



MOTION

Aquaculture

Boosting productivity and enhancing sustainability for a more resilient industry

Using powertrain technology to strengthen the value chain

Aquaculture production methods are evolving rapidly to meet global demand for healthy, high-quality food in a sustainable way, and the technology needed to keep pace impacts upon everyone in the supply chain. Whether you need to maintain the health of the fish, stabilize process flow, reduce asset wear and tear or improve overall efficiencies, ABB's variable speed drives (VSDs)/variable frequency drives (VFDs), motors and PLCs help future-proof production for all parts of the value chain.



Engineering Consultant

—
“Time is money. I need products that work in extreme

conditions, are super-reliable and easy to maintain.”



System Integrator

—
“Connecting and integrating components from conveyors to

aerators needs to be extremely easy.”



Original Equipment Manufacturer (OEM)

—
“I need access to the most reliable powertrain

technology, that is matched and fully compatible from selection and dimensioning to installation and commissioning. I also need the backing of my suppliers who can help me integrate powertrain components seamlessly into my designs.”



Energy and Sustainability Specialist

—
“We don't want to change the world, nor do we want to make an impact on

the environment. That's why finding the ultimate in energy efficiency and carbon neutral technologies is imperative. We must be able to reduce emissions, lower operational costs and eliminate the risk of environmental disasters.”


Offshore fish farm
– Page 9

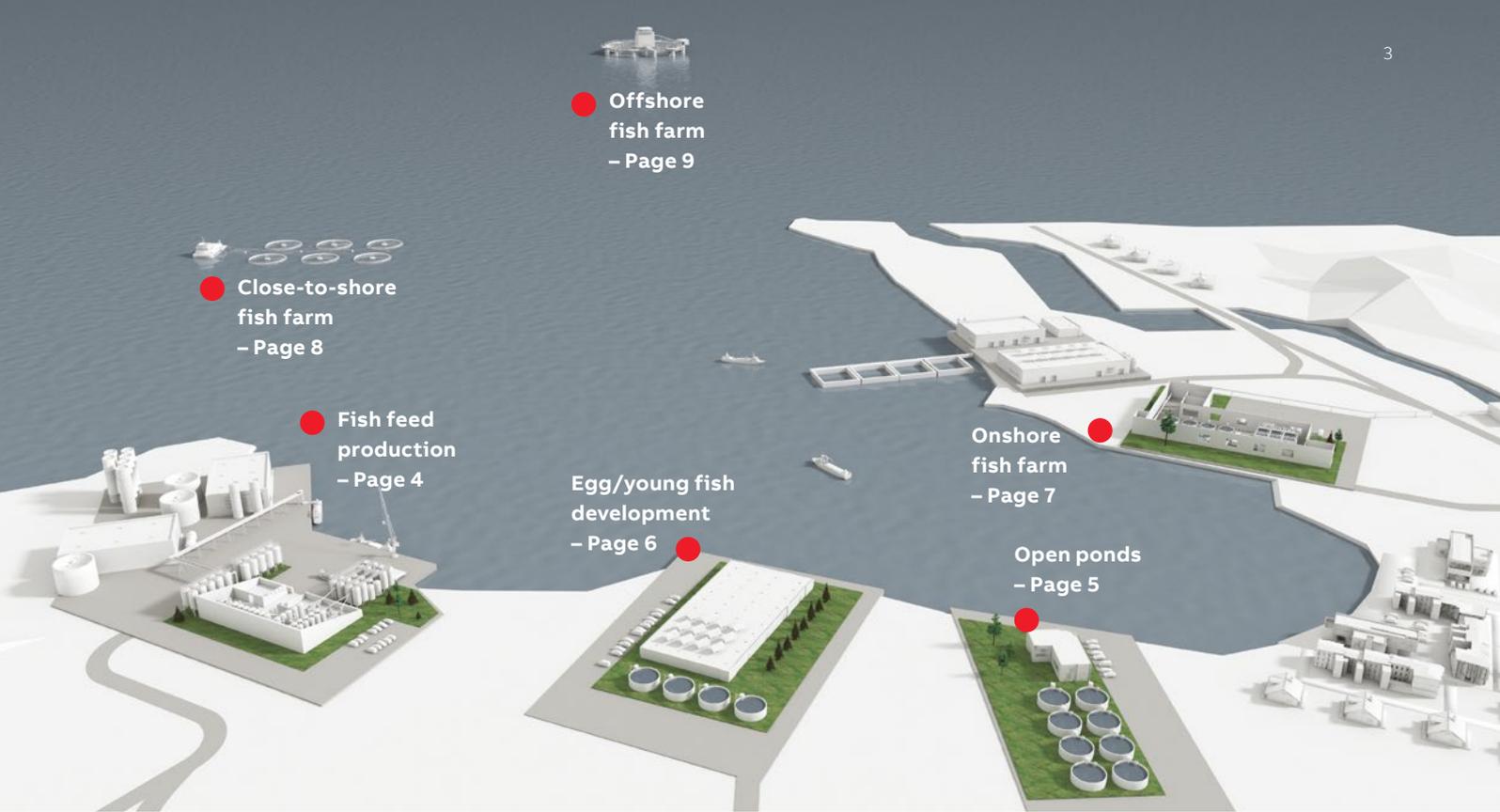

Close-to-shore fish farm
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Open ponds
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Aquatic and Personnel Safety Manager

—
“Health and safety of fish stocks and personnel are top priority. I strive to

select the right motor and drive products that contribute to giving us better ways to monitor fish health and performance, letting us optimize processes so we can minimize environmental impact – all while meeting the ever-demanding food safety regulations.”



Digital Officer

—
“Efficient fish farm management requires detailed access to fault

logs and operational data for condition monitoring and troubleshooting. As offshore farms become smarter, remote condition monitoring of our motor-driven applications becomes paramount.”



Production Manager

—
“Ultra-reliable automation systems are critical to avoid supply interruptions

that could damage the life of the fish and impact on the high quality food expectations of our customers.”



Maintenance Engineer

—
“Equipment reliability is vital to avoid breakdowns and damaged reputations.

Central to this is a global service network and preventive maintenance contracts that relieve pressure on in-house teams and increase speed of response to critical issues.”

Fish feed production

Fish feed can account for some 50 percent of the entire fish farming costs. Therefore, a seamlessly integrated powertrain helps operators produce the exact mix needed, without wastage, by precisely controlling the hammer mills, extruders, mixers and conveyors.

1 STORAGE BUNKERS

Raw materials, such as corn or molasses, transferred from ships or trucks to storage bunkers.

