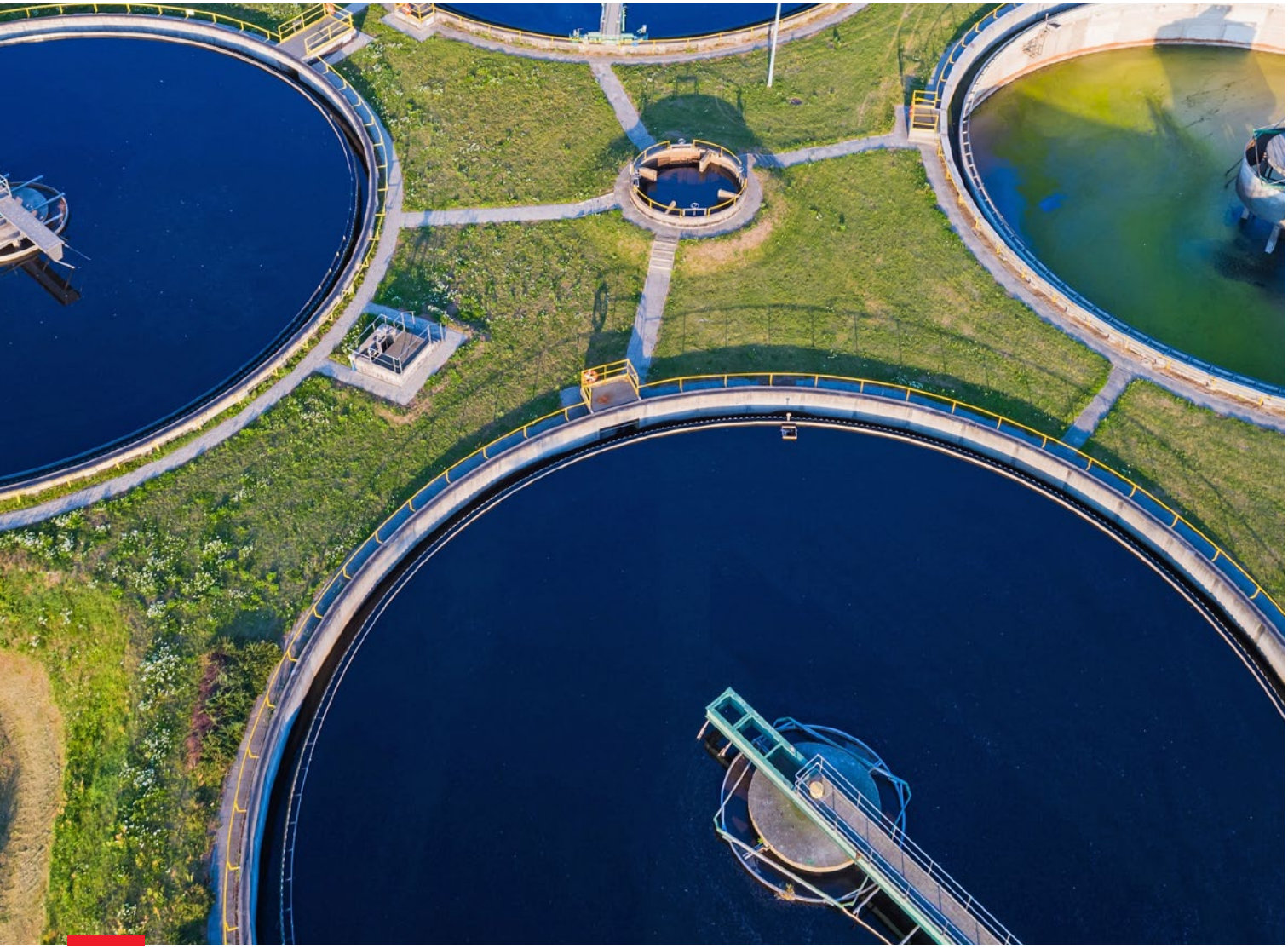


MOTION

Wastewater treatment plant
Building resilient, safe and sustainable facilities

How to maximize treatment for a limited resource

Whether drainage, effluent, surface water or sewage, there is a need to stabilize process flow, reduce wear and tear and improve overall efficiencies: and all against a backdrop of increasing regulatory requirements which demand additional energy intensive processes.

Plant and personnel safety

"I need to make my plant and personnel safety a priority."

Safety Manager

Tackle diverse safety demands...
By its very nature wastewater treatment carries risk to human health, with exposure to sewage treatment plants, sewers and sludge. Selecting the right products that minimize human exposure to the environment is critical.

...using best-in-class technology

Wheeled module drives can be rapidly manoeuvred into a panel, eliminating manual lifting which could lead to injury and reducing time exposed to potentially dirty environment.

Safe torque off, built into variable speed drives, brings motor-driven applications to a safe and efficient stop.

Arc flash-over is avoided by ensuring all panels undergo arc flash testing.

Cloud-based technology, using smart sensors, provides remote monitoring support for motors and general machinery avoiding hazards encountered in dirty and wet areas such as dosing.

Globally certified drives and motors packages protect plant and people and conform to global regulations using tested and certified motors and drives for potentially explosive atmospheres.

Energy efficiency

"We need to cut our energy bill and carbon footprint."

Energy Manager

Know where to look...
Pumps (14%) and aerators (53%) are the largest wastewater energy consumers. Because of catchment area characteristics pumps are often over-sized. Furthermore, overall electrical system efficiency (comprising transformers, drives, motors and load) can be up to 20 percent less efficient though poor design.

...and how to unlock the saving potential

Energy optimization reduces total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 2% to 10%, depending on the load torque and speed.

Energy monitors works out energy savings in kWh, MWh, CO_2 emissions and money saved.

