SAARS WEBINAR EVENT DEC 7 2021

Condition Monitoring for Motors and Powertrain

An introduction

Teijo Kärnä Product Manager Digital Solutions Motors and Drives

Taking reliability, availability and efficiency to the next level

The challenges of maintenance operations in the age of Industry 4.0

Reliability

"We want to minimize unexpected shutdowns and maintain reliability"

- Understand **actual conditions** of assets
- Assess the **risk exposure** to unplanned downtime

Asset lifespan and availability

"We want to understand and solve problems earlier and faster"

- Access **historic data** and **benchmarks** to optimize conditions
- **Receive alerts** and **predictive analytics** to maintain performance
- **Receive expert advice** and **collaboration** at a click

Limited resources

"We need to optimize our limited resources"

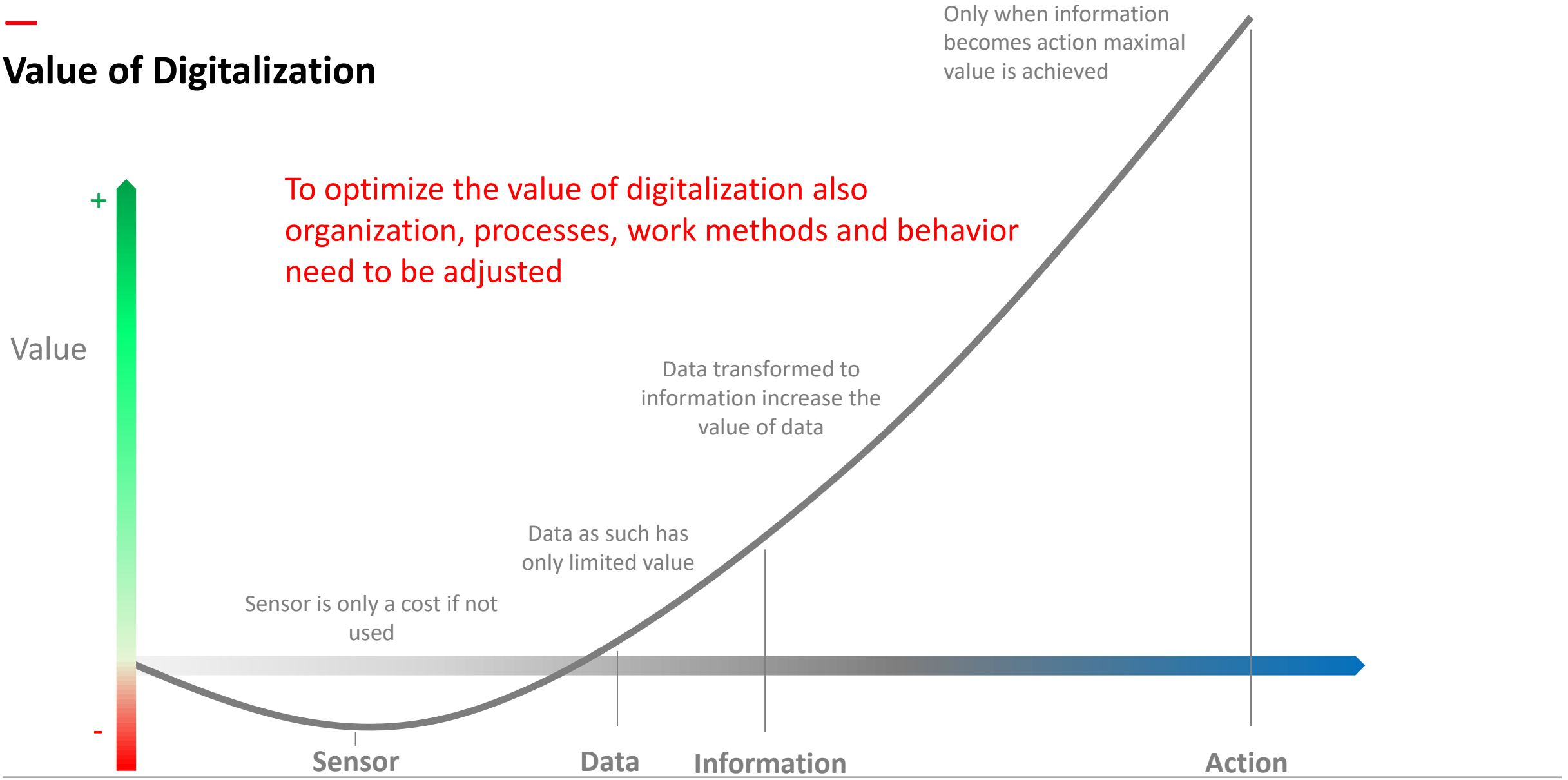
- Monitor drives in **remote** or **restricted locations**
- **Focus maintenance** on **actual requirements**
- **Avoid** global technical **skills shortages**

"The new normal"

"The global situation has changed and we need to implement remote working as common practice to maintain safety and success of our business"

- Improve **health** and **safety**
- Ensure **maintenance and productivity**
- Secure **business continuity** in adverse environment

Value of Digitalization



An Introduction to Condition Monitoring for Motors and Drives

Why monitor conditions of assets ?