Drive and motor applications

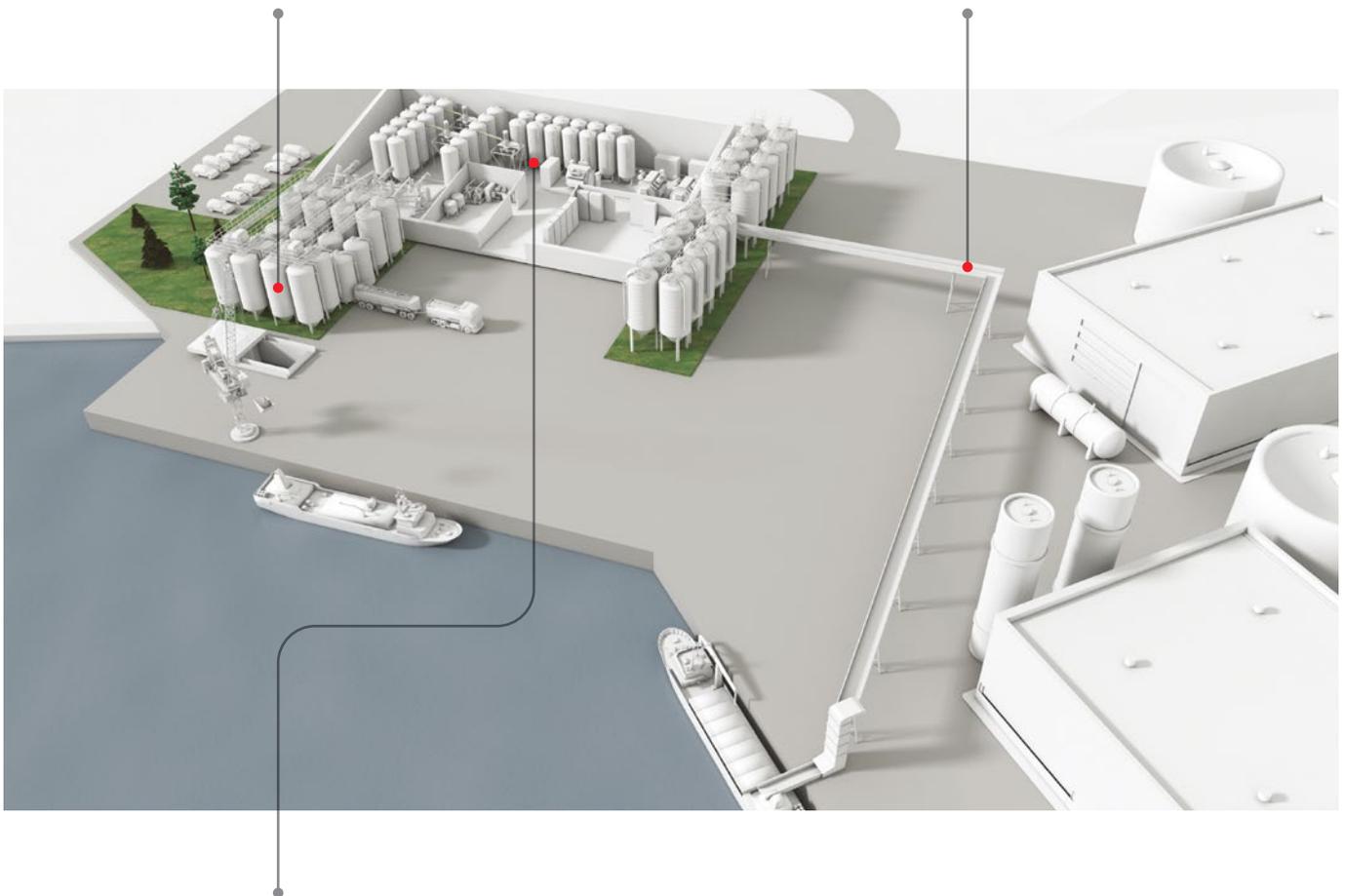
- Cranes
- Conveyors
- Pumps

2 TRANSPORTATION

Conveyors transfer the fish food pellets to ships for transport to offshore fish farms and to trucks for onshore fish farms.

Drive and motor applications

- Conveyors
- Feeders
- Packaging machinery



3 PREPARATION

Hammermills grind raw materials before being combined using mixers to produce dough. The dough is then pelletized in an extruder to produce fish meal pellets. The pellets are soft and enter a cooler to harden, using a combination of fans and sieves to separate pellets. Once prepared the pellets are stored in silos.

Drive and motor applications

- | | |
|-----------------|---------------|
| • Hammermills | • Ovens |
| • Mixers | • Pelletizers |
| • Extruders | • Compressors |
| • Air conveyors | • Aerators |

Open ponds

Temperature and light variance throughout the day and year can make it difficult to control conditions like temperature and oxygen content and water quality in outdoor facilities, while equipment uptime is crucial to ensure healthy growth and low mortality of fish. Meanwhile, the environmental impact, from diverting river water and returning process wastewater, must be kept to a minimum.

1 INLET

Fresh water is diverted from rivers and ponds into tanks.

