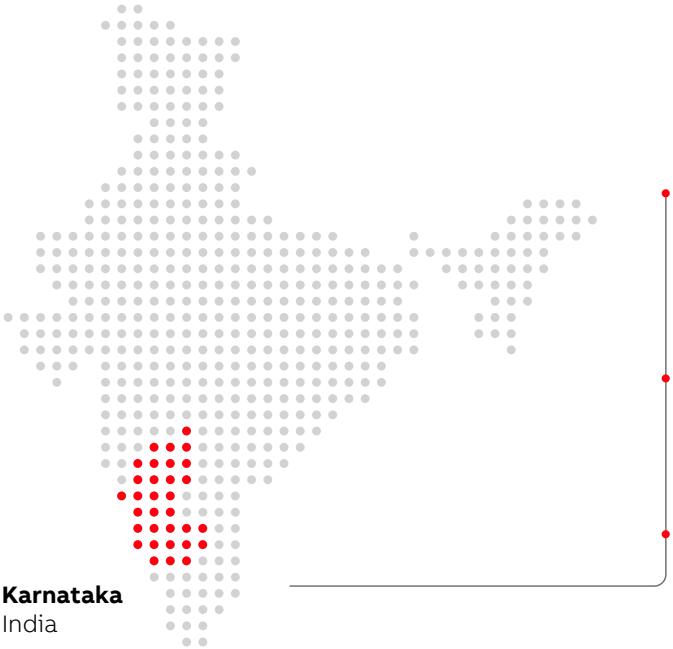


Conserving resources through advanced digital solutions

ABB Process Automation is a key provider of technologies and solutions that help conserve valuable resources such as clean water and natural gas.

We designed our ABB Ability™ Symphony® Plus SCADA to maximize the reliability and availability of water plants and networks. The control solution deploys integrated information management, the integration of equipment, and process optimization based on data from an entire water network. ABB's AquaMaster 4 electromagnetic flowmeters, which can run on battery power, provide reliability even in low flow conditions and in areas where most mechanical flowmeters would fail. ABB flowmeters are used across India in urban, semi-urban and rural settings. For example, in the Koppal district, a drought-prone region in southwestern India, we provided end-to-end digital water management solutions to help the local water authority not only track, measure and optimize water use, but also pump and distribute treated river water to homes. Equipped with ABB Ability™ Symphony® Plus SCADA and ABB's AquaMaster 4 flowmeters, the district is effectively monitoring water flow, managing leaks and delivering overall productivity improvements to its widely dispersed network.

ABB supports India's Koppal district to ease water shortages with digital water management solutions



Karnataka
India

600,000
of Kushtagi and Yelbargi Taluka villages currently rely on local wells and face regular water shortages .

620 tanks & 16 reservoirs
will bring clean treated river water to their homes in a new end-to-end solution.

ABB Ability™
Symphony Plus SCADA
will analyze flow and consumption by sharing real-time data with a central control room.

AquaMaster 4
electromagnetic flowmeters will track how much water is passing through the network.

We also offer solutions to rapidly detect and locate gas leaks, which is not only critical to the security and resilience of gas infrastructure, but also to reducing GHG emissions. Our complete Gas Leak Detection Platform makes it possible to find leaks in any natural gas infrastructure – upstream, midstream, downstream or utilities – with far higher reliability and speed than ever before by combining sophisticated measurement technologies with advanced data analytics. The innovative platform uses advanced laser absorption technology to provide fast, sensitive measurements that distinguish between naturally released methane and gases leaking from a buried pipe or other potentially dangerous source.

CASE STUDY

Guarding gas lines to make clean energy sources safe

Leaking natural gas pipelines are health and environmental hazards which, if undetected, can result in wasted resources, unwanted emissions, and even personal and ecological harm. Governments around the world are improving gas leak detection abilities to ensure public safety, conserve energy and reduce environmental impact. ABB gas leak detection technology can help.

The new portable ABB MicroGuard™ detection device enables surveyors to quickly find leaks on foot, and can be used stand-alone or with ABB's MobileGuard™ vehicle-based detection system, to precisely identify leak locations.