Lessons from a real case in the United Kingdom (Motor at a Pumping station)

Imagine that you have a powertrain in dry well with restricted access

Without sensor

Nobody ever goes near the assets.

When something fail, you you will be surprised, then…

- Pull the spare asset out of your warehouse
- Find an electrician and beg them to come
- Get lifting gear in place

It will take at least a day to replace, even if you have a spare on stock.

Time and cost can easily spiral out of control.

With Condition Monitoring

Nobody ever goes near the assets

But customer will get a warning before anything has happened, then …

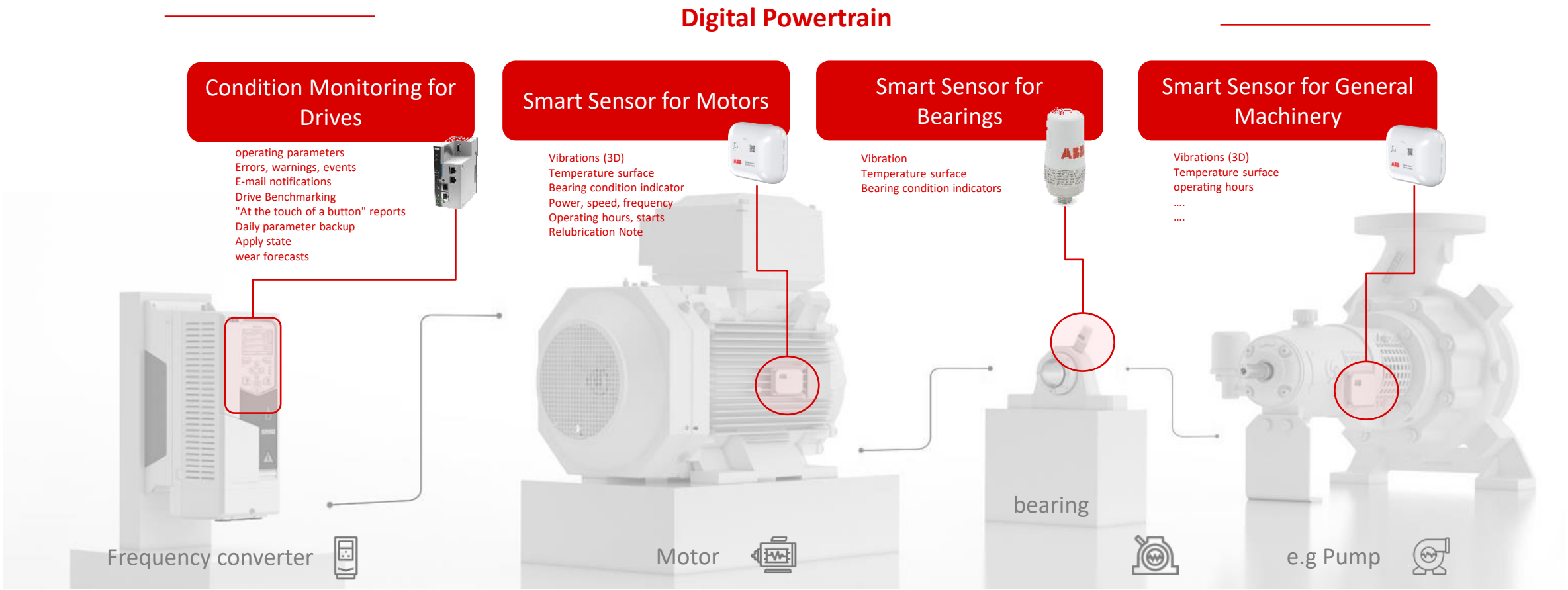
- Order a new asset / spare parts
- Plan an intervention.
- Planned engineer visit comes spare
- Run down and run up in an orderly fashion

Without a spare asset on stock, without an electrician on standby.