Drive and motor applications

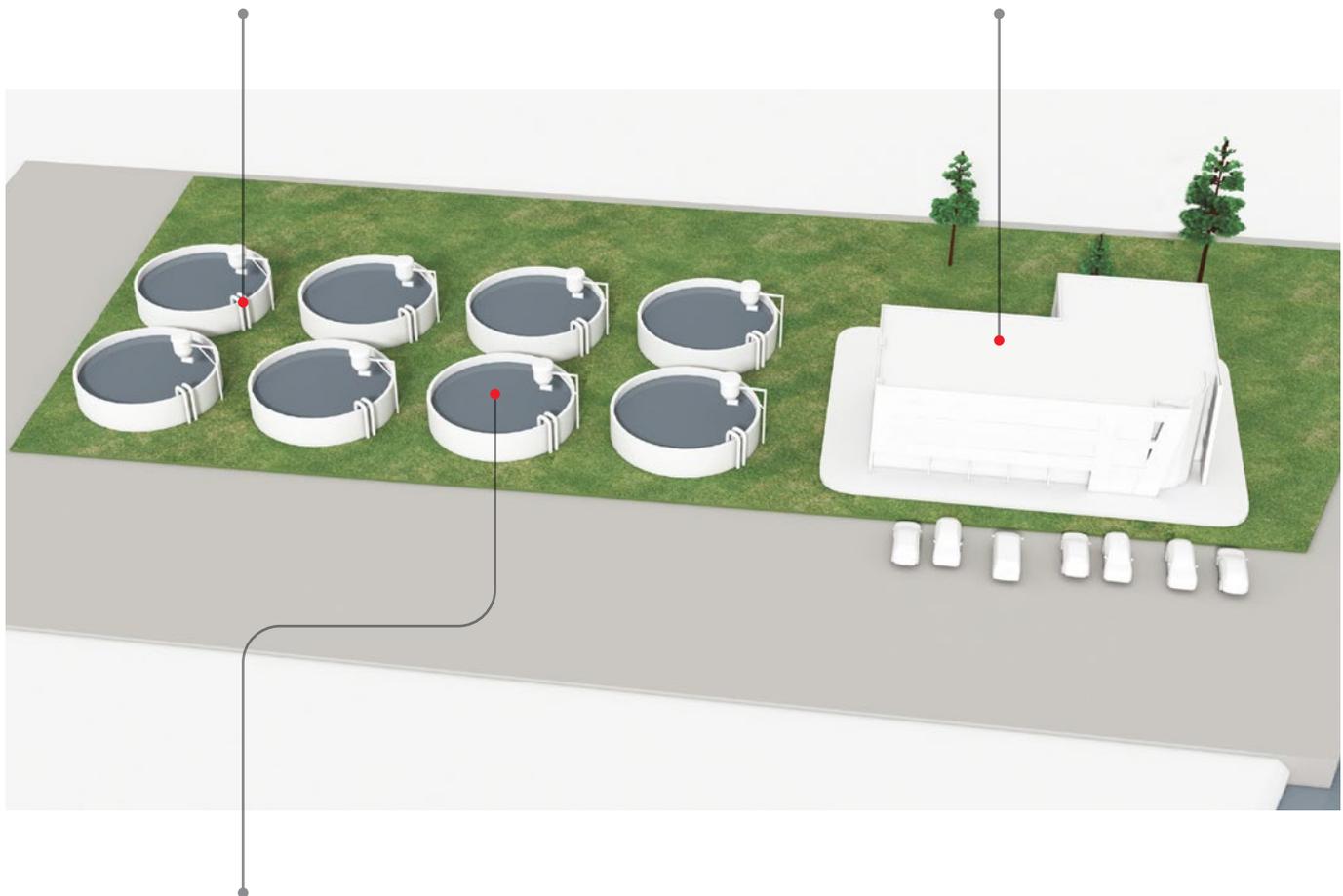
- Pumps

2 RECIRCULATION AND RETURN

Recirculated aquaculture systems involve process wastewater being cleaned and recirculated as much as possible. Excess wastewater and waste organic materials are returned to the environment.

Drive and motor applications

- Pumps
- Aerators
- Filters
- Sludgehandling



3 BREEDING

Fish are grown in freshwater tanks and fed every 1 or 2 hours to ensure optimal growth and health with minimum mortality.

Drive and motor applications

- Pumps
- Aerators
- Filters

Egg/young fish development and smoltification

Close monitoring and careful control of water quality and temperature is vital to ensure the best possible yield. Pumps and temperature control are typically the largest energy users in a smolt facility, and so improving efficiency can have a dramatic impact on profitability and environmental footprint, while helping to create better, more consistent conditions for farming.

1 EGG INTRODUCTION

Eggs, or fish laying them, are introduced into a small pond. Upwards of a million eggs may be introduced in a single cycle, and kept under carefully controlled conditions.

Drive and motor applications

- Pumps

2 ENVIRONMENTAL CONTROL

Air and water temperature are controlled to facilitate optimum growth rate for fish. This includes cooling/heating of circulated water, and also a HVAC system for the building.

Drive and motor applications

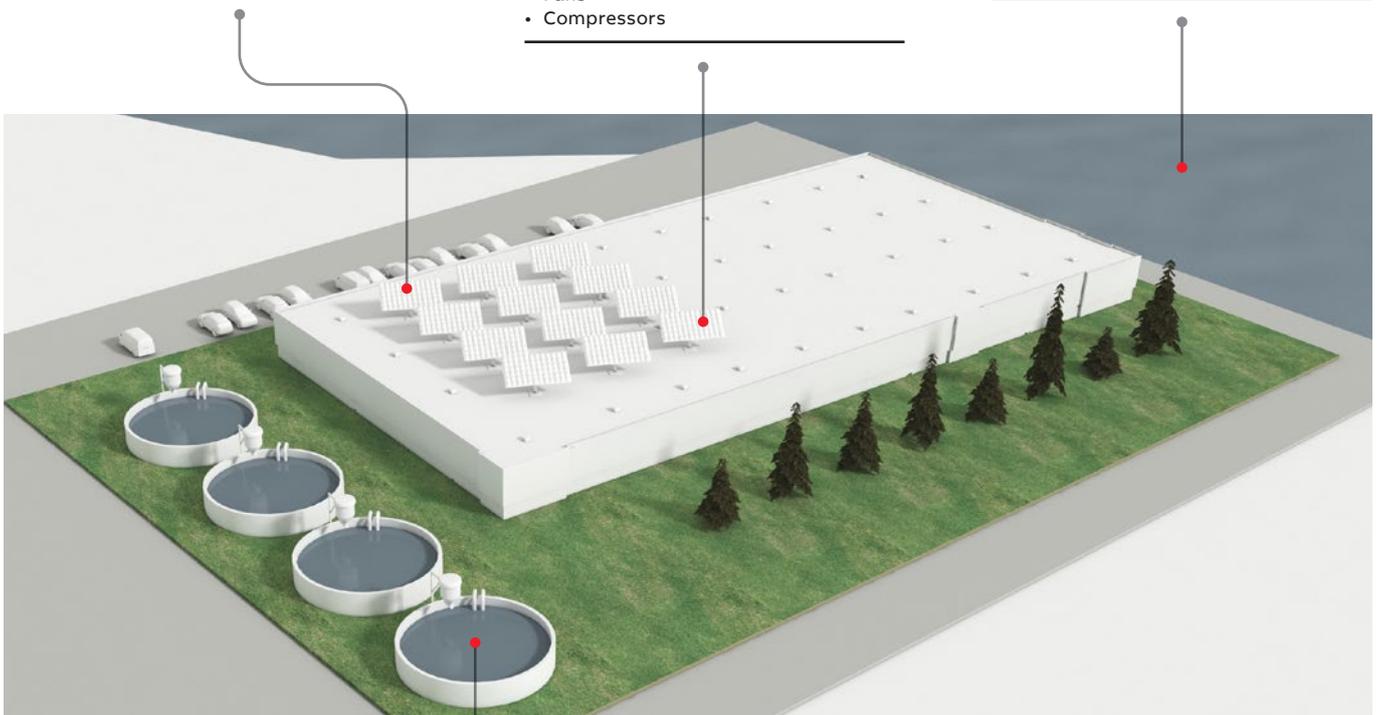
- Pumps
- Fans
- Compressors

3 RELEASE

Once fish have grown sufficiently, they are released into sea nets (see page 8) or freshwater ponds where they can continue growth.

Drive and motor applications

- Pumps
- Conveyors



4 FEEDING

Fish are fed from hatching until they reach 3-5 cm, at which point they are released into the next stage of farming. Fish may be kept in outdoor ponds or indoor facilities.

Drive and motor applications

- Pumps
- Compressors
- Blowers

Onshore fish farm

High startup costs mean that operating expenditure must be tightly controlled to optimize profitability. Careful control must be exerted over dosing to reduce the risk of residual pollutants entering the food chain, while NO_x and O_2 levels must be precisely controlled to ensure optimal conditions for growth.