These offerings employ laser absorption for fast, highly sensitive measurements that identify gases leaking from a buried pipe or other source. The technology continuously measures emissions, wind velocity and local coordinates to pinpoint leaks. Software eliminates false positives, reducing search areas and guiding technicians to locations. Digital reports are generated in real time, helping crews to prioritize resources and repairs. Regulatory compliance is easier because data is digitally available, immediately.

A leading Asian oil company monitors its extensive pipeline network with MobileGuard, significantly expanding speed and range of detection, and reducing safety risks and environmental impact, all while conserving gas and cutting monitoring costs. These benefits helped the customer achieve important business objectives in a difficult year. Similarly, more than 30 cities in China use MobileGuard to monitor pipelines to improve health and safety.

This technology can be used on aircraft and drones (ABB HoverGuard™), to survey locations inaccessible on ground, as well as on fixed locations (ABB EverGuard™) to continuously monitor high-risk areas in well pads, gathering lines, pipelines, factories, distribution stations and storage facilities.

ABB gas leak detection helps find leaks upstream, midstream and downstream. These technologies help utilities and service providers to improve safety, conserve energy and reduce environmental impact. They are important components in a comprehensive industrial or municipal sustainability strategy.

In Western Australia, our gas measurement technologies will soon also be used to help convert waste into sustainable energy. In 2020, three ABB ACF5000 analyzers were selected to monitor, measure and analyze the composition of exhaust gases at the new, large-scale East Rockingham Waste-to-Energy facility near Perth. ABB Ability™ Condition Monitoring for measurement devices will enable us to monitor these analyzers remotely throughout their lifecycle.

Lessons learned

Over the past decade, the oil & gas, mining and marine sectors have dramatically changed, and our business has adapted to serve their needs. Increasingly, our customers are turning to ABB to help them save energy, increase safety, reduce costs and achieve their own, wider sustainability goals. Because our customers face increasing regulatory obligations across all of their markets, an investment in automation technologies that improves environmental performance is frequently viewed not only as the right thing to do, but also as a sound business decision that can drive overall safety, efficiency and productivity.

Based on our experiences during the previous sustainability reporting cycle, we have learned that we need to elevate the profile of our contributions to sustainability. While our customers have always known and recognized ABB for the safety and efficiency of our portfolio, we see an opportunity to emphasize how our solutions can contribute to reducing their environmental footprints. This will involve educating our salesforce, raising awareness of our contributions among all of our employees, and building a stronger understanding of our offering in the market.

RESOURCE-EFFICIENT AND ENVIRONMENTALLY SOUND SOLUTIONS IN

Motion

Building on more than 130 years of experience, ABB's Motion Business Area provides leading technologies that enable our customers to increase their energy efficiency, improve their safety and reliability, and maintain precise control of their processes. Like ABB's other Business Areas, we are proud to provide solutions that contribute to the ongoing energy transition and deliver major reductions in emissions and environmental impacts. Our Business Area offers the world's leading portfolio of industrial electric motors and the variable-speed drives that ensure they perform at optimum efficiency. Connecting products with our digital solutions and services further optimizes performance, system efficiency and energy savings.

We believe the environmental potential of our products and services has not yet been fully appreciated. An estimated 45 percent of the world's electricity is used to power electric motors in buildings and industrial applications. Electric motors have been in use for 150 years, and they have steadily improved over time. Yet for the past decade, they have undergone a renewed period of technological advancement. The latest wave of improvements has opened the door to significant reduction of the carbon footprint of industrial electric motors. An expanding range of highly energy-efficient electric motors and variable-speed drives that can be used to run them will underlie much of the ongoing effort to meet the goals of the Paris climate Agreement.

Reducing emissions through more efficient motors

While motors of all sizes have been embedded in great quantities into nearly every built environment, the majority of electric power consumed by motors is used by mid-sized motors. Many of these are larger than necessary for the applications at hand and are often run at full speed, even when that extra power is not needed. Roughly 75 percent of the industrial motors in operation are used to run pumps, fans and compressors, a variety of machinery that is ripe for major efficiency improvements. At ABB Motion, we equip our customers with innovative, practical and highly efficient solutions that are both smart and optimized for their intended applications. We continue to push the limits of technology, searching for innovations that will take our solutions to the next level.