Allows UK water industry to move from “run to fail” to “proactive maintenance”

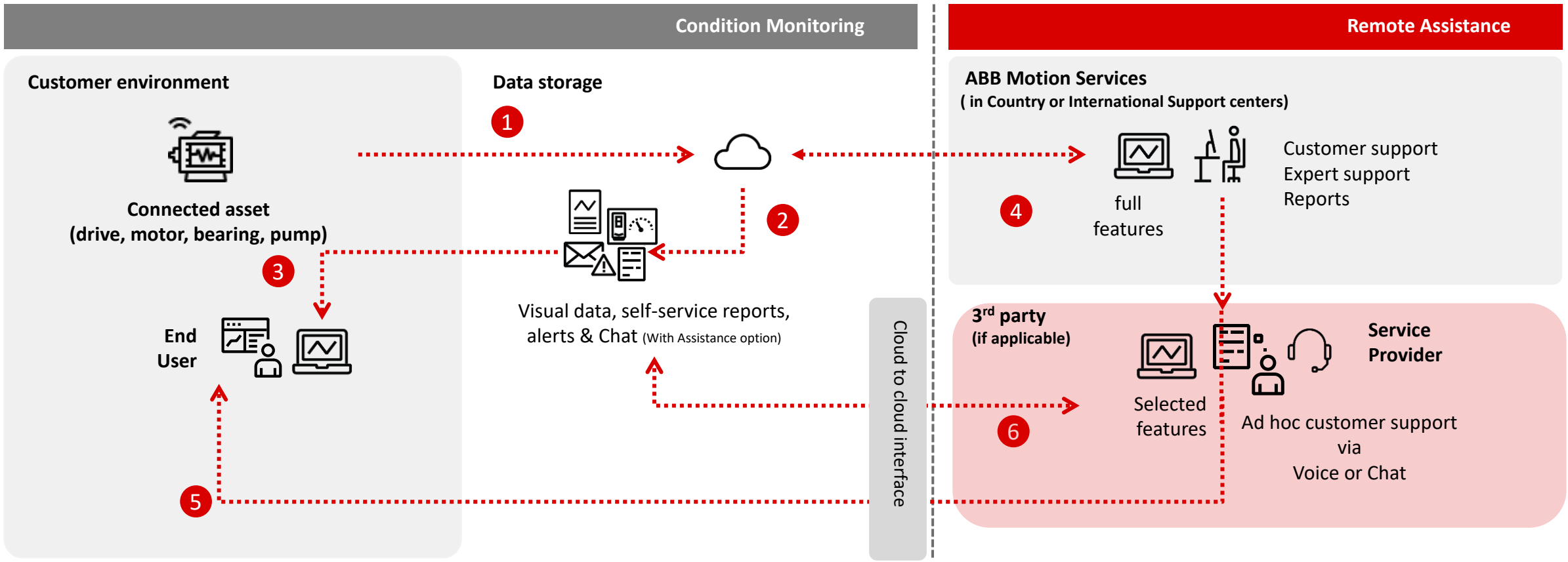
Extending to the Powertrain

Motors, drives, bearings and rotating equipment in same UI



Condition Monitoring Digital Powertrain

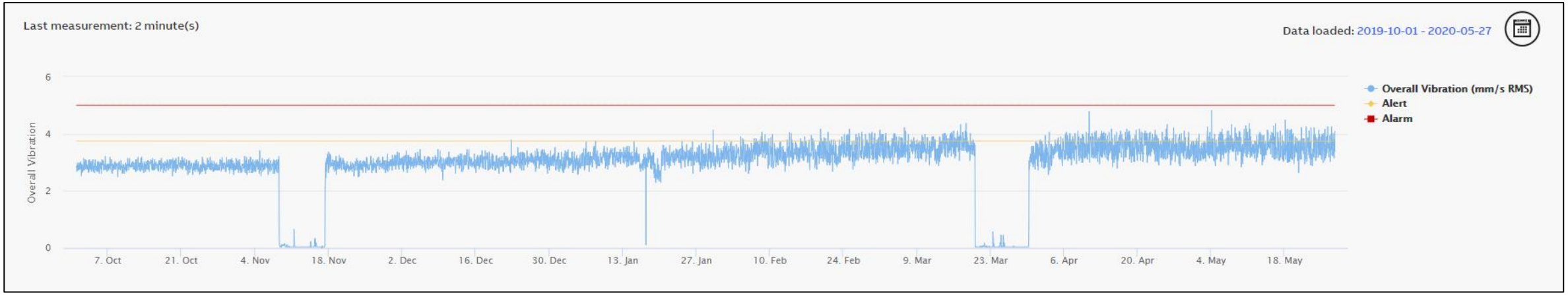
Service architecture in a nutshell



Customer Case– 2020-05-27

Food and Beverage – Vibrations alarm

Measuring once an hour gives us the advantage of clearly seeing a development over a longer period of time, even if it is not large.



What happened:

- The sensor alerted the customer for increased vibrations. Clearly increasing trend that can be seen over a long period.