Variable speed cooling fans ensure drive modules have cooling fans for energy saving during partial loads.

ABB Ability™ Smart Sensors help to spot energy saving opportunities among low voltage motors and many smaller powered general machines such as pumps.

Synchronous reluctance motor (SynRM) can reduce losses by up to 40 percent, bringing optimal efficiency and reliability.

Productivity and resilience

"We must avoid supply interruptions and deliver high customer outcomes."

Production Manager

Build in resilience...
Wastewater plants need to run without interruption and in the most efficient and environmentally conscious way. Ensuring the reliability of plant assets is the best way to reduce supply interruptions, lower environmental impact and keep your business efficient and effective.

... with flexible motor-driven solutions

Using an ultra-low harmonic (ULH) drive will not intensify harmonics in the power network. Instead it reduces the losses in the mains supply, improves the mains quality and reduces the risk of disturbance of other equipment connected to the mains. Using ULH drives in combination with generators will reduce the generator size required, compared to a similar standard drive

Blockage detection / Pump cleaning function keeps the pump's impeller clean by running a sequence of ramps between minimum and maximum pump speed. This feature avoids the high costs associated with removing the pumps to manually clean and the health and safety implications of the lifting operations.

Cyber security is paramount by ensuring that drives can be integrated in a system that meets IEC 62443 requirements.

Multiple inputs and outputs (I/Os) allow a variety of process information from the VSD/VFD to the motor control.

Fieldbus technology enables process equipment to integrate with any plant control systems, giving greater intelligence and better control of production.

Operation and maintenance

"Uptime is our number one priority."

Maintenance Manager

Lower operational overheads...
Wastewater pumps suffer a higher wear rate because of grit, rags, debris and other solids. Managing these issues saves energy by avoiding pumping against partial blockages.

... by utilizing smart functionality

Temperature, load, under/overvoltage protection and warning features help anticipate breakdowns.

A real-time clock allows timed tracing of faults, so you know what happened and when.

Soft starters gently ramp the power up to limit extreme pipework turbulence, thereby avoiding cavitation and failure of mechanical components.

ABB Ability™ Condition Monitoring services support remote pumping stations by delivering accurate, real-time information about drives and motors, ensuring equipment is available, reliable and maintainable.

Finding improvements every step of the way

1 WET WELL

Collecting wastewater from domestic, commercial and industry.

Applications:
- Sewage pumping stations (lift stations)
- Submersible, dry well or suspended pumps

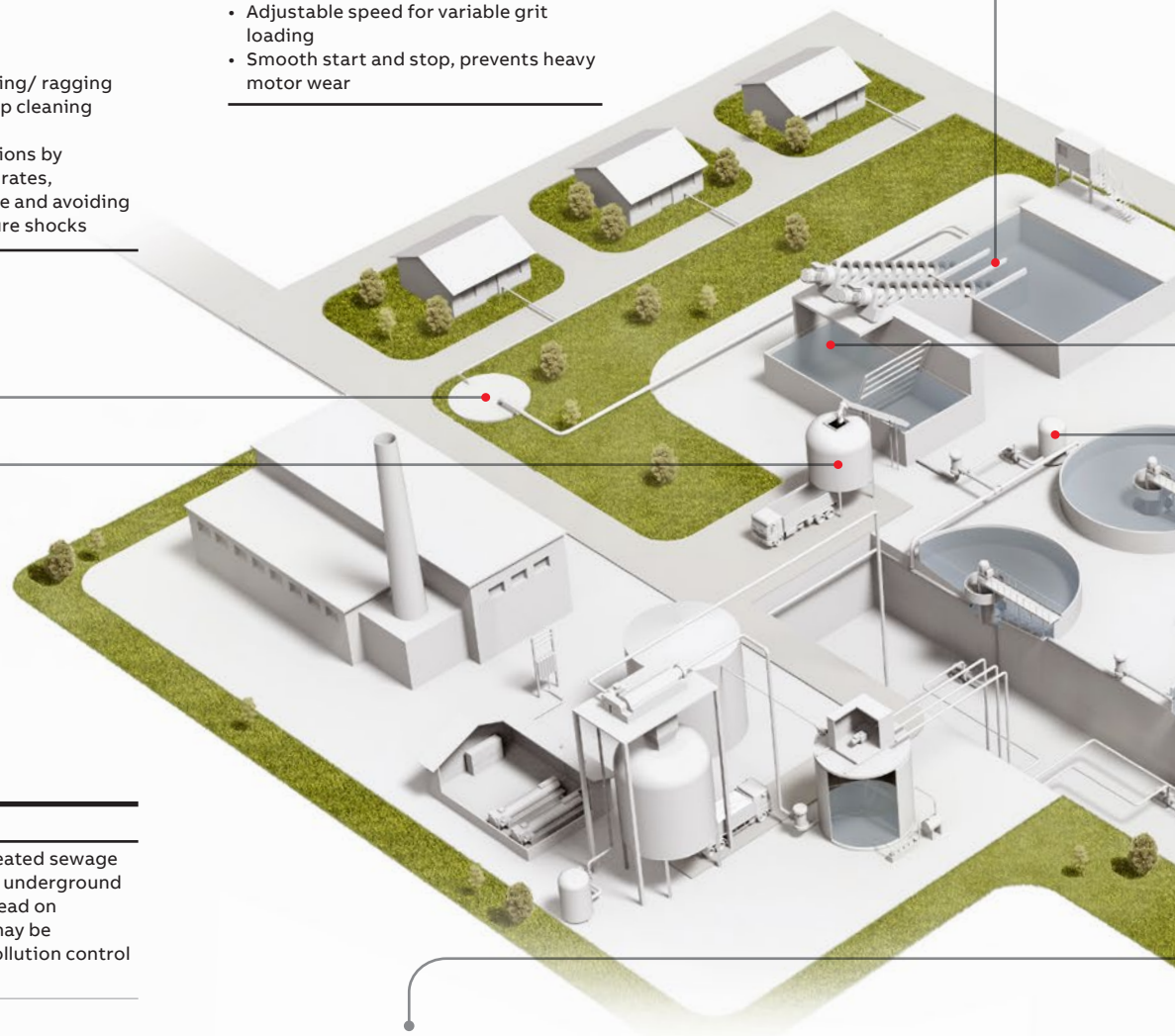
Requirements:
- Reduce the risk of clogging/ ragging with drive's built-in pump cleaning software
- Regulate inflow fluctuations by stabilizing pump on/off rates, optimizing cleaning cycle and avoiding water hammer or pressure shocks