1 WATER TREATMENT AND RECIRCULATION

Process wastewater is treated and reused, with stages including grit removal, solids disposal, screening, chemical dosing, sedimentation and aeration. This process uses 5-10 percent of water compared to conventional fish farms.

Drive and motor applications

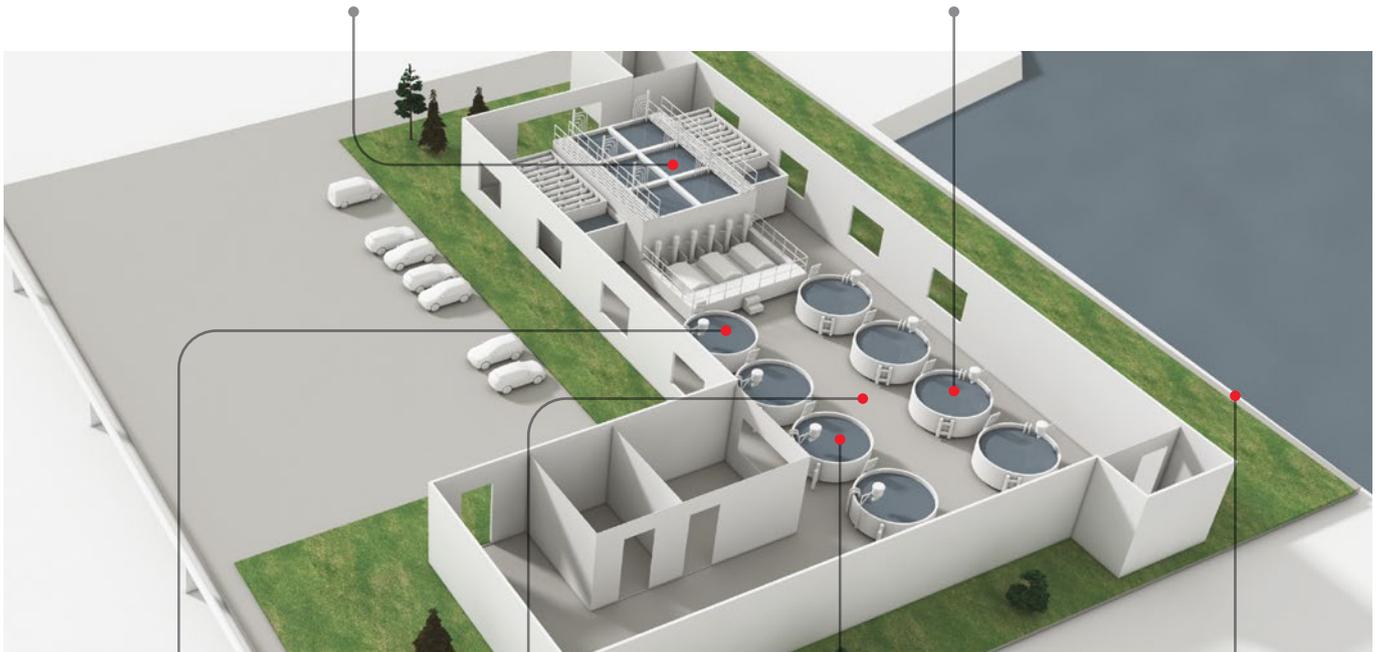
- Screw conveyor
- Scrubbers, filters
- Pumps
- Bar screen
- Digester
- Blowers
- Sludge handling

2 BREEDING

Conditions are carefully controlled to manage variables such as water temperature and pH content to allow the breeding of different species, and create perfect conditions for fish to thrive. Feed is regularly provided, while medicine may be introduced to prevent disease.

Drive and motor applications

- Pumps
- Fans



3 HARVESTING

Fish are cleaned and harvested ready for processing.

Drive and motor applications

- Pumps
- Conveyors

4 ENVIRONMENTAL CONTROL

Air and water temperature are controlled to facilitate optimum growth rate for fish. This includes cooling/heating of circulated water, and also a HVAC system for the building.

Drive and motor applications

- Pumps
- Fans
- Compressors

5 COOLING

Water temperature is carefully controlled to provide optimal conditions for growth of fish.

Drive and motor applications

- Pumps
- Compressors

6 INLET

Water is taken from the sea, and artificially managed to provide optimal growth conditions for particular species.

Drive and motor applications

- Pumps
- Compressors

Close-to-shore (CTS) fish farm

Reliability and 24/7 operation are critical to ensure a steady farming environment in all conditions, while compensating for external factors such as day/night cycles and weather. Fish can take several years to mature, and so any lost production can be extremely costly.

1 HARVESTING

Mature fish are pumped out of the cage and into a vessel, and then transported to a processing facility.

