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Sustainability in industry

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Presenter

Dmitry Svechkarenko leads the R&D team at ABB Corporate Research Center in Sweden. In this role, Dmitry is leading a team of highly-skilled researchers working in the field of electrical machines and electric drives, industrial digitalization. He is passionate about innovation, technology and customer experience.

Dmitry Svechkarenko
R&D Team Lead, ABB Corporate Research

Agenda

Sustainability in industry

- Energy efficiency as the first fuel for sustainability
- The role of data insights in identifying energy saving opportunities
- R&D collaboration project between CERN and ABB – motorSENSE
- Way forward and conclusions

Energy efficiency as the first fuel for sustainability

The world is going electric

Electric motion plays a significant role in

SUSTAINABILITY (CLIMATE & ENERGY)

AUTOMATION

MOBILITY

Energy efficiency is a must

45% of the world's electricity is converted by electric motors into motion

< 23% of the world's electric motors are controlled by drives

Demand for electric motion to double by 2040

Making the case for energy efficiency

The global population is expected to rise **from 7.7 billion** in 2019 **to 9.7 billion** in 2050

The **global economy** is expected **to double** over the same period

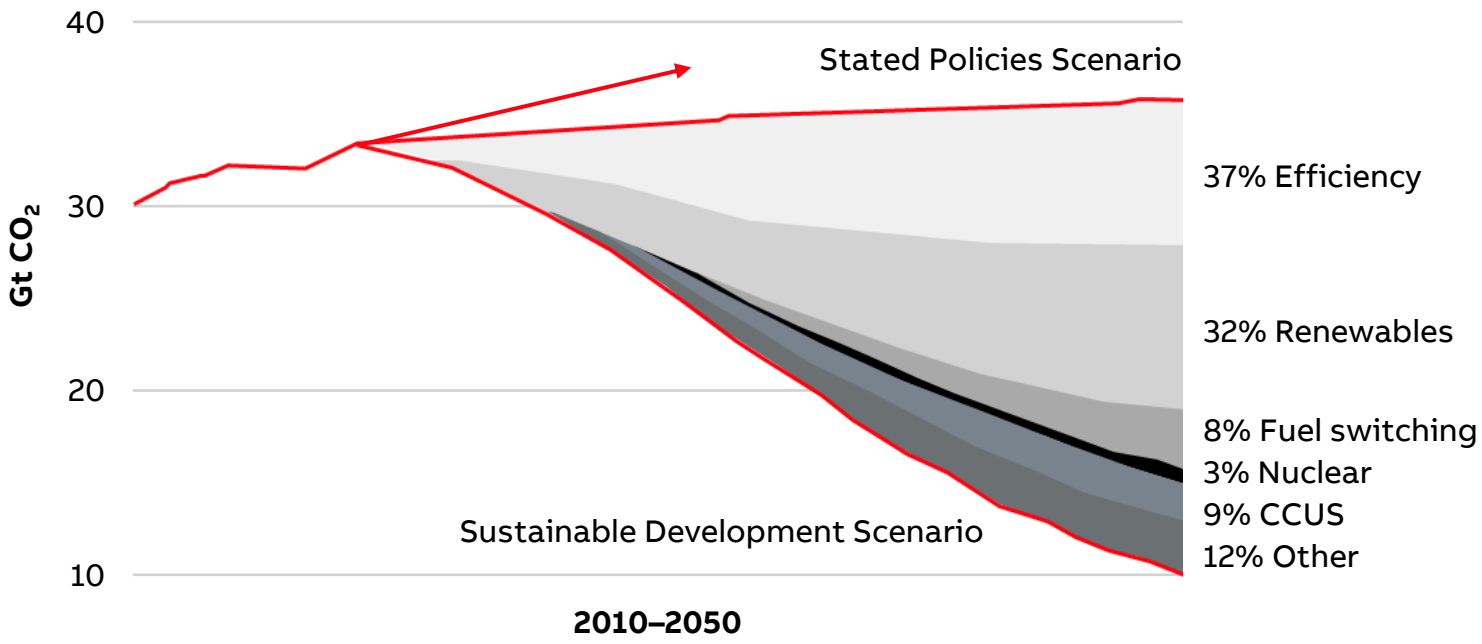
Urbanization, and the rise of living standards will increase the **demand for energy**

Without action, **climate change** would dramatically worsen

The number of electric motors in the world **will double by 2040**

Electric motors consume **over 45% of the world's electricity**

Making the case for energy efficiency



CO_2

Improving energy efficiency is the most **viable solution** to meet **climate change goals**

According to the **International Energy Agency**, it accounts for **more than one third** of the effort needed

How global industry is speeding up investment in energy efficiency

ABB energy efficiency survey 2022

97%

Are either **already investing** or **planning to invest** in making their energy usage more efficient

90%

Say rising energy costs are at least a minor threat to the profitability of their business; **53%** say they are a **moderate or major threat**

89%

Expect their investment in energy efficiency to **increase over the next 5 years**

58%

Don't feel that the government and third parties provide all the information they need on energy efficiency

40%

Plan to make energy efficiency improvements **this year**

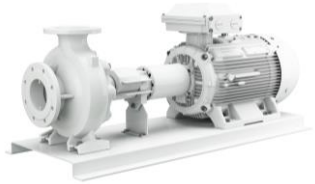
52%

Plan to achieve net zero **within 5 years**

The role of data insights in identifying energy saving opportunities

Transforming industries

Integrating sustainability into design by connecting physical and digital worlds

	WATER	CHEMICALS	ENERGY
Market segments			
Rotating machinery	 Pump systems	 Cooling systems	 Compressor systems
Industrial application	 Pump	 Fan	 Compressor
Powertrain solution	 Electric Motor or Generator	 Variable Speed Drive (VSD)	 IoT-connected products

The critical role of motors

There are **more than 300 million** industrial electric motor-driven systems in operation worldwide

Electric motors consume over **45% of the world's electricity**

The number of electric motors in the world **will double by 2040**

With **high-efficiency motors** we can **cut electricity consumption by 10%**

As for LV motors, an IE5 SynRM can offer **up to 50% lower energy loss** in comparison with an IE2 induction motor

On large motors, ABB launched the **Top Industrial Efficiency** (TIE) initiative to ensure always offer the highest efficiency.