2 GRIT REMOVAL

Process for removing sand, silt and grit from water.

Applications:
- Screw conveyor

Requirements:
- Adjustable speed for variable grit loading
- Smooth start and stop, prevents heavy motor wear



3 SOLIDS DISPOSAL

The final destination of treated sewage sludge can be land, buried underground in a sanitary landfill or spread on agricultural land. Sludge may be incinerated whereby air pollution control must be considered.

Applications:
- Scrubbers and filters
- Pumps

Requirements:
See page 6 for more details on sludge treatment.

8 FINAL CLARIFIER

Flocs of biological growth are removed, making it the last chance to clean-up effluent prior to disinfection.

Applications:
- RAS and WAS pumps
- Flocculator

Requirements:
- Improve clarifier efficiency by matching paddle or circular speed with chemical dosages
- Improve efficiency of clarifier by maintaining consistent sludge blanket
- Lower wear on scrapper mechanism

9 NITRIFICATION

Aerobic biological wastewater treatment process converting ammonia to nitrate.

Applications:
- Pumps
- Blower

Requirements:
- pH meter signal controls chemical feed pump meter controls aerator pump/ blower speed
- Improved control of pH through drive-controlled pump to feed caustic
- Improved oxygen control through drive-controlled aerator

Every stage of wastewater treatment can be fine-tuned to improve resilience, lower energy consumption and enhance safety.

4 SCREENING

Removes large debris from wastewater.

Applications:
- Bar screen

Requirements:
- Drive controls the rake in relation to solids deposited on screen by measuring water level ahead of screen
- Adjustable rake speed for varying amount of solids, lowers energy and decreases wear on mechanism
- Smooth start-and-stop decreases motor wear

5 CHEMICAL DOSING

Phosphate removal is carried out by dosing chemicals, normally iron, or occasionally aluminum, salts. Chemicals used are expensive, hence why wastewater treatment plants need to exercise strict control of the dosing regime.

Applications:
- Pumps

Requirements:
- Pump controlled by in-line chemical sensor, flow sensor or manual adjustment provides optimal chemical feed rates
- Controlled chemical dosing reduces chemical costs by minimizing overfeed and eliminating frequent on/off pump cycling of pump

6 SEDIMENTATION

Solids settle in sedimentation tank while grease floats to top.

Applications:
- Primary sludge pumps
- Anaerobic digester

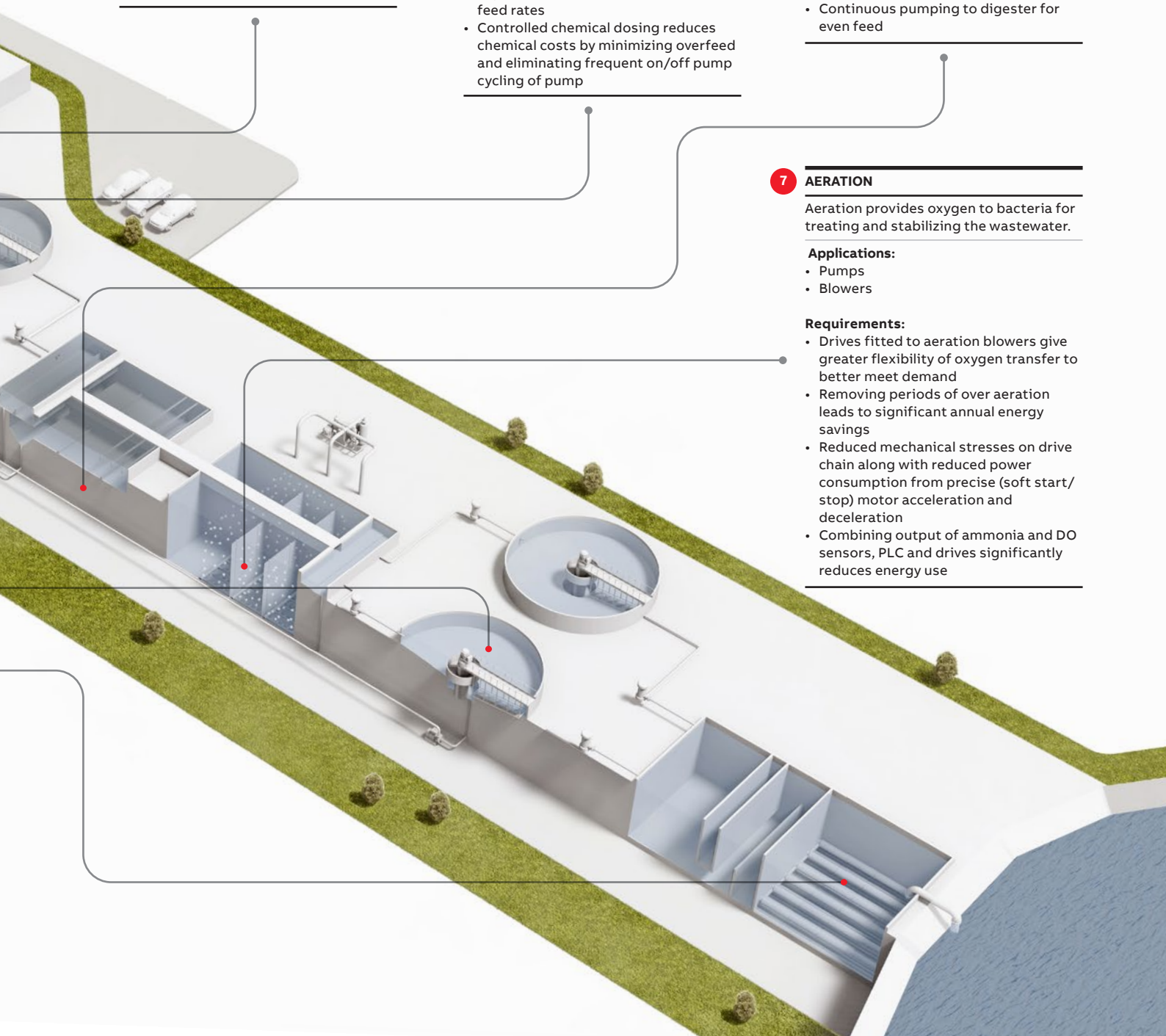
Requirements:
- Drive adjusts motor speed to prevent pumping of excess water
- Drive takes 4-20 mA signal from sludge density meter or pressure gauge allowing sludge withdrawal with minimal water content
- Continuous pumping to digester for even feed