In 2020, we launched the ultra-premium ABB IE5 SynRM, a synchronous reluctance motor that offers the performance advantages of permanent magnet technology with the simplicity and service-friendliness of an induction motor. SynRM motors do not use magnets or rare earth materials. Instead, they achieve a maximized reluctance torque from a simple but robust rotor design. Researchers estimate that replacing 80 percent of world's installed motors with IE5 ultra-premium-efficiency motors like SynRM would save

160 terawatt-hours of energy per year, equivalent to more than the annual power consumption of Poland. Recognized by the World Economic Forum as a sustainable energy innovation in a 2020 special report, SynRM motors offer up to 50 percent lower energy losses and significantly lower energy consumption in comparison with commonly used IE2 induction motors. SynRM motors are controlled by variable-speed drives, further maximizing their energy savings.

CASE STUDY

ABB IE5 SynRM motor receives Efficient Solution Label

In 2020, our IE5 SynRM (synchronous reluctance) electric motor received the Solar Impulse Foundation's Efficient Solution Label, in recognition of its ability to reduce energy use and CO_2 emissions. The labelling process involves a strict assessment by independent experts and lies at the heart of an initiative to build a portfolio of 1,000 labelled solutions that will be promoted to governments and businesses worldwide, with the aim of accelerating the transition to a sustainable, carbon-free economy. SynRM technology is based on an advanced rotor design with precise variable-speed drive control.

Offering the performance advantages of permanent magnet motors combined with the simplicity of an induction motor platform, SynRM technology does not use magnets or rare earth materials, deploying an environmentally friendly design that also simplifies servicing. Installing just one ultra-premium efficiency IE5 SynRM motor to replace an IE3 motor can reduce CO_2 emissions by as much as 22,000 kilograms per year for an application rated at 315 kilowatts – the equivalent of taking nine fossil-fuel-powered cars off the road. Another benefit of the IE5 SynRM motor is lower operating temperatures than induction motors, which extends the service life of bearings and windings, resulting in better overall reliability. SynRM motors also help improve the working environment with their lower noise levels.

Achieving greater efficiencies with variable-speed drives

While there are significant efficiency gains to be achieved from upgrading a motor, still greater energy savings are possible when a high-efficiency motor is used in combination with a variable-speed drive.

Variable-speed drives make substantial contributions to the efficient operation of many electric motors, but their role often goes underappreciated. Drives control the speed and torque of a motor to optimize its operation. In this way, the motors run only as fast as is required by the underlying load, leading to significant electricity savings. The highest-impact case of this is seen in pump, fan and compressor applications, which can be found across all industries and in buildings. Adding an ABB drive to an existing motor system without a drive can reduce electricity use by roughly 25 percent.

Ultra-low harmonic drives are a special class of drives manufactured by ABB featuring state-of-the-art technology that mitigates harmful disturbances in electrical networks. Harmonic pollution is a serious, often neglected problem that can cause electrical interference and make equipment connected to the circuit behave erratically, akin to the rogue waves that sometimes swamp boats at sea in a storm. Harmonics can trip circuit breakers, blow fuses and cause capacitor failures. The effects also include overheating, which wastes energy and shortens equipment life. Our ultra-low harmonic drives reduce harmonic content by up to 97 percent, resulting in energy savings and improved performance.

All of ABB's motors and drives are designed to maximize reparability, serviceability and modularity. ABB Motion offers a wide variety of extensions, upgrades and retrofits to lengthen the service life of the equipment.

Leveraging digitalization to optimize operations

Another technological development that is poised to improve the efficiency of the world's electric motors can be found in digitalization and connectivity – the "industrial Internet of things." Using wirelessly connected sensors, many of ABB Motion's motors and drives deploy cloud-based condition monitoring solutions to optimize performance and predict maintenance needs.

In 2020, ABB Motion entered a collaboration to modernize the motors of Swedish company Svenska Cellulosa AB (SCA), including the installation of ABB Ability™ Smart Sensors on electric motors in one of its facilities. In this two-year pilot project to reduce energy consumption and increase the efficiency and reliability of the company's paper and pulp production line, old motors have been locally recycled and replaced with more energy-efficient models and new drive systems. This circular collaboration includes Stena Recycling, which entered a local agreement with ABB Sweden in November 2019 to develop a process where all material fractions (iron, copper and aluminum) in electric motors can be recycled and reused in new products.