Why adding a drive matters

It is estimated that **just under 1 in 4** of the world's industrial motors are equipped with a drive

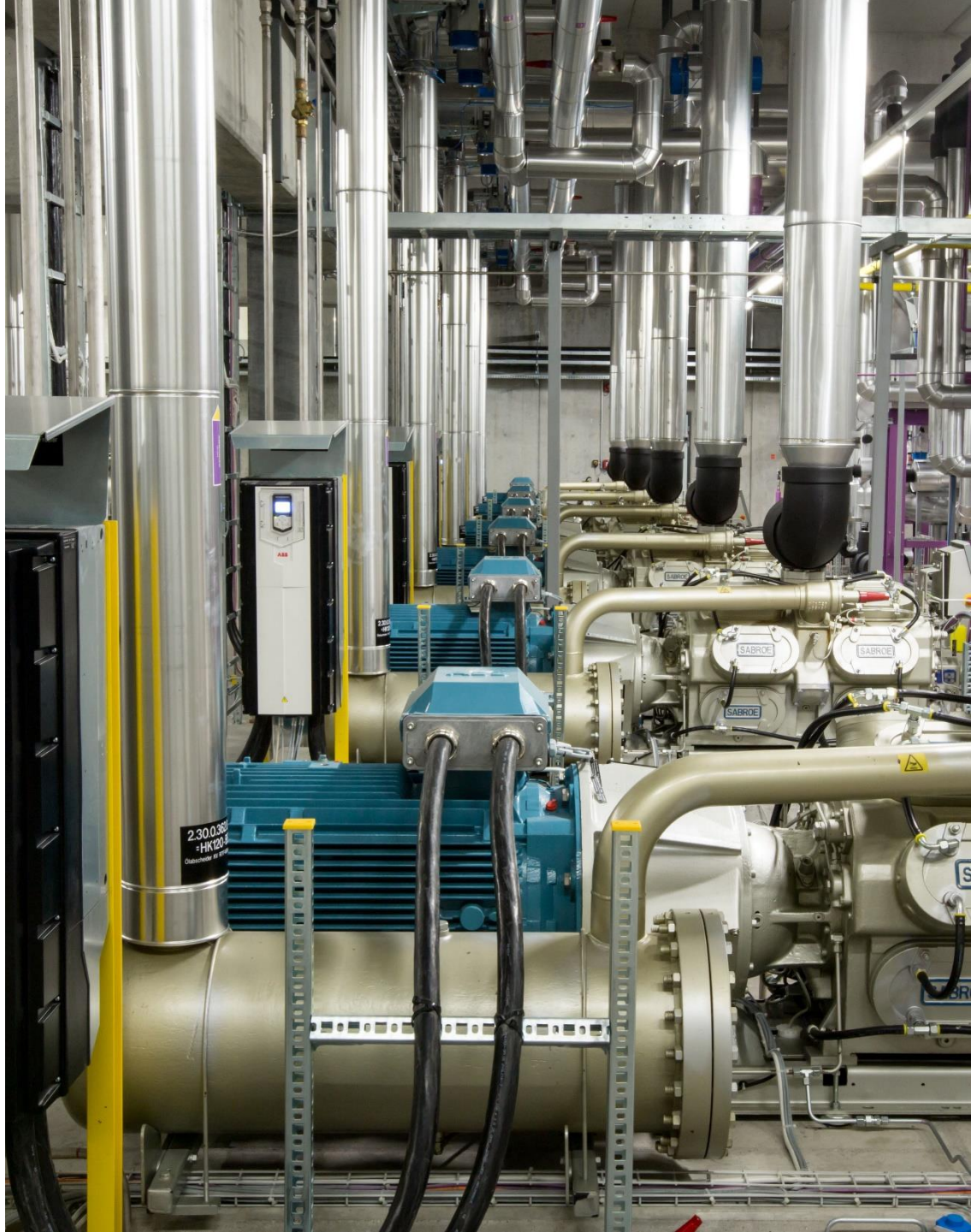
The number of motors equipped with a drive is expected to **only increase by 3%** over the next five years

While not every motor can use a drive, experts suggest that **around 50% of industrial motors would benefit** from being paired with one

When added to the existing motor of a pump, fan or compressor, a variable speed drive can typically **reduce power consumption by 25%**

Our ultra-premium efficiency synchronous motors are **designed to maximize efficiency** and need a drive

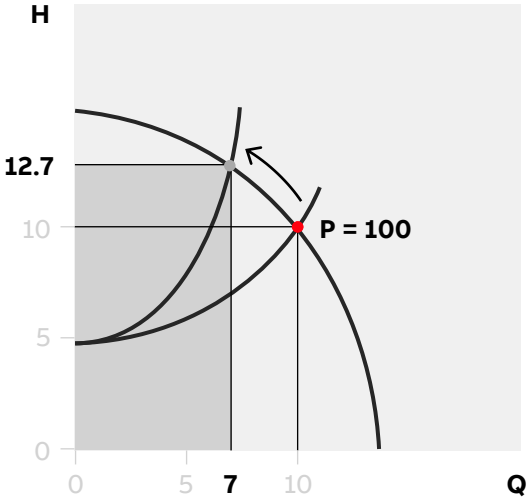
Drives allow better start-ups and lifetime **optimization of the motor-driven system**