7 AERATION

Aeration provides oxygen to bacteria for treating and stabilizing the wastewater.

Applications:
- Pumps
- Blowers

Requirements:
- Drives fitted to aeration blowers give greater flexibility of oxygen transfer to better meet demand
- Removing periods of over aeration leads to significant annual energy savings
- Reduced mechanical stresses on drive chain along with reduced power consumption from precise (soft start/stop) motor acceleration and deceleration
- Combining output of ammonia and DO sensors, PLC and drives significantly reduces energy use



...improving the performance of sludge treatment

1 HOLDING TANK

An aerated tank for temporary storage of digested or raw sludge prior to further treatment.

Applications:
- Mixers

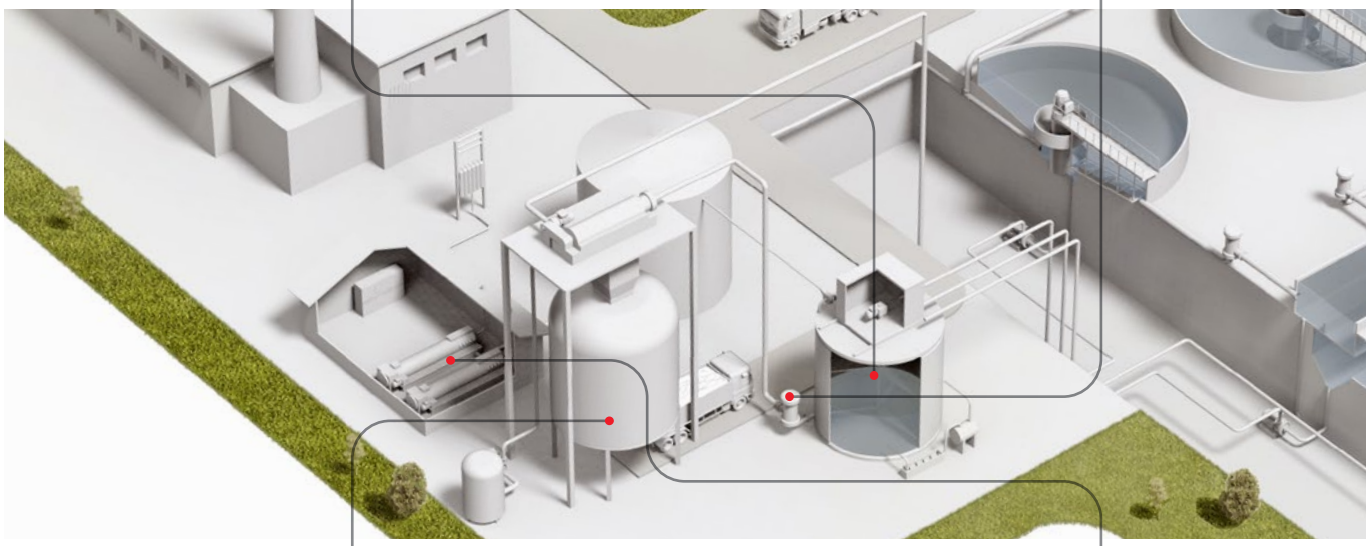
Requirements:
- With VSD/VFD control the mixing operations result in energy savings

2 DIGESTER FEED PUMP

Optimal control of sludge pumping.

Applications:
- Pumps

Requirements:
- Manual or automatic adjustment of pump speed based on available volume in sludge thickener or clarifier
- VSD/VFD on the holding tank sludge pump provides constant feed to digesters
- Include a sensor measuring pH tied to a alkalinity feed pump



3 ANAEROBIC DIGESTER

Anaerobic digestion is a collection of processes by which micro-organisms break down biodegradable material in the absence of oxygen.

Applications:
- Anaerobic digester
- Pumps

Requirements:
- Optimal control of oxygen by using VSD/VFD to control compressor speed. Sensors measure oxygen levels in digesters
- Optimal control of sludge supernatant pumping

4 DEWATERING CENTRIFUGE

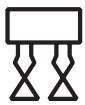
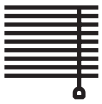
Centrifuge speed manually adjusted based on visual or lab determination of de-watered sludge solids content.