Drive and motor applications

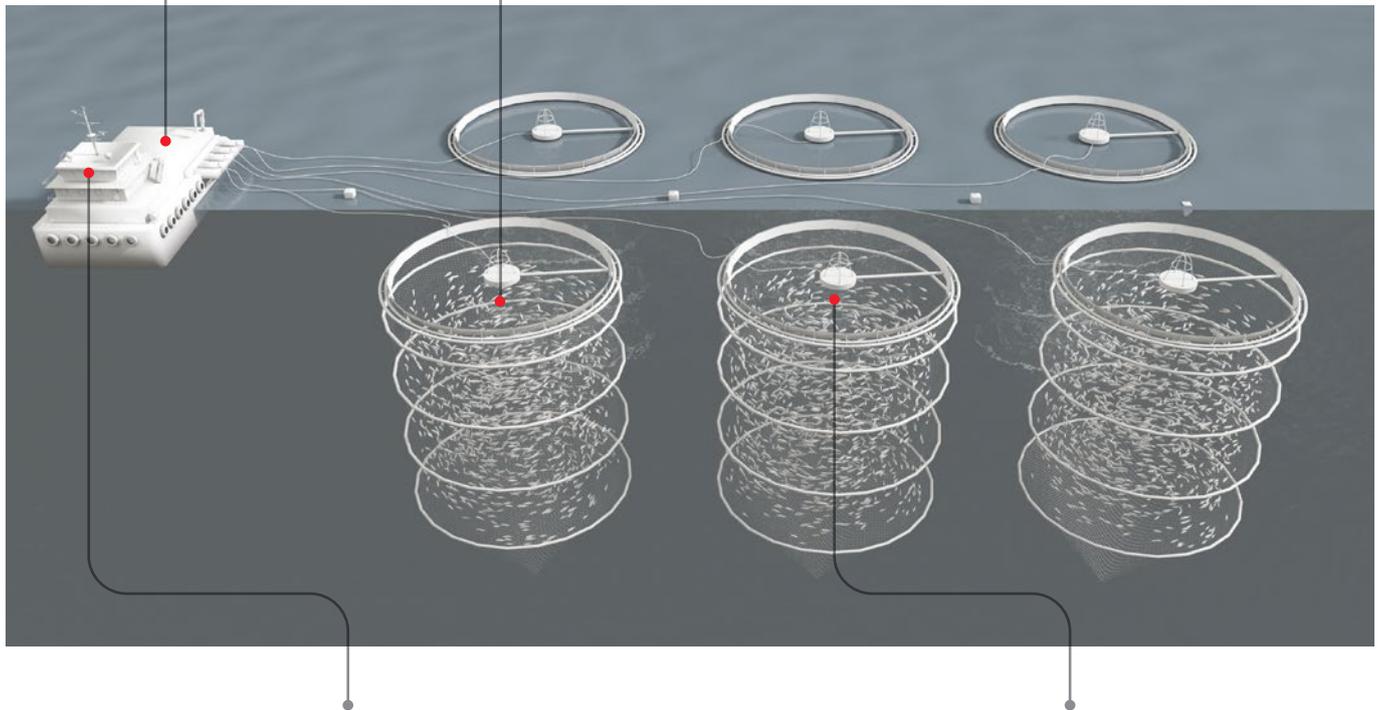
- Pumps

2 SEA NET

Fish are pumped into a cage structure, situated close to the shore to provide protection from weather and tides, as well as oceanic predators. Reliability and redundancy in the event of failures are both critical to ensure uptime.

Drive and motor applications

- Pumps



3 REMOTE MONITORING

Digital technologies provide 24/7 visibility and control over processes, allowing conditions to be monitored and constantly optimized. Smart sensors can transmit condition and performance data in near real-time, providing operators with enhanced insight into equipment efficiency and maintenance requirements.

Smart sensor applications

- Motors
- Pumps
- Bearings

4 FEEDING

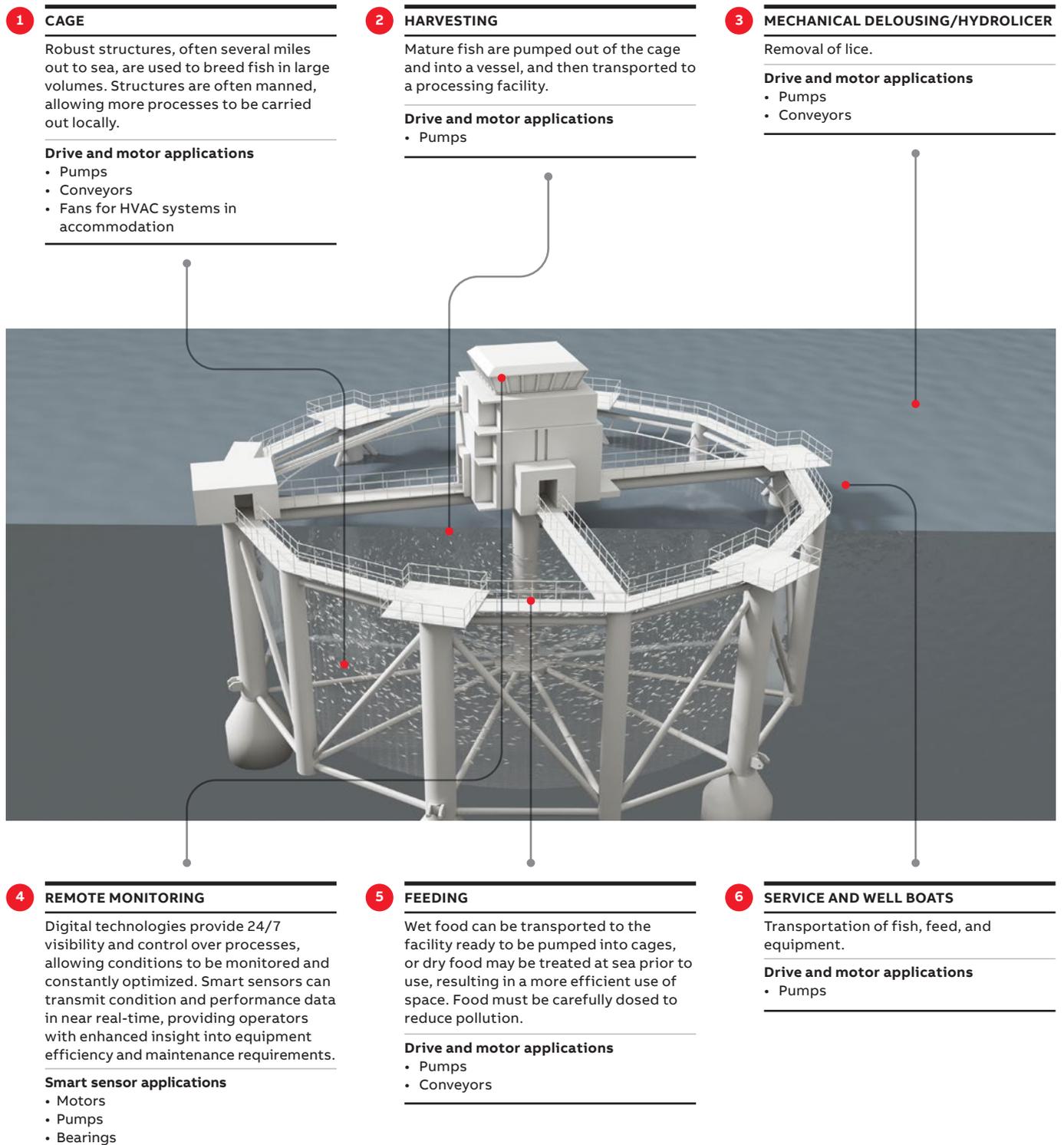
Feed is pumped into the cage from a boat. Feed must be carefully dosed to prevent excess from dropping to the seabed and creating pollution. O₂ levels are measured at the surface and at the bottom of the cage to help limit environmental impact.

Drive and motor applications

- Pumps

Offshore fish farm (high sea)

Saltwater is corrosive to machinery, creating a difficult operating environment for motors and pump equipment, and accessing maintenance resources at sea can be a challenge. Offshore fish farming has high start-up and operational costs, and so efficiency and productivity must be maximized to ensure profitability.