Different control methods for water pumps

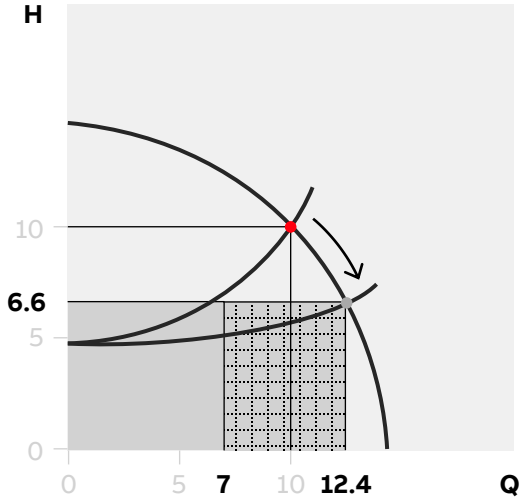
Needed power for reduced flow (70%)

Throttle Control



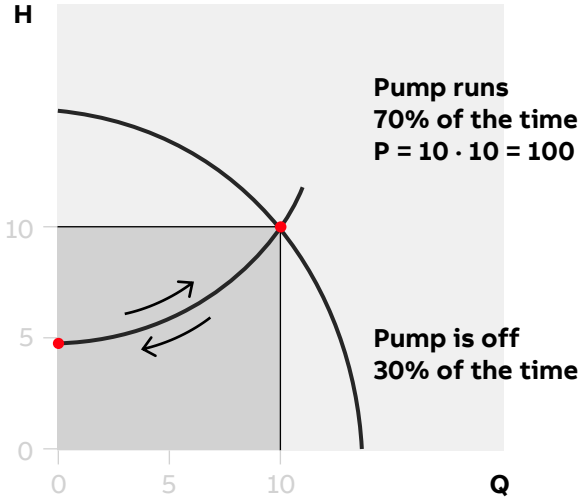
$P = 7 \cdot 12.7 = 89$

By-Passing



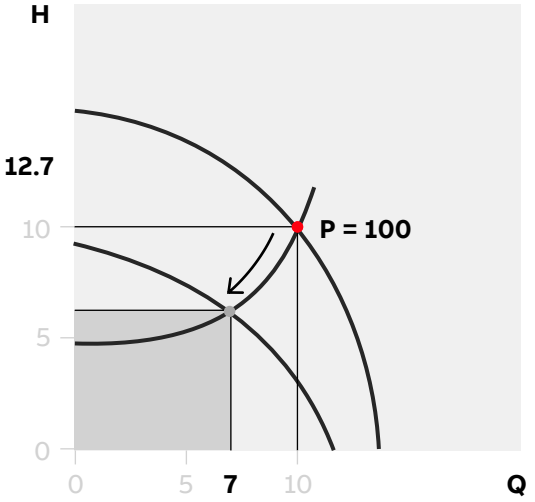
$P = 12.4 \cdot 6.6 = 82$

On-Off Control



$P = \frac{7 \cdot 100 + 3 \cdot 0}{10} = 70$

Variable Speed Control

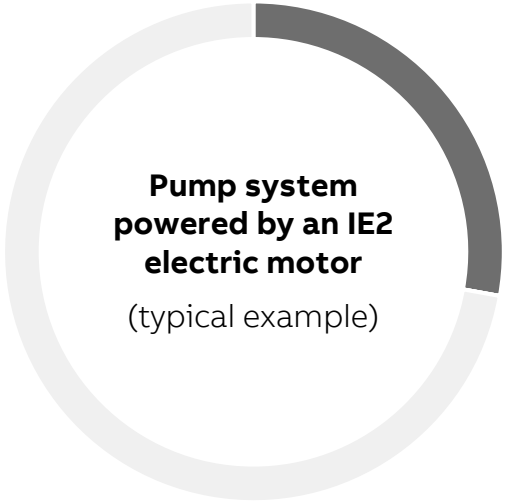


$P = 7 \cdot 6.4 = 45$

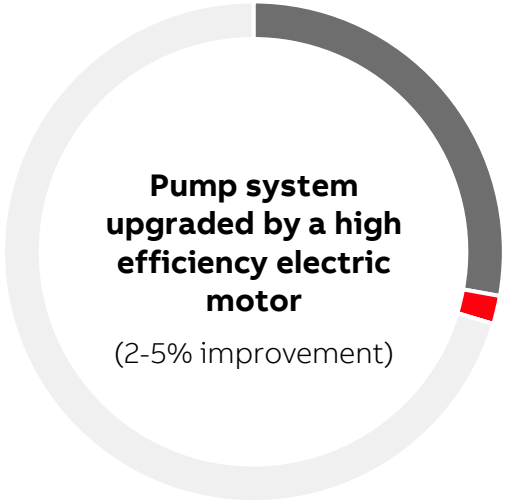
Improving the efficiency of electric powertrain

Electric motion that is efficient and intelligent provides the best performance

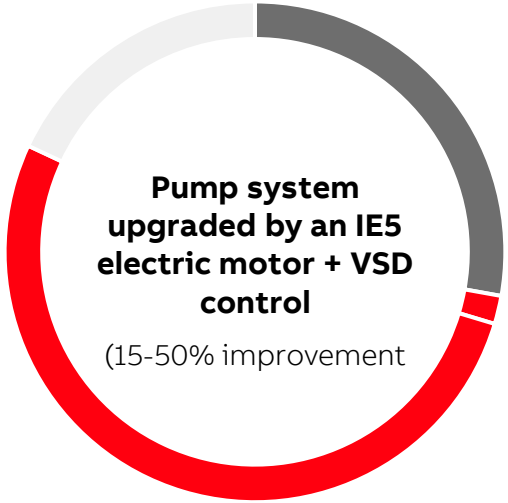
INDUSTRIAL APPLICATION



HIGH-EFFICIENT MOTOR



VARIABLE SPEED DRIVE CONTROL



Efficiency of electric powertrain-powered pump systems

28%[1]

↑ **30-33%**

↑ **45-83%**

1 28%: Total efficiency of pump system controlled by passive control (throttling valve) and IE2 type electric motor.