Applications:
- Centrifuges
- Pumps
- Conveyors
- Belt press

Requirements:
- Sludge pump speed manually adjusted based on visual observation of centrifuge throughput, thereby optimizing sludge feed rate
- Conveyor speed adjusted based on visual observation of output of centrifuge
- With VSD/VFD, sludge feed pump control optimizes process
- Belt speed controlled by measuring solids content of filter cake
- Improved efficiency of water removal from solids resulting in drier filter cake, thereby reducing sludge disposal volume

Unlock the potential in wastewater applications

Alongside energy saving, improved productivity and greater safety, there are many other benefits from using variable speed drives (VSDs)/variable frequency drives (VFDs) and high efficiency motors on motor-driven applications.

	Challenge	Solution	Benefit
 **Pumps**	• Reduce energy use and carbon emissions	• Motor-drive: 80 percent speed saves half the energy, according to affinity laws	• Typically, between 20 to 60 percent energy savings compared to throttled control system
	• Variations in process demands	• Drive: Built-in multipump control function ensures operation of pumps according to actual demand	• Fast response to changing demand • Optimized energy consumption
	• Complex and mechanically controlled water networks	• Motor-drive: Simplify the water network by eliminating need for control valves, by-pass lines and instrumentation, with speed control, built-in protections and functions	• Reduces wear on motors • Reduces leaks caused by pressure surges • Lower maintenance and life cycle costs
	• Clogging pumps	• Drive and softstarter: Built-in pump clean functionality to derag	• Reduces maintenance cost • Improved pump efficiency
	• Precise and optimal speed control	• Motor-drive: Enables the Best Efficiency Point (BEP) pumping	• Optimal pump efficiency
	• Direct-on-line starting creates pressure shocks that damages pumps, seals, pipe joints and valves	• Motor-drive and softstarter: Soft start of motor reduces stress on water and electrical network	• Reduced water hammer and other mechanical stress • Avoids pipe burst • Increased equipment lifetime
	• High cost when operating remote sites	• Motor-drive: Intelligent drives and smart sensors enable remote control and monitoring of pumps	• Anticipate operating lifetime of pumps • Reduce travel costs
	• Due to abrasive content and cavitation the lifetime of the impeller is shortened	• Motor-drive: Several software features to detect and prevent cavitation	• Allows for planned maintenance • Optimal energy efficiency
 **Blowers/ compressors**	• Overration and foaming	• Motor-drive and softstarter: soft start and stop • Drive: avoids mechanical resonance speeds	• Avoids wear and tear to mechanical parts, ensuring uptime • Savings on maintenance • Reduced foam • Active healthy bugs in the process
	• High operation and energy costs	• Motor-drive: controls the dissolved oxygen • High-speed/ Turbo blower drive technology	• Less mechanical wear • Better blower efficiency
	• Harmonics which can cause power quality issues	• Drive: Better blower efficiency • Ensuring ultra-low harmonic level in supply network	• Harmonics can be reduced down below 3 percent • Genuine unity power factor with no compensation needed
	• Right amount of oxygen	• Motor-drive: variable speed allows accurate oxygen level control	• Better generator stability • Increased efficiency • Easy link to process control system • Exact amount of oxygen • Reduced foaming
 **Mixers**	• Better mixing quality	• Motors-drive: optimal speed control for the mixing operation	• Precise dosage and reduction of chemical waste
 **Screw conveyor**	• Significant mechanical and stress on the motor during start-up	• Motors-drive and softstarter: torque and speed control	• Lower energy consumption and less wear and tear on the motor
 **Bar screen**	• Avoiding jamming of the bar screen operation	• Motors-drive: built-in monitoring functionality in the drive to avoid overloading	• Less use of energy • Less wear and tear of the motor
 **Anaerobic digester**	• Ensuring optimal operation of pumps	• Motors-drive: functionality to move solids	• Avoidance of jamming and rake

Features and functions benefiting wastewater

Drives, motors, PLCs, softstarters and service all play a vital part in keeping water flowing. Choosing the right product feature for the right environment is essential in ensuring an optimized production.

Variable speed drives/ variable frequency drives

Energy efficiency
- Control operating costs by seeing energy costs in local currency, kWh and CO_2 emissions

Communication
- Use information such as water flow rates and separator centrifuge speeds to get the VSD/VFD to adjust motor speed and torque
- Get detailed insight into productivity performance and quality control through fieldbus comms connecting VSD/VFD with plant monitoring systems

Ingress protection
- IP55 for wet and corrosive environments

Functional safety
- Safely stop pumps using in-built safe torque off (safety level SIL3 / PL e)

Low harmonics
- Eliminate supply disturbances that could trip production with built-in active supply unit and integrated low-harmonic line filter

Multi-pump control
- Ensures stable and uninterrupted production with multi-pump controls by optimizing the speed and number of running pumps

Sensorless flow calculation
- Reduces costs by eliminating external components

Soft pipe filling
- Increases piping and pump system lifetime by avoiding pressure peaks

Pump cleaning
- Prevents unplanned downtime by removing obstructions from pump's impeller

Level control
- Ensures optimal efficiency when filling or emptying a tank

Flow and pressure protection
- Protects pumping system from a low and/or high pressure and flow and prevents leakages/pump from running dry

Pump priority
- Achieves energy savings by alternating pumps based on pump efficiencies

Sleep boost
- Saves energy and extends pump life by decreasing start/stop cycles throughout the day

Softstarters

Prolong pipe and pump life
- Uses torque control to gently open and close valves and reduce water hammer during starts and stops

Protect pump system
- Motor preheat ensures a dry and warm motor, prolonging pump life and increasing uptime
- Coated boards and IP66 / UL Type 4x externally mounted keypads for harsh conditions