Unlock the potential in aquaculture applications

Alongside energy saving, improved productivity and reduced maintenance requirements, 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
 Aerators	<ul style="list-style-type: none"> • Good ventilation systems are required for aeration 	VSDs/VFDs offer: <ul style="list-style-type: none"> • Ease of use when equalizing pressures • Low energy consumption • Long service life 	<ul style="list-style-type: none"> • Longer interval between maintenance
	<ul style="list-style-type: none"> • Remote location of facilities can lead to poor quality mains supply causing interruption or breakdown, and generating harmonics 	<ul style="list-style-type: none"> • Power loss ride-through function is used if incoming supply voltage is cut off • VSD/VFD continues to operate using kinetic energy of rotating motor 	<ul style="list-style-type: none"> • Boosts reliability of fans ensuring feed is not spoiled
 Compressors (air and cooling)	<ul style="list-style-type: none"> • Right amount of oxygen 	<ul style="list-style-type: none"> • Variable speed drive provides accurate oxygen level control 	<ul style="list-style-type: none"> • Better generator stability • Increased efficiency • Easy link to process control system • Exact amount of oxygen • Reduced foaming
	<ul style="list-style-type: none"> • Coding/compressors are one of the biggest single energy consumers and therefore rely on energy efficient components 	<ul style="list-style-type: none"> • SynRM motor-drive: provides energy savings to IE5 standard 	<ul style="list-style-type: none"> • Between 20 to 60 percent energy savings across speed range
	<ul style="list-style-type: none"> • Ensuring ultimate reliability of compressor operation 	<ul style="list-style-type: none"> • Softstarters: suitable for motors running at full speed • Drives: extend speed range of compressor 	<ul style="list-style-type: none"> • Avoids wear and tear to mechanical parts, ensuring uptime
	<ul style="list-style-type: none"> • Poor quality power networks and remote locations can generate harmonics 	<ul style="list-style-type: none"> • ULH drive ensures very-low harmonic level in supply network 	<ul style="list-style-type: none"> • Harmonics can be reduced to below three percent • Genuine unity power factor with no compensation needed • Less risk of equipment downtime or erratic equipment behavior
 Conveyors (screw, air, etc)	<ul style="list-style-type: none"> • Precise, smooth and consistent control and synchronization of conveyor speeds 	<ul style="list-style-type: none"> • Drives: Built-in brake chopper provides precise control of conveyor deceleration rate(s), without external hardware • Safe torque off (SIL 3) prevents unexpected movement of conveyor 	<ul style="list-style-type: none"> • Each conveyor speed adjusted separately and synchronized to ensure material flow between process stages • Goods arrive in time and undamaged
	<ul style="list-style-type: none"> • Motor control centers are located remotely from conveyor, incurring costly, long motor cables 	<ul style="list-style-type: none"> • Robust IP55/65 motor and VSD/VFD package located close to motor 	<ul style="list-style-type: none"> • Reduced cable costs and lower risk of EMC disturbance
 Hammermills	<ul style="list-style-type: none"> • High overloads during start and throughout operation 	<ul style="list-style-type: none"> • Soft starting and reversing, smoothed high torque peaks, easy speed adjustment and change of direction 	<ul style="list-style-type: none"> • Speed adjusted according to load, improved reliability and prolonged hammermill lifetime
	<ul style="list-style-type: none"> • Connect load to mains while still rotating 	<ul style="list-style-type: none"> • Flying start used when a motor is connected to a flywheel or a high inertia load • VSD/VFD started with a reduced voltage and then synchronized to the rotating rotor • Once synchronized, voltage and speed are increased to corresponding levels 	<ul style="list-style-type: none"> • Reduces start-up times and reduces wear on equipment



	Challenge	Solution	Benefit	
	Pellet press/ extruder	<ul style="list-style-type: none"> • High starting torque and precise control within same batch is often needed to ensure best quality and consistency from raw material • High torque application creates safety risk • Pelletizing dough is costly and demands accurate dosing to avoid waste 	<ul style="list-style-type: none"> • Direct torque control provides accurate speed and torque control and adapts to batch or continuous control of application • Safe Torque Off (STO) brings motor to a complete, safe stop when activated • PID control provides constant feedback loop so the motor always operates at correct speed, while automatically compensating for external factors • Prevents conveyor drift 	<ul style="list-style-type: none"> • Improved accuracy increases productivity, saves energy and improves safety • Improves operational safety • Reduced wastage leads to improved profitability
	Pumps	<ul style="list-style-type: none"> • Different day/ night feeding and welfare patterns means water supply varies throughout day. • Direct on-line starting creates pressure shocks that damage pumps, seals, pipe joints and valves • High cost to repair pump motor's located at remote sites • Sea salt, plankton and cavitation impact lifetime of impeller • No feedback in the event of equipment failure 	<ul style="list-style-type: none"> • Built-in PID control and automatic sleep mode regulates pressure. Multipump control function ensures pumps operate to actual demand • Soft start of motor reduces stress on water and electrical network • Intelligent drives and smart sensors enable remote control and monitoring of pumps • Drive software detects and prevents cavitation • Stainless steel motors can last five times longer than conventional motors • Fieldbus modules provide online feedback and remote control 24/7 • Smart sensors provide constant system feedback 	<ul style="list-style-type: none"> • Increases lifetime of pump and saves energy • Fast response to changing demand • Reduced water hammer and other mechanical stress • Avoids pipe burst • Increased equipment lifetime • Anticipate operating lifetime of pumps • Reduce travel costs • Allows for planned maintenance • Motors require replacing less frequently • Automating aquaculture processes allows 24/7 control and monitoring during normal operation and fault situations



Features and functions benefiting aquaculture production

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 CO₂ emissions

Communication

- Use information such as flow rates 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 fish farm monitoring systems

Ingress protection

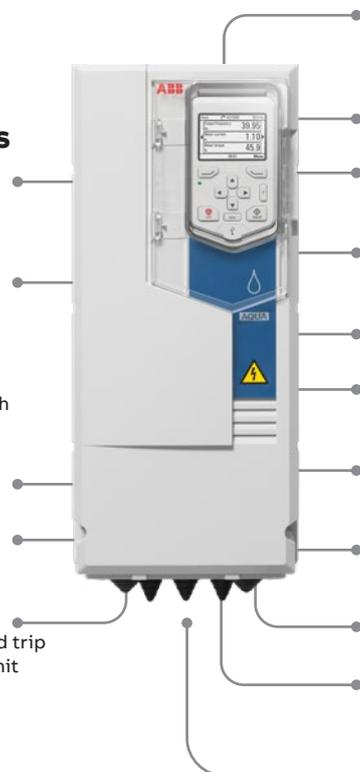
- IP55 for washdown zones

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 consumption rates

Sleep boost

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

3C3 conformal coating

- Protects sensitive electronics against H₂S

Anti-cavitation

- Extend the lifetime of the pump and pipes by detecting and mitigating cavitation



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

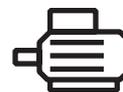
- Motor preheat ensures a dry and warm motor, prolonging pump life and increasing uptime
- Coated boards and IP66 / UL Type 4x externally mounted keypads for harsh conditions

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



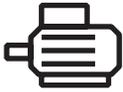
Drive and motor packages

Synchronous reluctance motor (SynRM) and drive

- Save energy across the aquaculture production process with IE5 synchronous reluctance motors and drive packages

Globally certified drives and motors packages

- Protect plant and people and conform to global regulations using tested and certified motors and drives for hazardous environments



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



Stainless steel motors

- IP69 stainless steel motor ensures suitability for aggressive, clean in place washdown procedures



Programmable logic controllers (PLCs)

- Comprehensive range of scalable PLCs, I/Os and robust HMI control panels delivering performance, quality and reliability
- 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 fulfilling the needs of tomorrow
- IIoT gateway functionality onboard the PLCs and control panels offer secure connection to cloud
- Hot swap I/O for continued operation, during maintenance or replacement of an I/O-module
- High availability of AC500 HA prevents downtime and enhances system availability
- AC500-XC for eXtreme Condition (extended ambient temperature, corrosive gases and humidity)



From the factory floor to the cloud and beyond

Intelligent powertrain

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

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.