The importance of data

About **85% of companies** say they are now **adopting IoT initiatives**

On average, the amount of connected equipment is **growing by 33% every year**

$7 trillion are being spent on digital transformation between 2020 and the end of 2023

Companies need **data-driven decision-making** in order to fully tackle energy efficiency challenges ahead

ABB Motion is able to implement **energy appraisal** and has the right solutions for **constant monitoring with ABB Ability™**

Connected assets allow **real-time monitoring**, facilitate **predictive maintenance** and **mitigate risks** related to unplanned downtime

ABB Energy Appraisal

Two efficient approaches – one energy saving goal

Digital Powertrain energy appraisal

Data automatically collected from Smart Sensors

Application-specific energy appraisal

Data from motor and application is manually collected through a site visit

Easy wins

Identified using calculation and expertise based on data collected

Detailed analysis

Identifies significant energy savings by switching to high-efficiency motors or adding variable speed drives

Recommendations

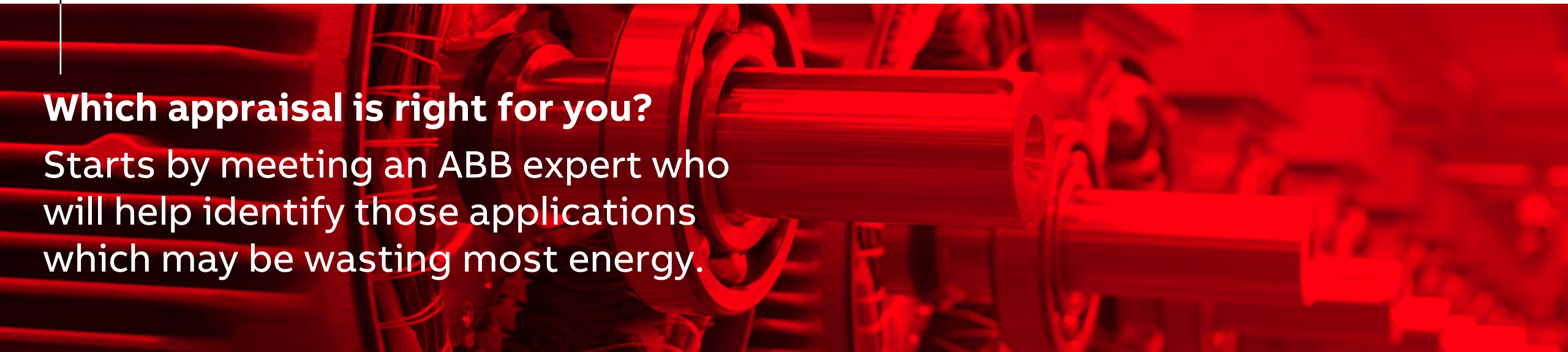
A report features an action plan, projected annual energy and CO_2 savings, payback time for the proposed investment

Implementation (optional)

Installation and startup or commissioning of motor and drive

Verification (optional)

ABB tracks the actual savings against the predictions



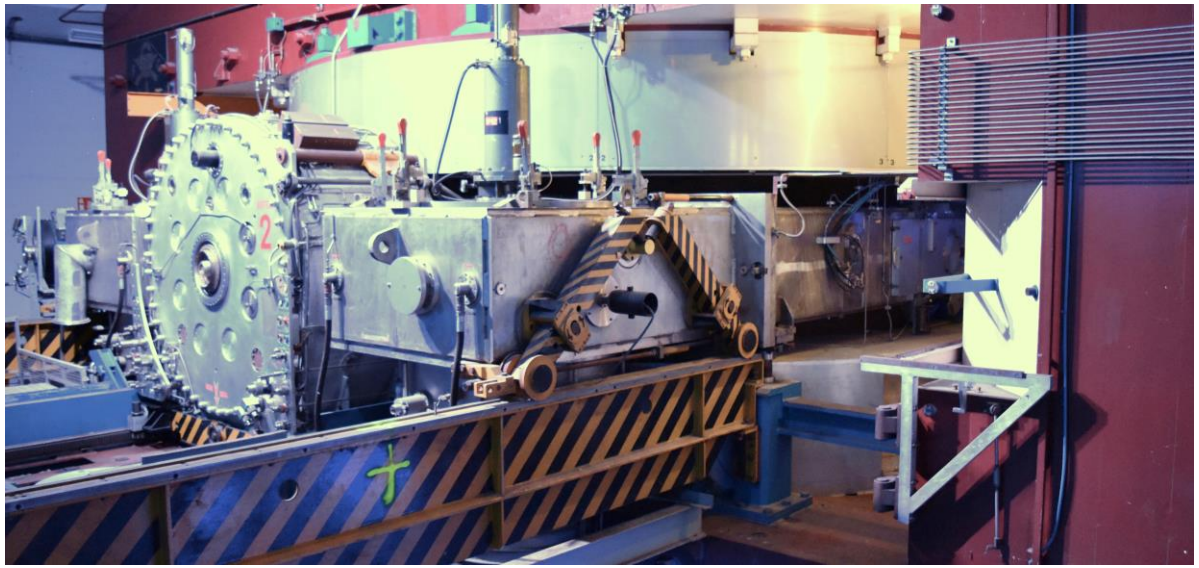
Which appraisal is right for you?

Starts by meeting an ABB expert who will help identify those applications which may be wasting most energy.