Maintain clean pipes and pumps
- Pump cleaning feature reduces impeller build-up to prevent and clear pump clogging thereby eliminating downtime

Simplify use
- Application wizards simplify commissioning and control of pump

Drive and motor packages

Synchronous reluctance motor (SynRM) and drive
- Save energy across the water treatment process with IE5 synchronous reluctance motors and drive packages

Drive and powertrain solutions
- Accessing from one source the drive, motor, transformer, switchgear and filters for mitigating harmonics and improving the quality of the network

Globally certified drives and motors packages
- Protect plant and people and conform to global regulations using tested and certified motors and drives for potentially explosive atmospheres

Low voltage motors

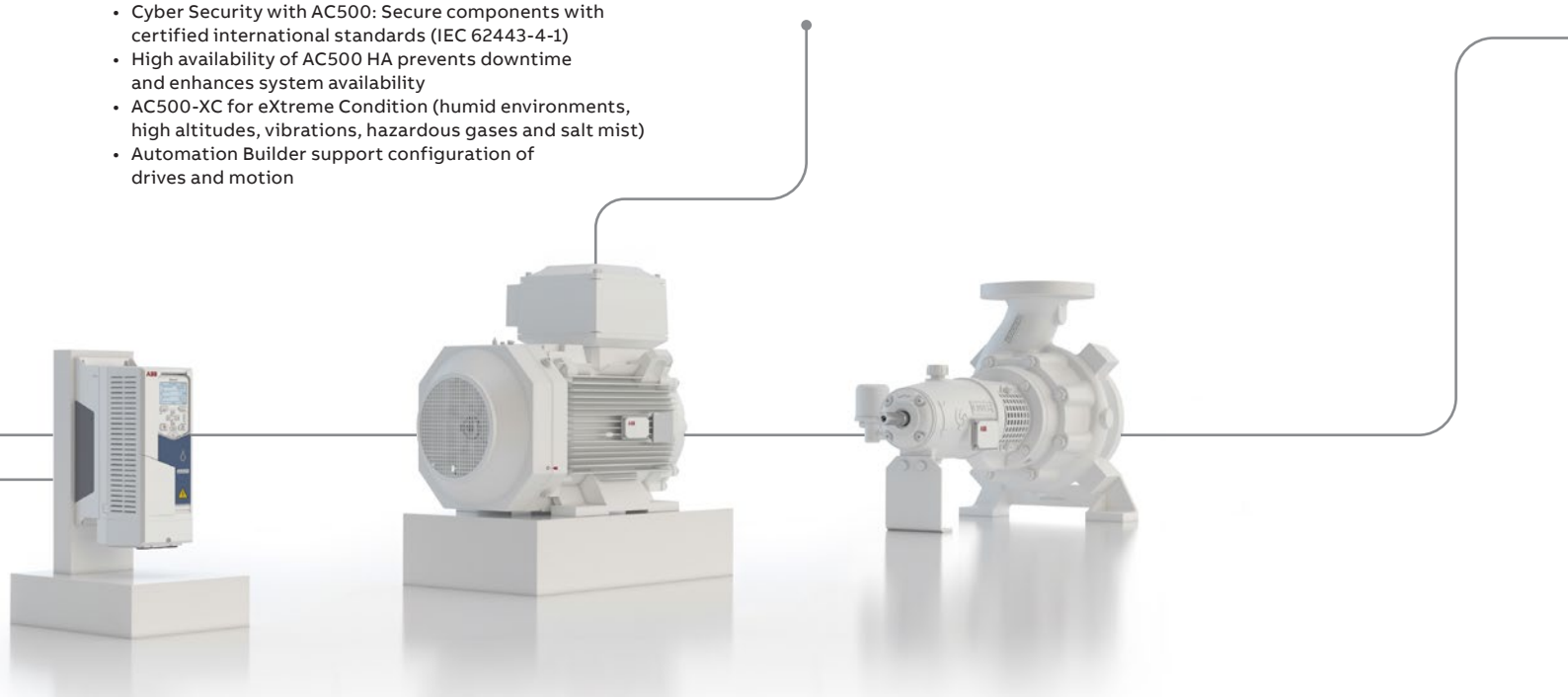
- Protection against external conditions
- Bearing locked at D-end to avoid axial play
- Bearings can be either greased for life or regreasable, fitted with grease relief systems
- Fan and motor fins optimized for low noise levels
- Oversized terminal box fitted as standard for ease of installation
- IP55 protection against ingress of water or solids. IP56 protection available as option.
- Surface treatment (polyurethane or epoxy) in accordance with corrosion class C3, with C4 and C5 as an option
- IE3, IE4 or IE5 efficiency levels to support emissions reduction
- Suitable for frequency converter operation

Medium voltage motors

- General purpose modular induction motor's pre-engineered platform ensures short and on-time delivery
- High power density and efficiency reduces cost of ownership
- Provides same output power with a smaller frame size – less weight, a smaller installation footprint and lower costs
- Horizontal or vertical mounting
- Compact design, interface flexibility and low noise

Programmable logic controllers (PLCs)

- Comprehensive range of scalable PLCs, I/Os and robust HMI control panels delivering performance, quality and reliability
- Remote access helps reduce commissioning time
- One integrated engineering tool for programming, simulation and commissioning for PLCs, safety, drives, control panels and network
- Flexible choice of network and fieldbuses to integrate I/O's, drives, HMI, Scada and 3rd party devices
- S500 I/O System:
  - Cost efficient remote I/Os supporting different fieldbus protocols
  - Hot-Swap I/Os for increased availability
  - Fast integration into existing environment
- IIoT gateway functionality onboard the PLCs and control panels offer secure connection to cloud
- Cyber Security with AC500: Secure components with certified international standards (IEC 62443-4-1)
- High availability of AC500 HA prevents downtime and enhances system availability
- AC500-XC for eXtreme Condition (humid environments, high altitudes, vibrations, hazardous gases and salt mist)
- Automation Builder support configuration of drives and motion