We offer a suite of advanced digital solutions using smart sensors that help make factory operations more efficient, predictable and safe. The ABB Ability™ Digital Powertrain consolidates sensor and drive data with cloud-based analysis of all components in an industrial system. By assessing the data from variable-speed drives, motors, pumps, bearings and other components, it generates deep data insights that help customers optimize processes and performance, realizing efficiency gains and energy savings.

Our digital solutions also play a key role in a pilot project to create Switzerland's first digital hydropower plant. In partnership with Hewlett Packard Enterprise, ABB worked with Axpo, Switzerland's largest producer of renewable energy, to help realize their Hydro 4.0 initiative. Together, we installed ABB Ability™ Smart Sensors on their motors to capture valuable maintenance and performance data from the plant's equipment. The ABB Ability™ Condition Monitoring digital solution enables Axpo to deploy condition monitoring across the plant, so engineers can identify anomalies, anticipate maintenance needs, and gain real-time insights into operations. The solution results in much more efficient maintenance without incurring any additional risk of unpredicted failure. This increased efficiency allows Axpo to provide sustainable power for its customers at lower cost and with greater reliability.

Lessons learned

Over the past seven years, we have learned that maintaining a strategic approach to sustainability is fundamental to securing the commitment of senior management, which in turn is critical to making progress on major initiatives. This ensures that we focus on areas where we can have the greatest impact. As the market leader in energy efficient motors and drives technology, we understand that we must also lead by example in our own operations. We have set highly ambitious targets and will maximize the use of our own products, solutions and expertise to achieve them.

We have also learned that cross-functional collaboration is fundamental to the success of sustainability initiatives. For example, the Motion green electricity initiative was made possible only through effective collaboration with ABB's Supply Chain Management, Sustainability, Operations and Real Estate functions. From this solid foundation, we will continue to make a strong, sustained push to raise awareness at all levels. Our goal is to make sustainability a source of pride for employees and a lever in attracting new talent. During the stakeholder engagement process that accompanied the development of ABB's 2030 sustainability strategy, we were pleased by the positive response from our stakeholders, especially customers. It's clear that we all have a critical role to play to contribute to a low-carbon society.

Our role, as ABB Motion, is to provide the most energy efficient products and services to our customers, and to always innovate for more. But we also need to work together with academia, public decision makers, NGOs, customers and partners to change the way society uses electricity. By joining forces, we can make the world more energy efficient.

RESOURCE-EFFICIENT AND ENVIRONMENTALLY SOUND SOLUTIONS IN

Robotics & Discrete Automation

In ABB's Robotics & Discrete Automation Business Area, we are enabling manufacturers to address demand driven by four megatrends: the rise of individualized consumption; digitalization; labor shortages due to aging populations; and general uncertainty, which can have significant impacts on production. To address these trends, flexibility and simplification have become increasingly important, driving our Business Area to innovate and improve our portfolio of solutions in search of even greater efficiencies.

Increasing operational efficiency

Among our comprehensive range of solutions that help manufacturers improve efficiency, the robotic order-picking installation at Heemskerk's Rijnsburg production facility in the Netherlands provides a notable example of how advanced solutions improve sustainability. Heemskerk Fresh & Easy is one of the largest vegetable processing companies in Europe, producing 3.5 million to 4 million fresh convenience products every week. These include salads, ready-to-cook meals and pre-cut vegetables and fruit – healthy products with very short shelf lives.

Its central facility's new robotic system was designed to prepare orders according to each food retailer's needs, so that the products can be shipped directly to stores and supermarkets instead of making an intermediate stop at a distribution center. This reduces the amount of time that fresh food spends in the supply chain, resulting in extended shelf life and less wasted food.

The system utilizes an ABB IRB 660 four-axis robot that takes crates containing the orders for a particular market and places them on a conveyor belt. The crates then move to the order picking zone, where six IRB 6700 six-axis robots positioned on a track pick them up and place them in a location designated for that market. Two more IRB 6700 robots consolidate the orders in stable stacks. The crates are then picked up by another IRB 660 and placed on dollies to be transported directly to the supermarket. The system can seamlessly process an endless variety of orders and ensures that 75 percent of the products processed today are on store shelves the following day.

About one-third of all the food produced and packaged for human consumption is wasted every year, according to the UN's Food and Agriculture Organization. The system at Heemskerk currently processes more than 800,000 crates every week, but can handle double or even triple that volume without modification. Its efficiency and flexibility allows Heemskerk to ramp volume quickly up or down based on demand, without added investment and with minimal waste.