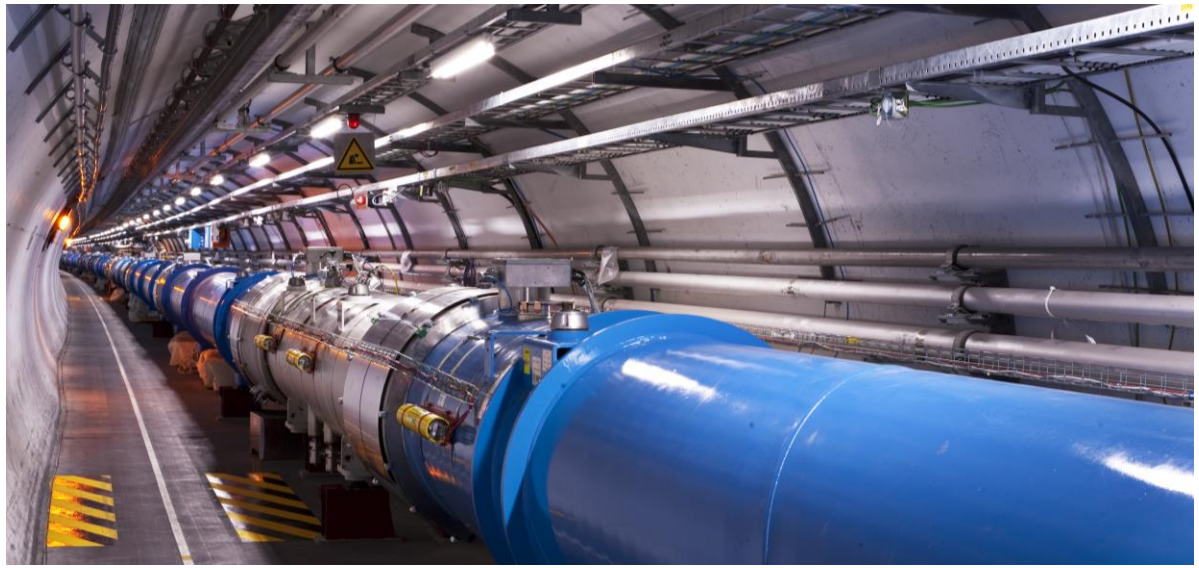
R&D collaboration project between CERN and ABB – motorSENSE

Development of particle accelerators

Synchrocyclotron in 1957 to Large Hadron Collider in 2023



Diameter:	5 m or 15.7 m circumference
Magnet power:	750 kW
Flux density:	1.88 T
Magnet temperature:	ca 293 K
Particle speed:	80% of the speed of light



Diameter:	8 486 m or 26 659 m circumference
Magnet power:	40 000 kW
Flux density:	8.33 T
Magnet temperature:	1.9 K
Particle speed:	99.9999991% of the speed of light

Development of industrial electrical motors

Induction motor in 1957 to Induction motor in 2023

Diameter:	0.3 m
Motor power:	18.5 kW
Airgap flux density:	ca 1 T
Nominal temperature:	403 K (130 C for Class B)
Rotor speed:	1465 rpm
Efficiency:	~86%

Diameter:	0.3 m
Motor power:	18.5 kW
Airgap flux density:	ca 1 T
Nominal temperature:	403 K (130 C for Class B)
Rotor speed:	1482 rpm
Efficiency:	~94%

Making energy efficiency less mysterious

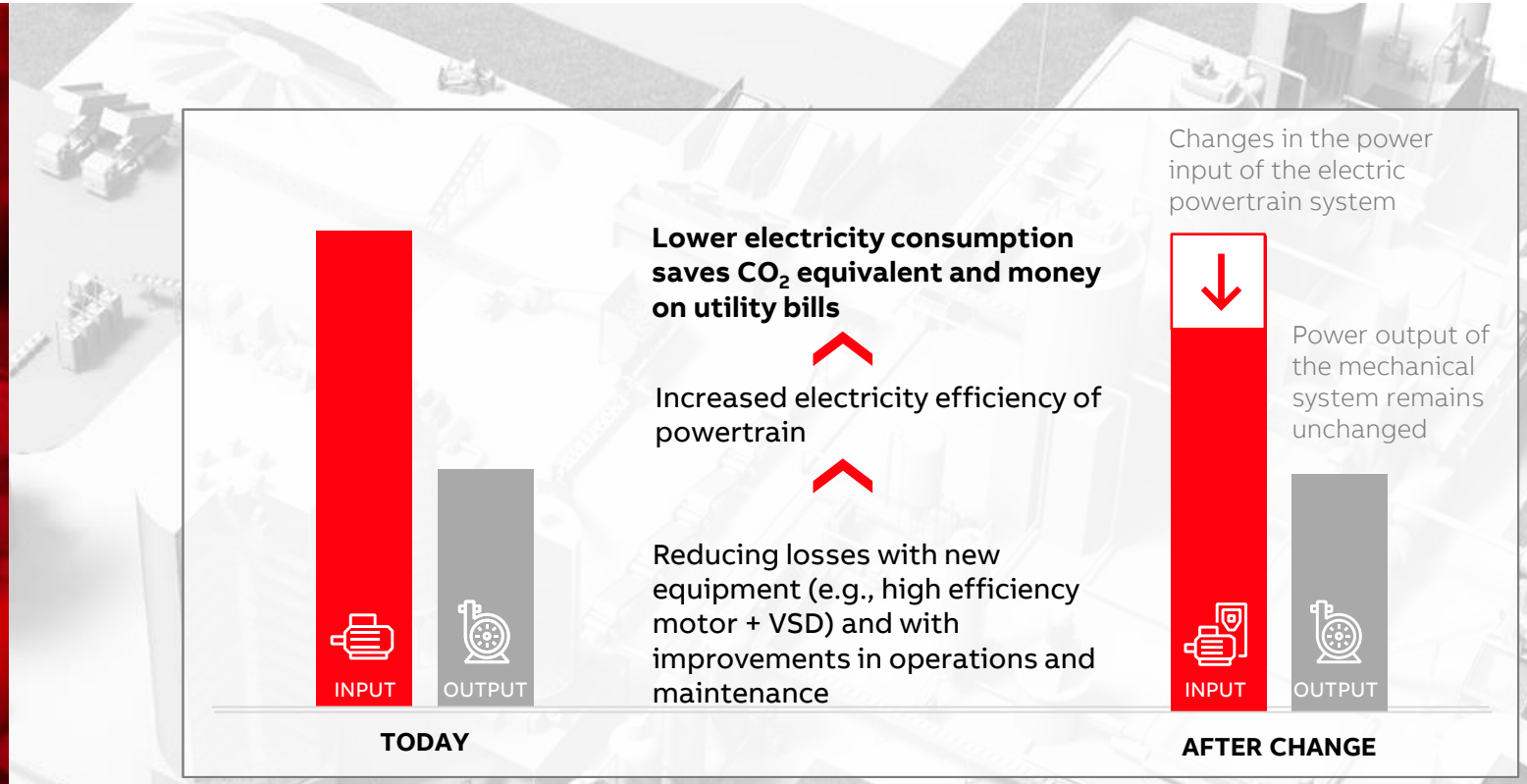
Reducing cost and carbon intensity by increasing the efficiency