Action:

- The customer contacted ABB to make an on-site measurement with a hand-held vibration instrument

Consequences and risks:

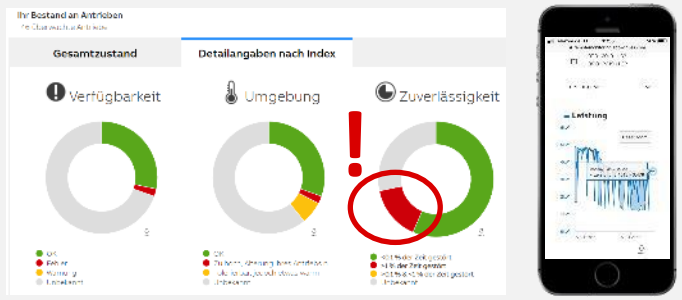
- An upward trend in this way will put more stress on the machine components over time. Which will lead to more damage and to that a greater effort may be needed.

Food & Beverage customer - $4,000 per hour downtime
(12 hours downtime common to clean work in progress)

What value does the service deliver ?

Peace of mind, health and safety, risk management, optimized maintenance….

Remote Maintenance management



Web and mobile access with status overview

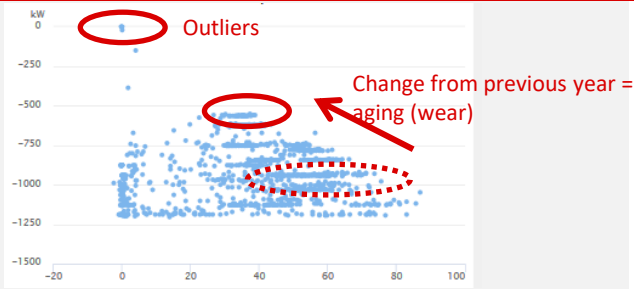
Convenience

Analysis reports with maintenance recommendations *

Proactive & predictive Maintenance

Historian and trends + asset comparisons

Optimized maintenance



Analysis of outliers and anomalies

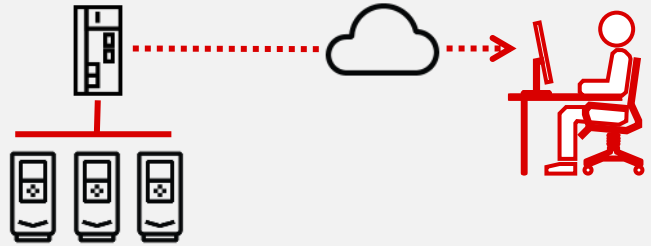
Faster response & protection

Your asset is talking

- Errors, warnings, events
- operating limits
- Individual threshold values
- parameter changes
- Remote connection aborted