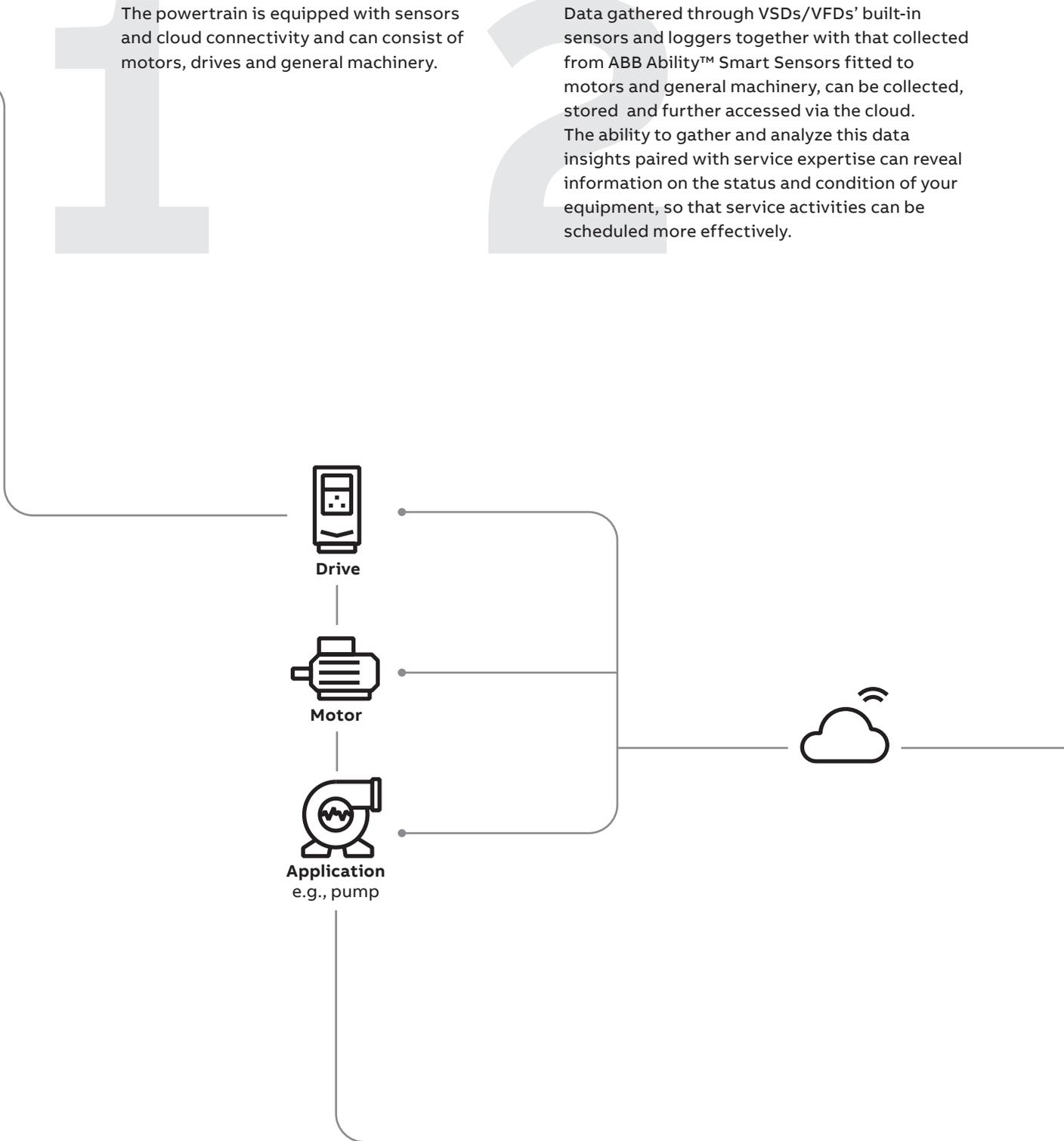


ABB Ability™ Condition Monitoring for powertrains optimizes the performance and efficiency of electric motor-driven rotating equipment. It enables better decision making by providing real-time access to data on all parameters for drives, motors and general machinery.

Accessing data for analytics

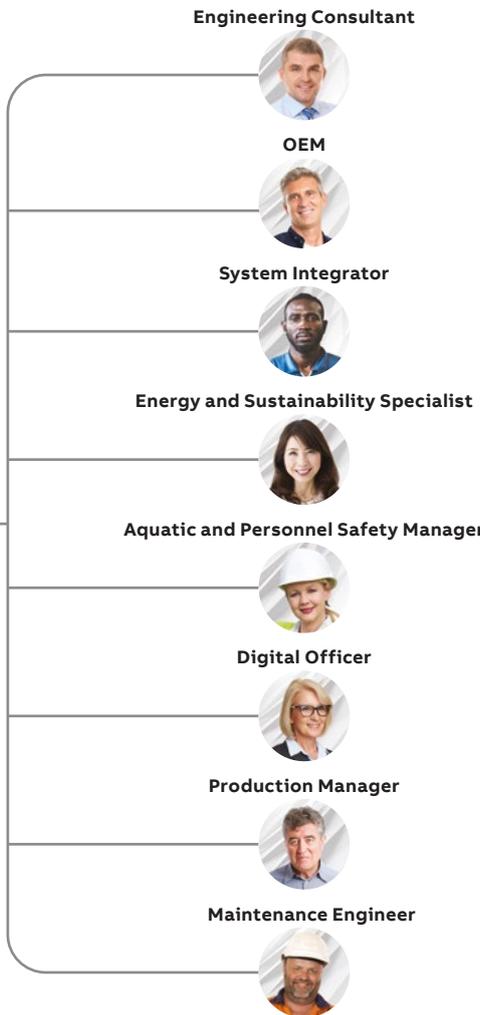
Detailed information can be extracted into a company’s portal and systems. Information on many aspects of the aquaculture process is available, including the ability to know exactly when and how production equipment was cleaned. Detailed dashboards give full transparency so that you can take actions 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 aquaculture 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.