Application

Mechanical machinery that use kinetic energy to move fluids, gases, and other process materials.

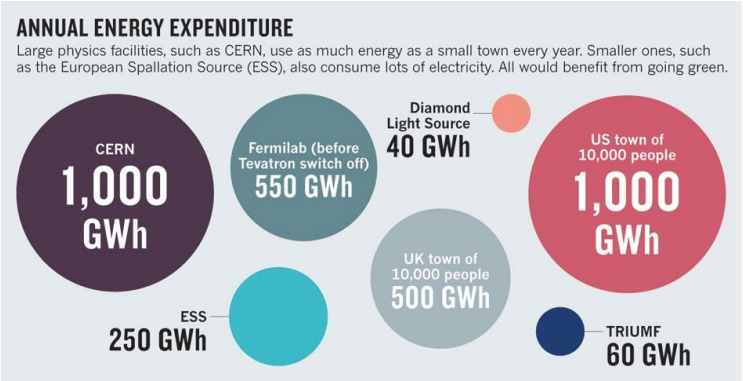
Motors and Drives

An industrial application that converts electrical energy into mechanical energy.



motorSENSE – ABB Future powertrain in Big Scince

Towards energy efficient and reliable operation of large-scale research facilities



01/2022 — 12/2023

Start — End

Project Scope

Project aims at assessing and improving the energy efficiency and reliability of the cooling and ventilation infrastructure of large-scale research facilities with the case study of the European Organization for Nuclear Research (CERN).

Project Goals & Deliverables

Goal 1: Create a roadmap with a target of achieving a 10-15% of overall energy reduction in the cooling and ventilation infrastructure at CERN.

Goal 2: Create and validate a system digital twin of the cooling and ventilation infrastructure (electrical motors, drives, pumps, fans, etc.) by enabling online diagnostics and maintenance.

Goal 3: Public dissemination of results to share the learnings, best practices to inspire industries and large-scale research facilities around the World to become more sustainable and reliable.