From the factory floor to the cloud and beyond

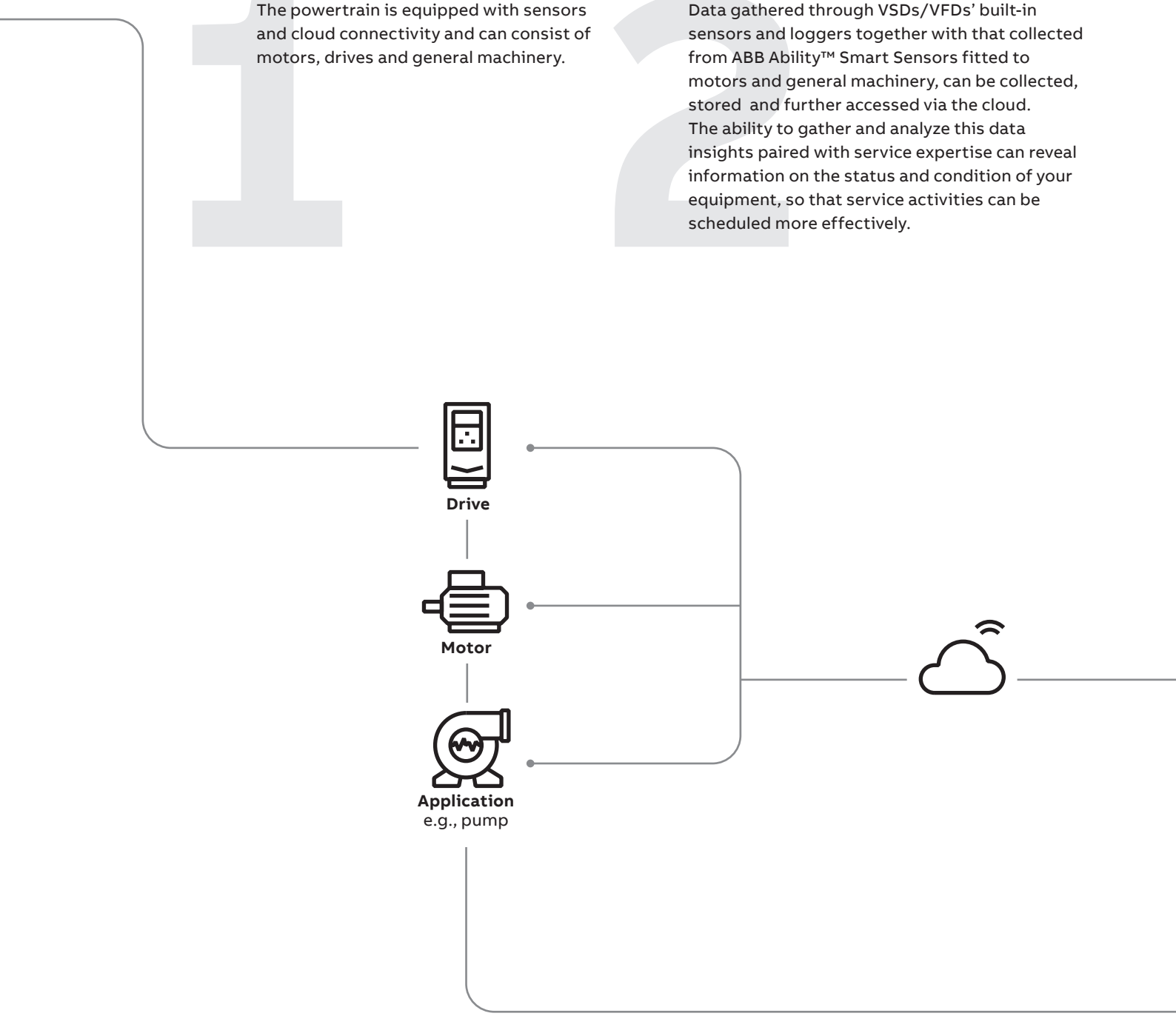
ABB Ability™ Condition Monitoring for powertrains optimizes the performance and efficiency of electric motor-driven rotating equipment. It enables better decision making by providing real-time access to data on all parameters for drives, motors and general machinery.

1 Intelligent powertrain

The powertrain is equipped with sensors and cloud connectivity and can consist of motors, drives and general machinery.

2 Turning data into valuable insights

Data gathered through VSDs/VFDs' built-in sensors and loggers together with that collected from ABB Ability™ Smart Sensors fitted to motors and general machinery, can be collected, stored and further accessed via the cloud. The ability to gather and analyze this data insights paired with service expertise can reveal information on the status and condition of your equipment, so that service activities can be scheduled more effectively.



Accessing data for analytics

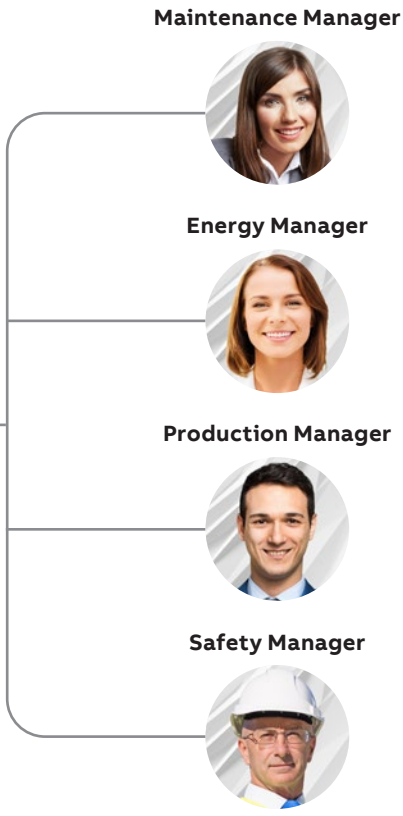
Detailed information can be extracted into a company's portal and systems. Information on many aspects of the wastewater process is available, including the ability to know exactly when and how production equipment was cleaned. Detailed dashboards give full transparency so that you can take actions that lead to less downtime, extended equipment lifetime, lower costs, safer operations and increased profitability.