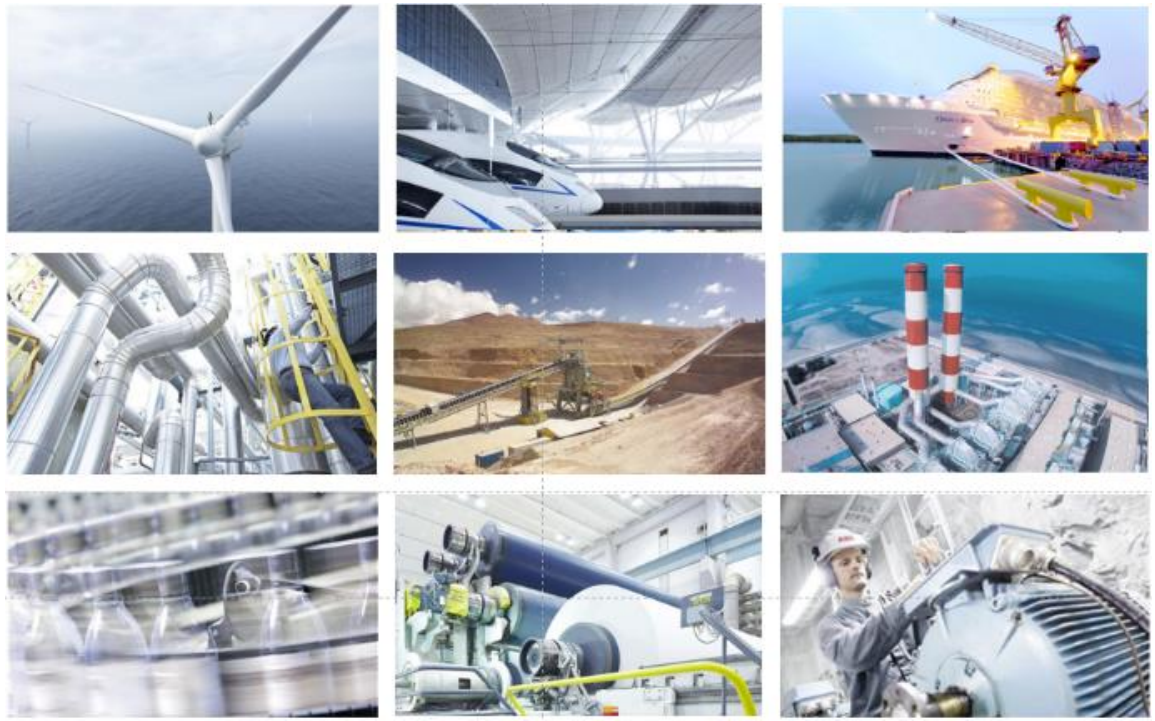
Automatic email notifications

Peace of mind



On-call expertise - your partner ABB

Values of the Digital Powertrain



- **Manage and minimize risks.** Prevent plant downtimes, improve occupational safety, resolve warranty claims and avoid penalties for delays.
- **Eliminate inefficiencies.** Save energy, reduce labour cost, use resources efficiently, manage lack of skills and generational gaps. Optimize along the value-added chain, what to purchase, how to use, when to replace.
- **Optimize investments**. Accurately engineered plants requiring less redundancies and fewer spare parts and run longer.
- **User experience.** Offer people a more satisfying way to do things. Flexible configurable functionality, easily scalable fleets, pay-per-use. Easy to use, easy to share.
- **Disruption/Defence.** Attack competitors by doing things in a different way with less risk, higher efficiency and better user experience. Alternatively, defend against someone doing it to you.

Customer benefits

How does ABB Ability Condition Monitoring for Motor and Powertrain help your business ?

ABB Ability Condition Monitoring can help to...

- **Reduce downtime by as much as 90%**[1]
  - Service or replace an asset before they break down
  - Shift unplanned maintenance to planned outages
- **Extend asset lifetime by up to 30%** [2]
  - Avoid asset failures by timely servicing
  - Prevent secondary damage by avoiding breakdowns
- **Increase energy efficiency by around 10%** [3]
  - Create better loading profiles based on energy consumption patterns
  - Rationalize the installed base
- **Net working capital** – less redundant plant and inventory.
- **Risk mitigation** – Operational risks, health and safety risks etc.

"When we reduce 2 unexpected downtime, the monitoring has paid for itself" - ***Pulp & Paper***

"We have reduced unplanned downtime by a further 20 hours a year" , Mining

"I have reduced asset inspection by 66%" , Chemical

Overall, reduced operation costs, increased profits, fewer accidents, greater compliance to environmental commitments and improved reputation!
Our customers have seen the results: **payback within months, sometimes within weeks !**

(1) As part of complete care package , vs a "run to fail" strategy, reported by a customer in Australia
(2) Thanks to compliance to maintenance program and proactive action; Smart sensor client, UK;
(3) Measure and recommendations about energy usage, Smart sensor and condition monitoring client, NL.