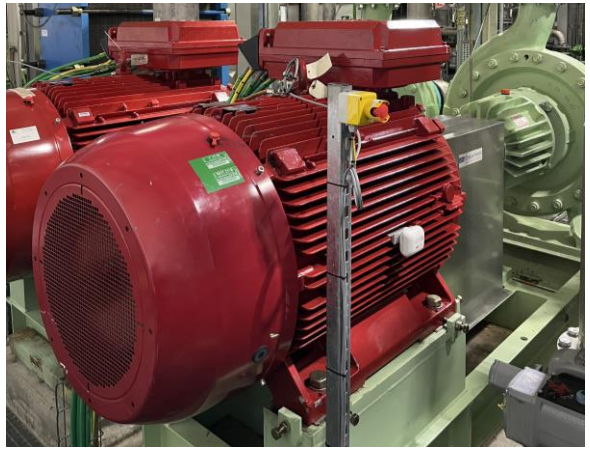
Technical Challenge & Approach

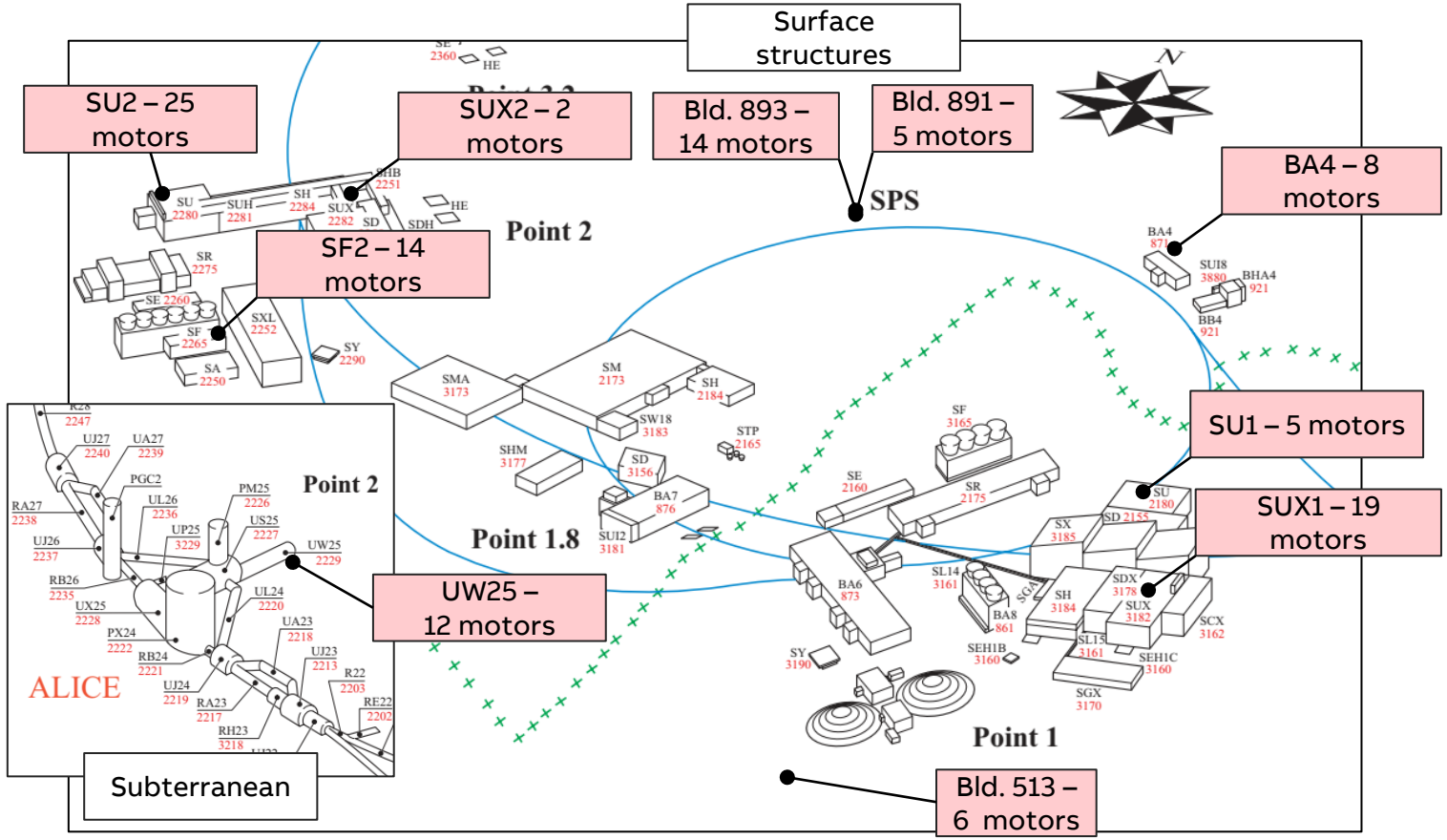
- Assess the existing installation by analyzing the fleet aggregated data, operation history, maintenance history and real time operation data collected by the measuring equipment.
- Develop an asset and system digital twin to be used for energy efficiency and reliability assessment based on physics model, statistical models, and machine learning and AI.
- Based on collected data and conducted assessment run the various scenarios with respect to defined KPIs.