Using every opportunity to reduce GHG emissions

Emissions reduction is an important area in which state-of-the-art robotics have a role to play. PixelPaint is a new process developed to improve the efficiency of robots used to paint vehicles. In conventional processes, approximately 30 percent of the paint is wasted. ABB's new pixel-painting robot paints directly on to the target surface using the printing nozzle head instead of spraying with a conventional atomizer, reducing waste to zero. PixelPaint is available as a cell using two ABB IRB 5500 robots. With no need for masking or de-masking, a customized paint job can be carried out in a single pass, reducing cycle times by around 50 percent. Emissions are reduced because less paint is required, avoiding the CO_2 normally emitted during its production.

ABB's non-overspray PixelPaint solution was recognized as a groundbreaking innovation with a "Technology" award at the SURCAR annual conference in Cannes in June 2019. SURCAR is a forum for the global car body finishing community.

CASE STUDY

Robotic recycling sorting systems

While almost everyone understands the importance of recycling, few people understand the process by which plastic bottles, cans, paper and cardboard are sorted once they arrive at a material recovery facility (MRF). Given that MRFs must sort through anywhere from 30 to 900 tons of materials each day, it is clear that workers cannot do the job manually.

That is why Bulk Handling Systems has combined their Max-AI Visual Inspection System with ABB's FlexPicker robots to revolutionize the process of removing designated materials or colored items from recycling streams. The resulting Automated Quality Control recycling systems, AQC-1 and AQC-2, are compact and easy to maintain, and can rapidly identify and pick out selected materials from the line.

With camera-based machine vision and artificial intelligence, FlexPickers can be directed to sort dozens of material types. The faster and more precise identification and

separation of items that can be achieved by this smart system represent a quantum leap from manual sorting processes and offers considerable advantages over the specially designed “dumb” machines and equipment that are commonly used to pull materials out of the recycling stream.

Typically, large spinning discs called “star screens” are used to separate paper and other flat, lightweight materials from the line. Density separators vibrate glass from the recycling stream through fine metal screens. A massive rolling magnet collects all ferrous metals. Optical sorters identify plastics, which are then removed from the line with targeted puffs of air, while rare earth magnets generate eddy currents to push aluminum cans off the line.

These technologies work, and they work well, but they can be easily jammed or rendered ineffective when people put the wrong materials into their recycling bins. Star screens get easily clogged up by plastics bags, coat hangers and other tangling materials; bottle caps and other small objects get mixed up with glass; and if people forget to empty the liquids out of plastic bottles, they are too heavy to be blown off the line by puffs of air.

The combination of FlexPicker robots with other innovative technologies can eliminate these types of line failures, avoiding costly delays and interruptions.

Reducing waste and energy consumption

By their very nature, robotics and other factory automation solutions serve to increase efficiency and reduce waste and energy consumption. This is particularly true in the fast-evolving field of collaborative robots, or “cobots.” ABB has been at the forefront of robotics breakthroughs that allow humans to work closely and safely with machines. These systems can optimize production efficiency as well as reducing the amount of factory floor space required for a production line.

A number of solutions have been developed to ensure that our robots operate efficiently and reliably. Remote Access allows ABB technicians to deal remotely with problems that may arise in the operation of robots. Condition monitoring helps customers assess energy consumption and respond proactively. Condition monitoring also helps ABB evaluate a problem, making technicians better prepared, with the right spare parts in hand for a customer site visit. Fleet assessment is used to identify stressed robots that may require replacement.

Fostering the circular economy

Together with Stena Recycling, Combitech, Electrolux and Stora Enso, ABB is a leading member of the Circular Initiative. This collaborative, industry-wide forum for Swedish companies aims to increase the circular flow of materials throughout Swedish industry. ABB, Stena Recycling, Combitech and Electrolux have, for example, worked together on a joint trial/pilot project that aims to improve the efficiency of the recycling process for electrical products. Robotics and shared product data are used to scan waste for specific products and materials. With data provided by manufacturers, the recyclable portions can be identified and then extracted. The end result is higher-quality recycled material with less leftover waste. This pilot project is currently processing unwanted vacuum cleaners; the ultimate goal is for the technology developed to be used for the processing of all types of electronic waste. For ABB, this partnership represents an important opportunity to test new solutions where automation and robotics are key components of a larger self-learning system.