Energy Efficiency and Digitalization

Use long term data to uncover hidden opportunities

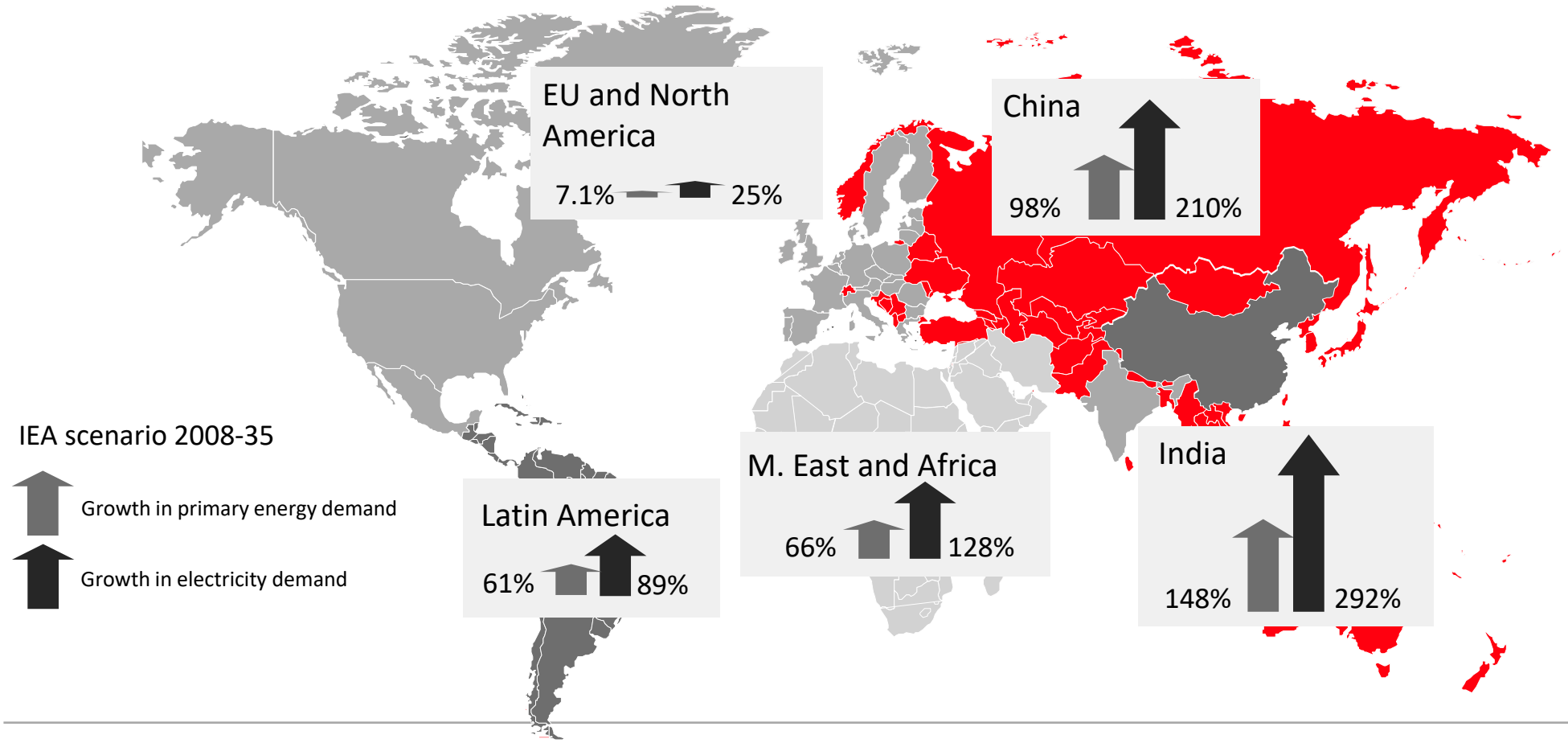
The world keeps evolving…

Change your horizon

… discover the hidden

The Facts

Rising demand



Why motor and drive effectiveness matters?

Keeping the world turning, while saving energy every day

Managing electric energy consumption

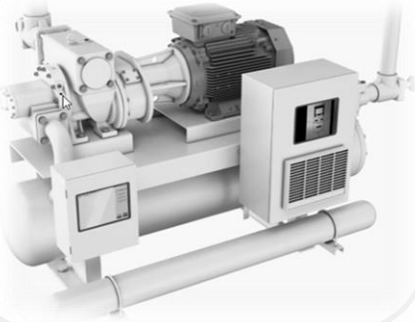
38% by motors in commercial buildings

70% by motor systems in industrial applications

75% of motors used for pumps, fans, and compressors with substantial efficiency improvement potential

25% power reduction when adding a variable speed drive to an existing motor of a pump, fan or compressor

Pump system



Managing assets across their entire life cycle

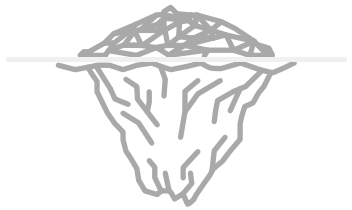
Total Cost of Ownership (TCO) = **Capital expenditure (CAPEX)**
- Plan & design
- Procure & build
- Commission

\+ **Operational expenditure (OPEX)**
- Operate
- Maintain & modernize
- Decommission

Energy efficiency, a key to succeed in the future…

Paris agreement and UN's sustainable goals target **carbon neutrality**

With optimized, high-efficient rotating equipment **global electricity consumption** could be **reduced by up to 10 percent**



Known, regulated and visible

Hidden potential

Improving the efficiency of a 11kW motor by **3%** will reduce CO2 emissions by **15.9 tons** over 10 years

…technology is available to improve the efficiency

Fix speed

IE1, IE2 → 2%..4% → IE3 → 2%..4% → IE5

10%..70%

Variable speed

+ VSD → 1%..3% → IE3 + VSD → 2%..6% → IE5 + VSD

Solutions are available

ABB Energy Appraisal service

Revealing how much energy you can save and where

Are you wasting energy but you don’t know where to start?

Energy Appraisal service

Traditional method

Walk The Site

- Visual review of installed applications
- You and an ABB-certified engineer walk the site
- Identify a pool of opportunities and target applications

Monitoring, data collection

- Learn more
- Identify target pump, fan and compressor applications
- Collect necessary data from motors, used control methods and site conditions

Data analysis

- An ABB-certified engineer analyzes the data.
- Evaluation of potential savings per application
- Prioritize and report on the opportunity pool based on payback and risks

Recommendations

- We provide an estimate of saving potential, payback time for investment, CO_2 reduction, etc.
- We will prepare an action plan and manage the implementation, if desired

Two Key Areas to assess motor energy saving potential

Motors running variable torque loads (pumps & fans)

About 90% of pumps and fans are oversized and running on partial loads.

– These are the target applications to achieve significant energy savings.

– Using the affinity laws, it is easy to calculate the power needed to run the motor at a certain speed.

Example: A pump or fan running at 80% speed consumes as little as 50% of the energy of one running at full speed.

Old Motors with poor Efficiency

By making the decision to use energy efficient motors, you can lower your energy costs and have a positive effect on the environment. ABB's energy efficient motors are designed and labeled to comply with the international IEC standards.