Present data acquisition framework at CERN

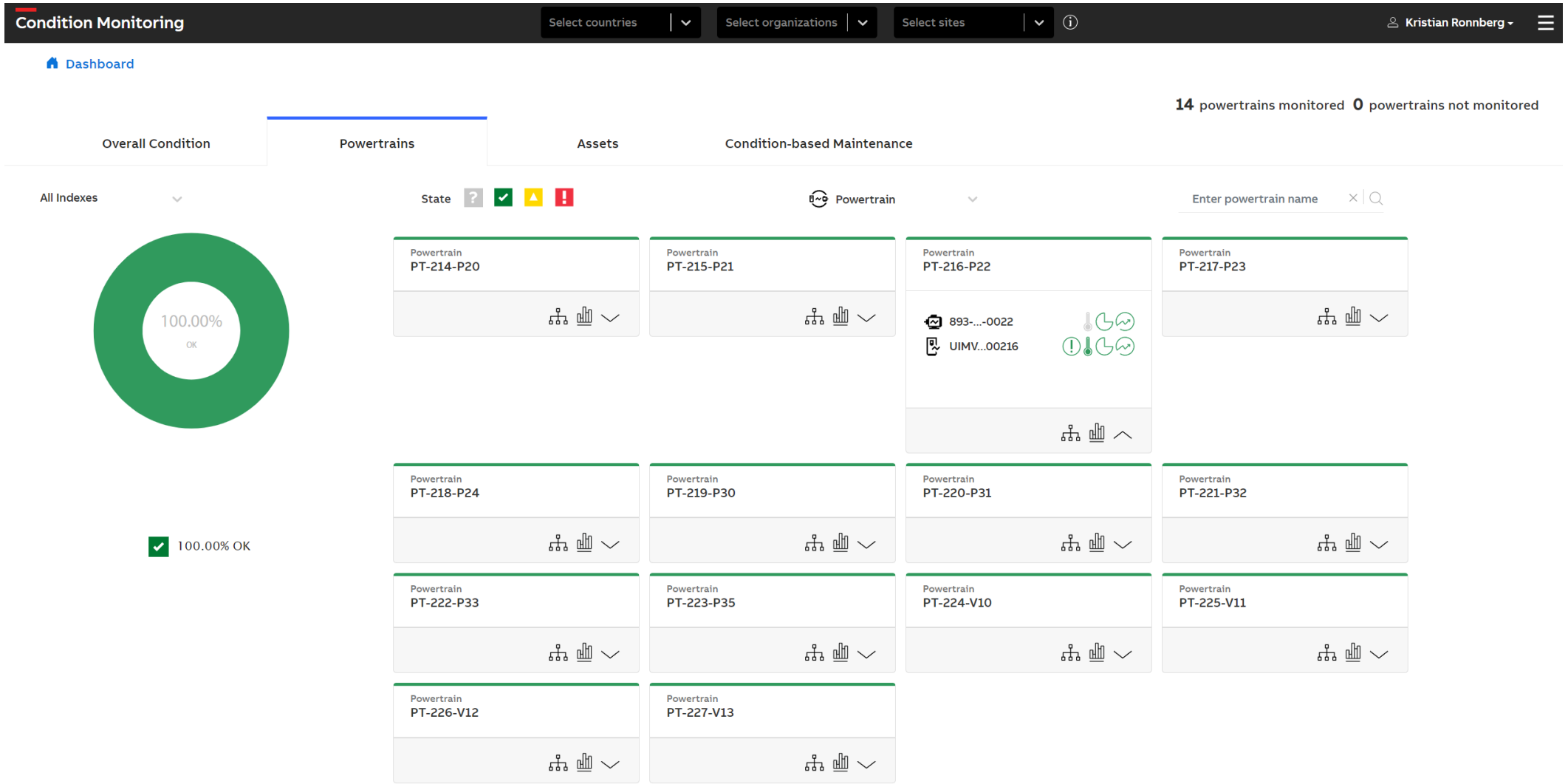
Digitally connected motors and drives

- 109 motors are digitally connected through ABB Smart Sensors
- All sensors are of generation 2 Smart Sensor High Performance type.
- 97 in surface buildings - accessible throughout the year
- 12 in subterranean structures – only accessible during the year end technical stop. Off limits when experiments are running.

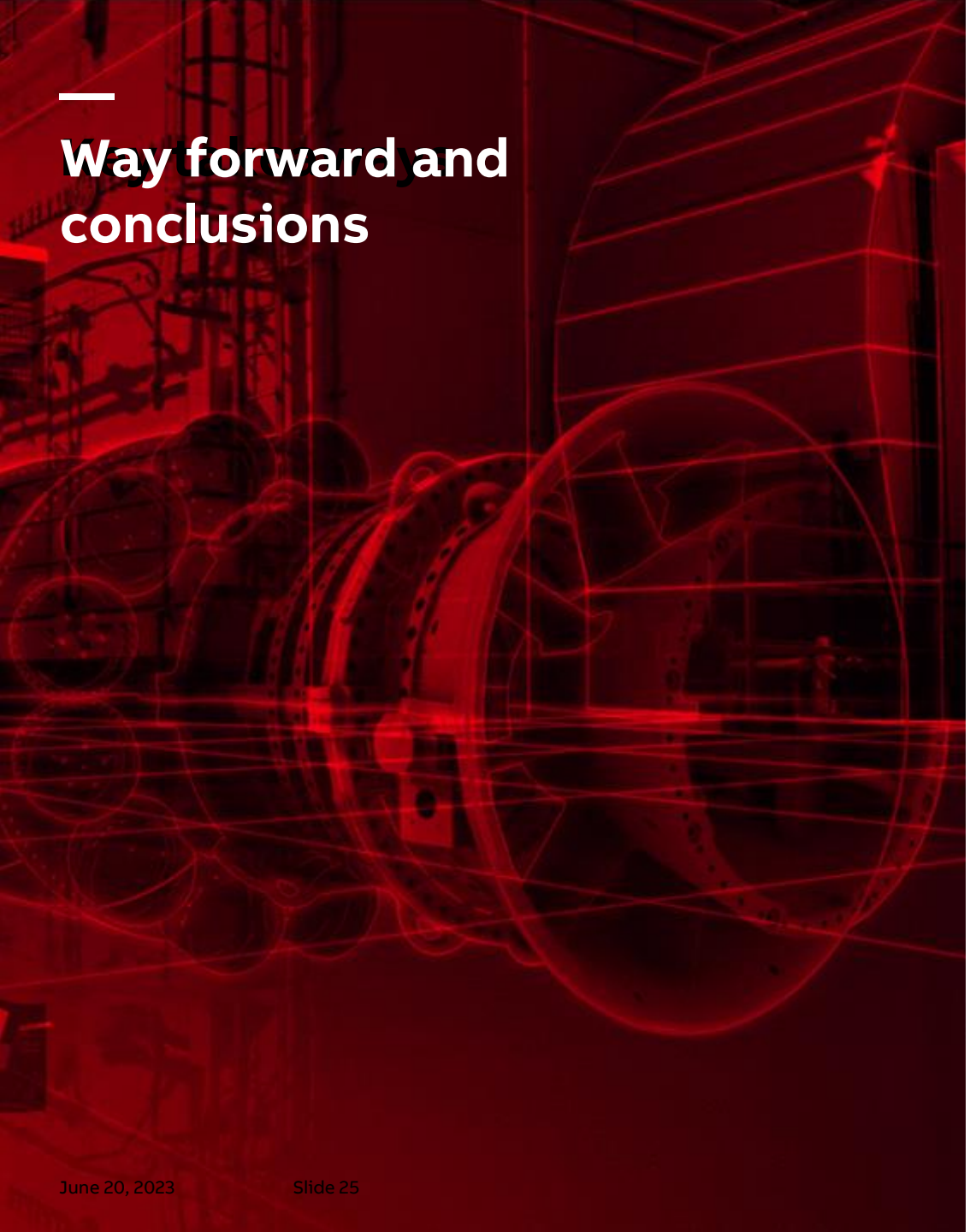




Data available through powertrain portal & back-end functionality



Way forward and conclusions



Way forward and conclusions

- Start with applications that provide significant benefits (pumps and fans)
- Identify opportunities by quick scanning with on-site assessments.
- Leverage condition monitoring to trend power consumption and other performance parameters
- Validate the assumptions with digital powertrain appraisals for planned continuous monitoring periods
- Build models that can be widely applied to analyze, engineer and select the best solutions, with better estimates of savings
- Pay attention to Operating and Maintenance actions to save energy while identifying opportunities for changing or adding equipment


ABB