Reducing waste by refurbishing unwanted robots

Of course, robots are themselves a manufactured product, and we are committed to producing them in a more resource-efficient and environmentally friendly manner. One way to achieve this is through remanufacturing, which allows customers to sell inactive or legacy robots to ABB through our buyback service, rather than scrapping or storing them. Over the last 25 years, we have refurbished and upgraded thousands of robots, giving them a second life. Before being labeled as an ABB-certified remanufactured robot, every second-hand unit undergoes rigorous checks and is guaranteed to offer the same levels of performance, durability and safety as a new ABB robot. ABB's network of global remanufacturing facilities includes centers in Ostrava, Czech Republic, Auburn Hills, Michigan, and Shanghai, China, as well as local remanufacturing service centers in Brazil, Mexico, Germany and Vietnam.

CASE STUDY

Transforming plastic waste into designer furniture

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

A staggering 640,000 tons of fishing nets are dumped into the seas every year, but that represents just a small proportion of the 150 million tons of garbage floating in the world's oceans. Thanks to a clever adaptation, however, one of our robots is now being used to make designer furniture from the plastic that is threatening ocean habitats across the world.

Deployed by the Swedish sustainable design house Sculptur, this specially modified ABB robot is turning the discarded nets and plastic waste into furniture. In an innovative twist, we have tweaked one of our industrial robots so that it functions as an advanced 3D printer.

Because the robot can point the injection molding equipment at any angle as it applies the plastic grains, the equipment is far more versatile than conventional 3D printers and helps save around 50 percent of the required base materials. Our simulation and offline programming software, RobotStudio, provides a complete digital twin of physical assets, and a newly developed add-on for 3D printing enables the printing robot to be programmed in just a few minutes. A complete designer piece can be manufactured in less than two hours.

Sculptur and ABB share a philosophy and a vision – that by using recycled products and cutting-edge technology they can together make the world a better, more sustainable place.

Lessons learned

Since ABB initiated its last sustainability reporting cycle in 2013, the Robotics & Discrete Automation Business Area has evolved to regard the sustainability of our products, services and operations as a central consideration. The quest for production efficiency has always been at the heart of what we do, but we have increasingly learned to address matters of sustainability, resource conservation, safety and circularity as a conscious and critically important field of activity. This effort is a key aspect of one of our Business Area's most critical improvement programs, which seeks to achieve further quality improvements for the benefit of our customers. The program considers all aspects of the customer journey and aims to achieve quality in every dimension the first time we undertake any action. On this basis, we intend to enhance our overall efficiency, including in our use of resources.

In taking a conscious and comprehensive approach to sustainability, we consider not just the time savings that our portfolio can deliver to our customers, but energy savings, safety improvements and more. By considering all of the impacts of our offerings, we have lowered the total cost of ownership of our solutions and made them more attractive to our customers, while reducing their impacts on the environment.

In many cases, this comprehensive approach has called for greater cooperation and collaboration across ABB's Business Areas and functions, as well as with external technology providers and research institutions. Advances such as stronger recycling processes could not have been achieved without taking an outward-looking, cross-disciplinary approach to our activities. By prompting us to reexamine our approach to R&D, our sustainability targets broadened our Business Area's perspective and led to significant technological refinement of our portfolio. By thinking of ways to use new materials and processes to make our products and services more sustainable, we have also made them better – more efficient, cleaner, more reliable, more compact and more versatile.

Among the other lessons we have learned from this reporting cycle, Robotics & Discrete Automation has embraced the importance of promoting the value of a sustainable approach to our colleagues, our customers and our suppliers. By highlighting the concrete benefits of this approach, we are better able to achieve rapid technological progress and expand our Business Area's contributions to the sustainability and value-creating potential of the industrial sector around the globe.

Finally, our Business Area has embraced the importance of strongly promoting diversity and inclusion within our ranks. Following ABB's announcement of its ambitious new targets in this area, Robotics & Discrete Automation engaged its employees in a global brainstorming process. The point of this exercise was to identify concrete and practical solutions to advance diversity and inclusion in our workplaces and build an even better culture within our Business Area.