Depending on the application, the achieved efficiency improvement can be significant when the old motor is upgraded to a new one. Remember to follow the local MEPS.

ABB provides easy tools to assess benefits and payback times for changing to new modern motor technology.

The default assumption is, that the motor dimensioning is correctly done.
These assessments are focused on finding the optimal devices for the chosen task,
not to analyze what the task is (process or system)

Energy Efficiency end Digitalization

Use long term data to uncover hidden opportunities

Two Key Areas to assess motor insights with digitalization

Recognize the long-term trends

Minimize inefficiencies of your assets

- Condition monitoring of Motors and Drives in same User Interface
- Condition Monitoring and Condition Based Maintenance recommendations.
- Alarms and alerts
- Reports
- Expert & support Services

Discover hidden opportunities

Earlier it has been too cumbersome and expensive to measure smaller motor real operation and performance.

With digitalization it is possible to not only to do condition monitoring but also power usage and operation.

With digitalization it is now possible to “uncover the hidden energy consumers“ in combination with Condition Monitoring

Digitalization enable energy efficiency and sustainability by improved life cycle management

**The default assumption is, that the motor dimensioning is correctly done.
However, trend data will show how motor is really operated
and possible improvements of motor dimensioning can be determined**

ABB Energy Efficiency enabled by Digitalization

1

You and an ABB-certified engineer plan a visit to your facility to get an understanding of the environment. Sensors to be mounted on selected assets. Collect general data during the visit and start collecting data

2

Data is collected during first 3 months period to verify current performance and operation based on long term usage data

3

ABB analyses your data utilizing our algorithms based on the data over measurement period

4

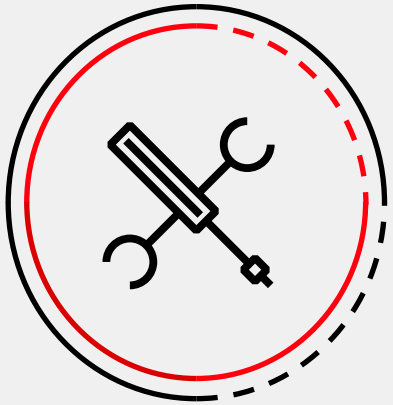
ABB expert will prepare an action plan and give recommendations about where the highest energy savings and best returns on investment can be achieved.

5

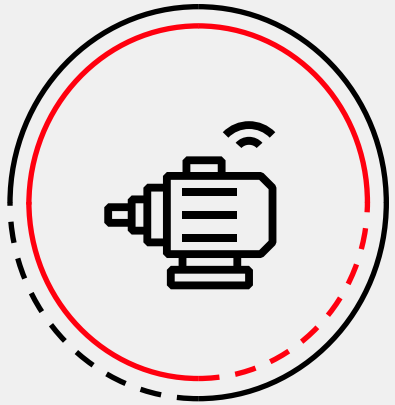
Modernize your fleet and continue to monitor performance and savings though out equipment lifetime

Energy Efficiency Insights

Combining digital solutions and ABB’s domain expertise



Plug & Play



Motor Agnostic

Domain Expertise

Energy Efficiency Insights

Based on real usage data

High level fleet overview

Fleet KPIs (i.e., heat map of the fleet, loading, efficiency, reactive Power, average consolidated Power usage on the fleet, average consolidated Energy consumption and fleet losses, Preliminary estimate of saving potential (kWh, CO2) etc.)

It provides a self-service overview of motors efficiency

Detailed asset overview

Asset Parameters and KPIs (i.e., Power Factor vs Load graph, Efficiency vs Load graph, graphical overview of % utilization and load profile, active power (kW), active Energy (kWh), Motor losses (kWh)

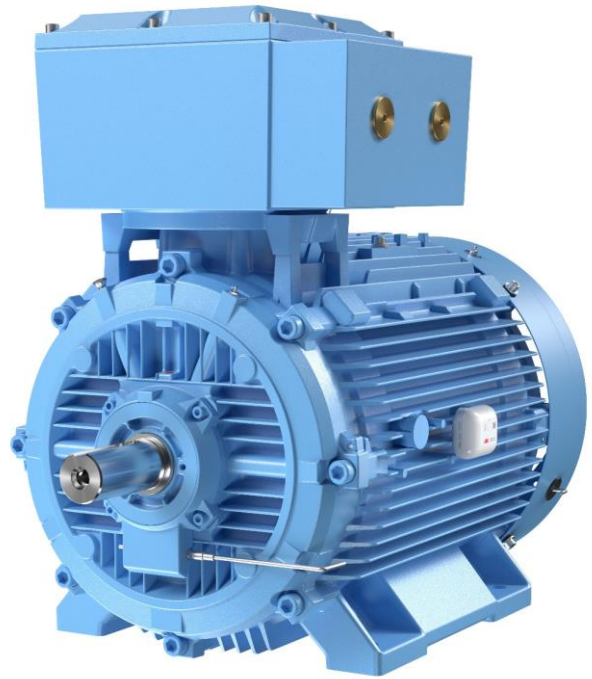
Analysis and recommendations by ABB experts
(i.e., savings potential (kWh, CO2, $), payback time, Upgrade proposal etc.)