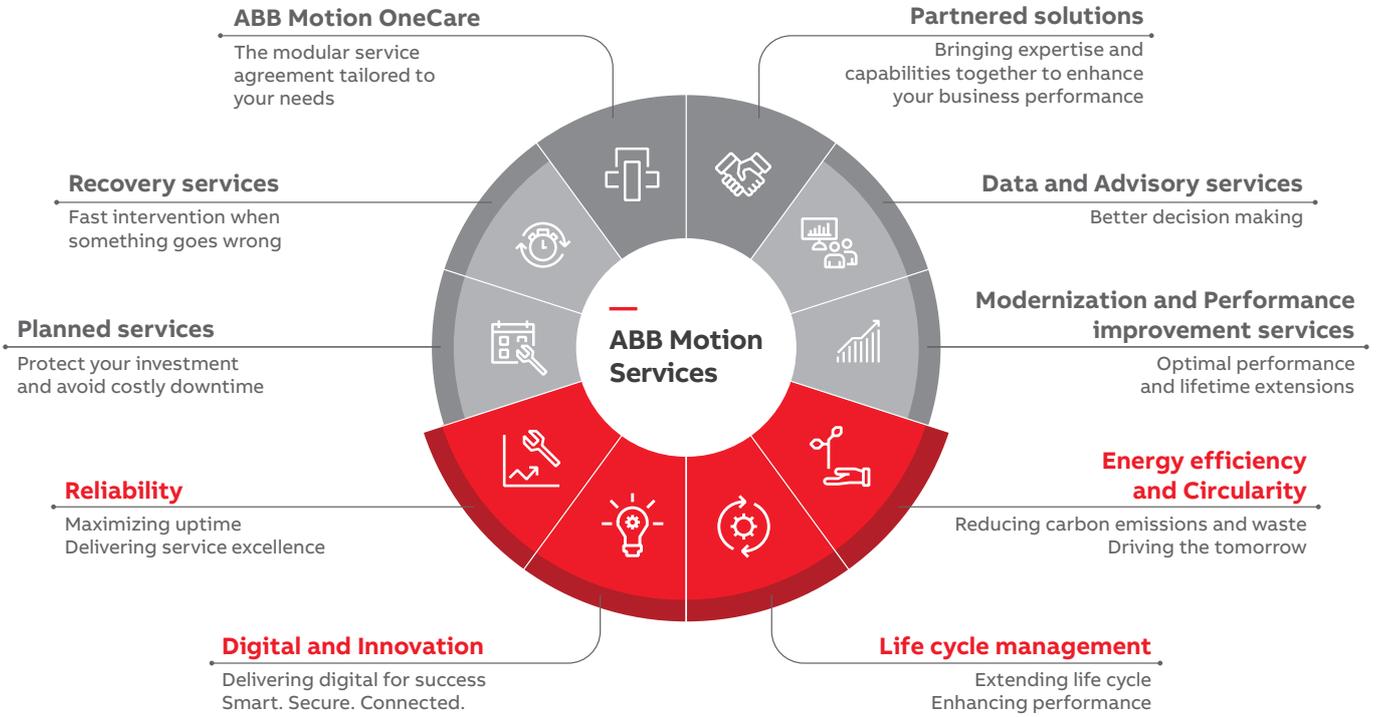
With a service offering tailored to your needs, ABB Motion Services maximizes the uptime and extends the life cycle of your electrical motion solutions, while optimizing their performance and maximizing your energy efficiency gains throughout the entire lifetime of your applications. We help to keep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

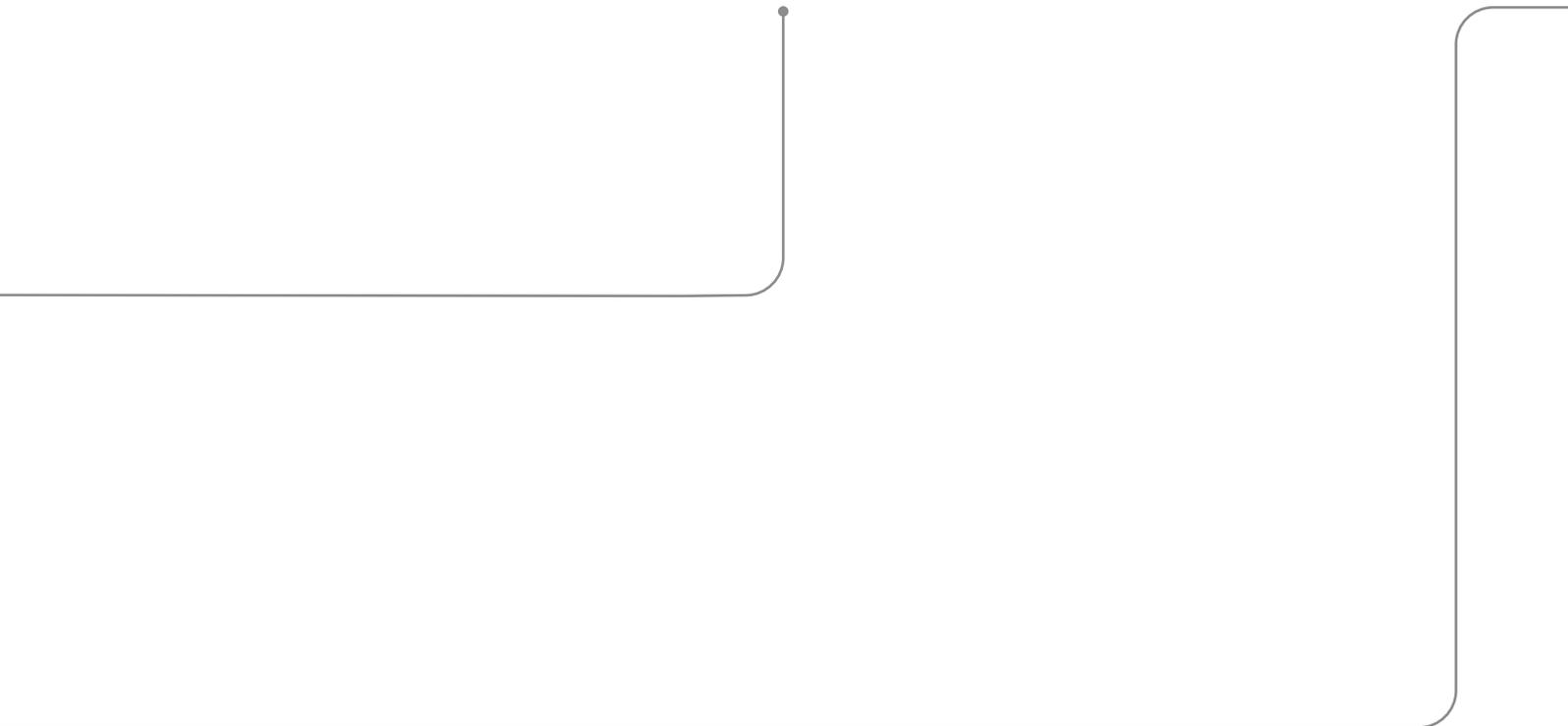
We quickly respond to your service needs. Together with our partners, local field service experts, and service workshop networks, we provide and install original spare parts to help resolve any issues and minimize the impact of unexpected disruptions.

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.





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 aquaculture 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
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