Gain a digital advantage

While the data is always at your disposal, ABB service experts can work with you to provide help on how you analyze the data and define the steps for improving your operations.

Ensuring that the right person is exposed to the right information at the right time brings:

- Appropriate response to production challenges, lowering operating costs and product waste.
- Greater insight into various aspects of the wastewater process, thereby improving quality and reducing variations, errors and waste.
- Maximum material traceability helps fulfil regulatory compliance.
- Lower risk of production failure and change the maintenance from reactive to predictive.



Our service expertise, your advantage

ABB Motion Services helps customers around the globe by maximizing uptime, extending product life cycle, and enhancing the performance and energy efficiency of electrical motion solutions. We enable innovation and success through digitalization by securely connecting and monitoring our customers' motors and drives, increasing operational uptime, and improving efficiency. We make the difference for our customers and partners every day by keeping their operations running profitably, safely and reliably.

With a service offering tailored to your needs, ABB Motion Services maximizes the uptime and extends the life cycle of your electrical motion solutions, while optimizing their performance and maximizing your energy efficiency gains throughout the entire lifetime of your applications. We help to keep your applications turning profitably, safely, and reliably.

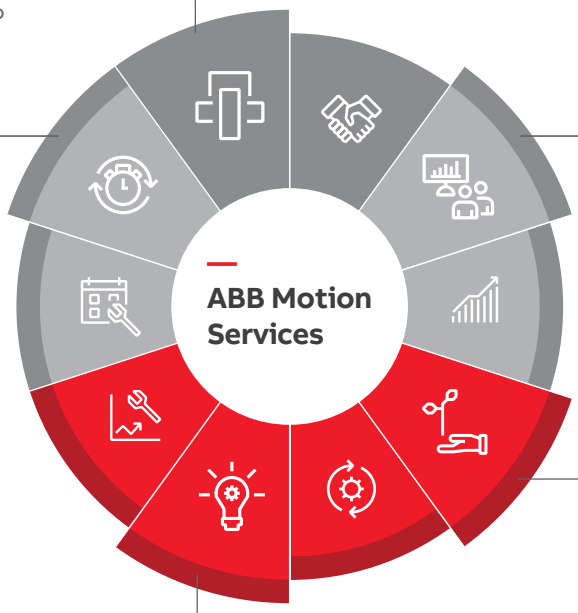
Digitalization enables new smart and secured ways to prevent unexpected downtime while optimizing the operation and maintenance of your assets. We securely connect and monitor your motors, drives or your entire powertrain to our easy to use cloud service solutions. Connecting your applications also gives you access to our in-depth service domain expertise.

We quickly respond to your service needs. Together with our partners, local field service experts, and service workshop networks, we provide and install original spare parts to help resolve any issues and minimize the impact of unexpected disruptions.

Our tailored to your needs service offerings and digital solutions will enable you to unlock new possibilities. Not only are we your premier supplier of motion equipment, we are your trusted partner and advisor offering support throughout the entire life cycle of your assets. We ensure your operations run profitably, safely and reliably and continue to drive real world results, now and in the future. Our service teams work with you, delivering the expertise needed to keep your world turning while saving energy every day.

ABB Motion OneCare:
The modular service agreement tailored to your needs

Recovery services:
Fast intervention when something goes wrong



Data and Advisory services:
Better desicion making

Energy efficiency and Circularity:
Reducing carbon emissions and waste
Driving the tomorrow

Digital and Innovation:
Delivering digital for success
Smart. Secure. Connected.

OUR EXPERTISE
YOUR ADVANTAGE

With you, wherever you are in the world

Partnering with ABB, gives you access to some of the world's most innovative technology, expertise and solutions.

Global reach
ABB operates in over 100 countries with its own manufacturing, logistics and sales operations together with a wide network of local channel partners that can quickly respond to your needs. Stock availability is good, with short delivery times for many products backed by 24-hour spare parts delivery.

In addition, we work closely with wastewater producers to develop custom products, services and solutions to help standardize processes across multiple sites and streamline your supply chain.

We have several global R&D centers with thousands of technologists and considerable investments annually on innovation.

End-to-end product portfolio
Alongside its variable speed drives (VSDs)/ variable frequency drives (VFDs), motors and soft starters, ABB's automation offering includes a wide range of scalable PLCs, a selection of HMIs, instrumentation and robotics. With functional safety options, from built-in safe torque off in drives to safety PLCs, you can readily implement safety requirements.




ABB's offering includes:

- End-to-end **power and automation solutions**, from power distribution, raw material receipt, to process and machine control, to end of line packaging
- **Power protection and power quality solutions** to safeguard equipment and processes
- Industry leading **robotic automation solutions** that improve your speed-to-market, flexibility and help make packaging a differentiator
- A complete range of **protection, connection and wire management solutions** that withstand harsh environments and extreme temperature swings, and provide the reliability needed for continuous operations

Streamline sourcing

ABB's end-to-end product and services portfolio streamlines your sourcing and purchasing activities and standardizes production across multiple sites, saving you money on spare part inventories while reducing maintenance costs.

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For more information, please contact your local ABB representative or visit

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