ABB expert will support you to achieve higher efficiency through our latest ABB technologies

Motor Smart Sensor

Key Parameters

- Wireless communication
  - Bluetooth® 5.0, Bluetooth® Low Energy
- Certified for Hazardous areas
- Long battery life (up to 15 years)
- Ingress protection: IP66/67
- Superior sensors for dramatically better measurements
- Advanced algorithms to analyze equipment data



Example of a detailed Energy Efficiency Assessment Report

MOTION SERVICE

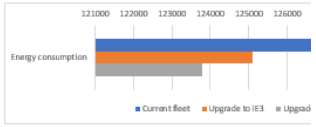
ABB Ability™ Digital Powertrain

Sustainability Report – Fleet overview

Organization Name	Test fleet
Organization ID	xxx
Mall	xxx
Date of Report	2021-06-23 06:43
Monitoring period	2021-03-01 to 20
Number of motors analyzed	22 Motors

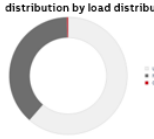
Executive Summary

The improvement potential is summarized below. The histogram between the current fleet and the possible upgrades. The table b percentual improvement potential and impact on CO2 footprint.



Energy and savings estimates	Up
Percentual energy saving estimate	
Absolute CO2 reduction opportunity	

Estimated energy consumption distribution by load distribution



Estimated er distribution

Load distribution is here presented to highlight the presence of underloaded motors and overloaded motors. A high number of underloaded motors implies savings opportunity.

IE class indicate savings. A high (IE2 and below)

Recommendation

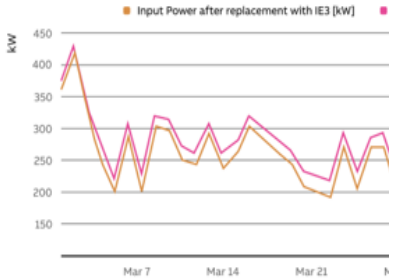
Based on the data above, we recommend further analysis which is available through subscription to an expert report. The expert report is a tailor-made document in which an ABB expert will suggest the most appropriate motors for upgrade.

Energy consumption analysis

Input power

Intro text

Assumptions....



Energy and savings estimates	Current Fleet	Upgrad Motors
Total energy consumption	128836 kWh	125111
Absolute energy saving estimate	-	3725.3

Reactive, Apparent power and P

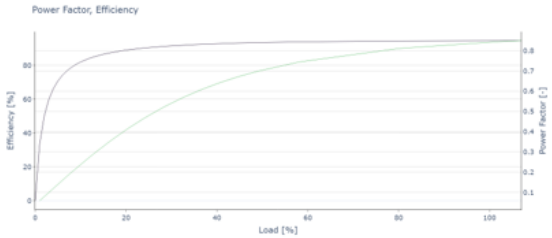
Intro text

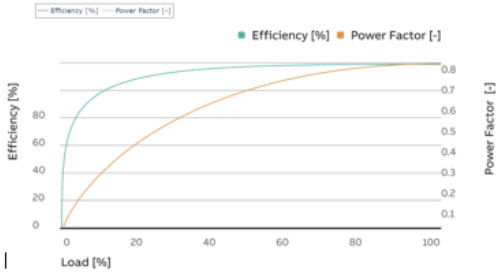
Plant/Fleet based kW or kVA reflects "maximum demand" which is often used by charge penalties when peak values exceed the contracted power for a certain tim (typically 15 mins) during the "billing period". The billing period could vary betwe

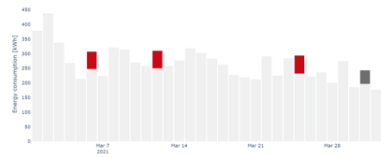
The reactive power (kVAR) or the power factor (pf) is also used in some countrie penalties (i.e. when the kVAR is greater than the contracted value or the pf drops contracted value for a certain time epoch during the "billing period")

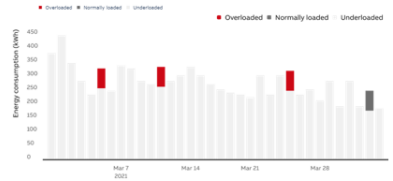
Higher kVAR also means greater losses in upstream connected equipment like ca transformers

Efficiency









Efficiency	
Average Load	18.12 %
Peak Load	107.00 %
Total Power Consumption when Underloaded	8384.28 kWh
Total duration of underloaded operation	748.00 Hrs

Q & A


ABB