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ABB Motion Services

How to improve OEE and energy efficiency by modernizing your aging production assets

Jari-Pekka Matsinen, Global Strategic Market Manager

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Presenter introduction: Jari-Pekka Matsinen

19 years serving industrial customers

Title: Global Strategic Market Manager

Background: International sales manager specializing in strategic customers and industry segments, business to business marketing and sales, and customer lifetime value creation.

Seasoned professional in variable-speed drives systems. Proven track-record of more than 19 years' working experience at a pioneering technology leader that works closely with utilities, industry, and transportation & infrastructure customers, globally.

Proficiency in international sales, electrical power system engineering and power electronics.

Based in Helsinki, Finland.

ABB Motion Services

We keep your world turning – while saving you energy

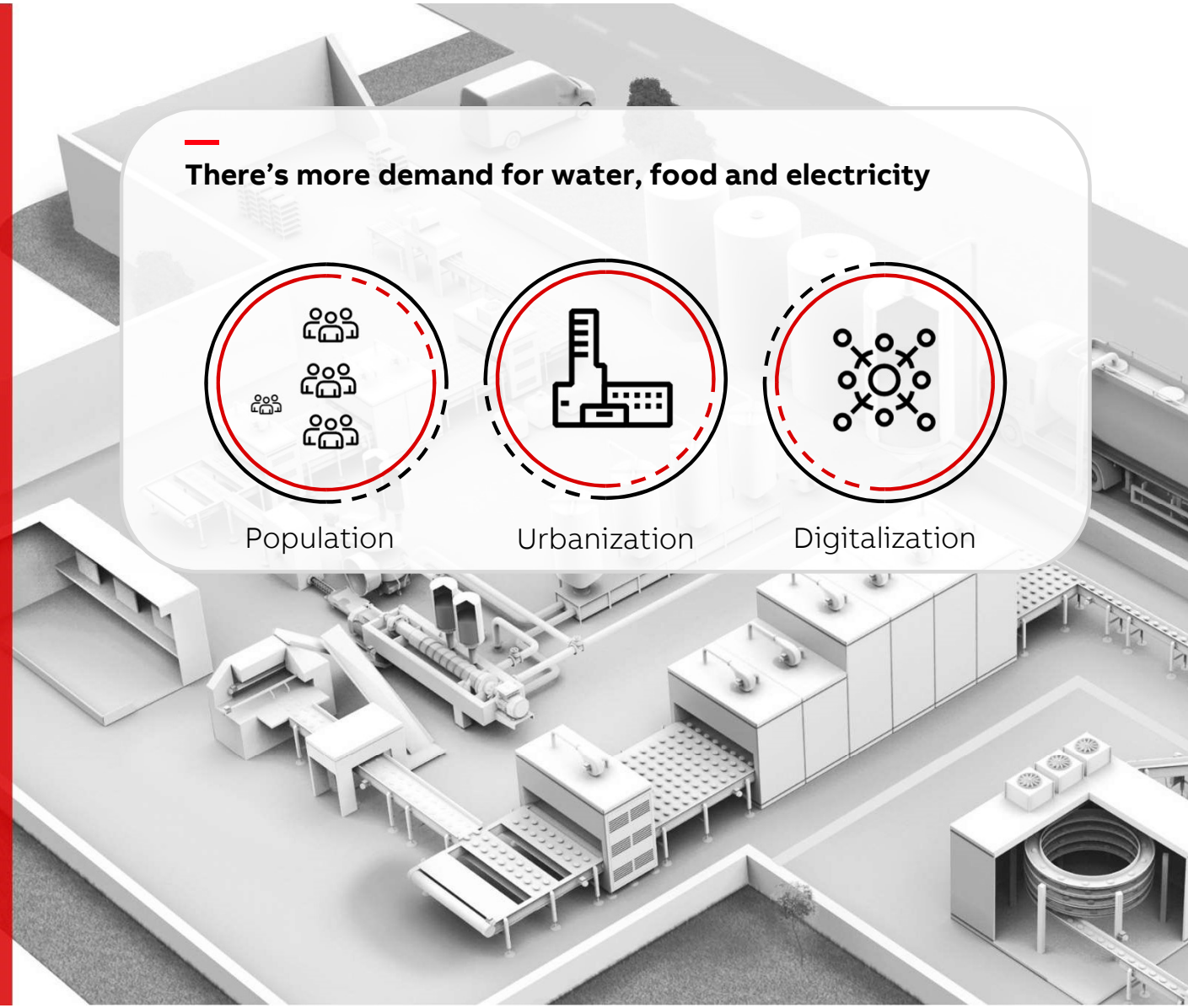
Industry drivers
Understanding what's driving industry in 2020 and beyond

ABB Smart Motion
Understanding what's the smart motion and where you can experience it

Overall equipment effectiveness
Improving profitability by modernizing ageing assets economically

Energy efficiency
Reducing carbon emissions and electricity consumption by energy efficient powertrain

Sustainable solutions
Meeting sustainability targets with safe, reliable and smart assessments



Industry drivers

Industry drivers

Understanding what's driving industry in 2020 and beyond

Global mega-trends

- Population and urbanization
- The quest for a circular economy
- The ongoing rise of digitalization

ABB

- Automation
- Robotization
- Motion
- Digitalization
- Electrification

Consumers trends

- Moving beyond meat
- The 'rich-in' revolution
- Authenticity and experience

Industry drivers

Transparency
Build consumer confidence with digital tools that provide accountability.

Sustainability
Embrace innovation to reduce business costs and protect the environment.

Novelty
Capitalize on innovation trends with technology to support customized / personalized experiences.

Convenience
Optimize production agility to remain competitive with digital convenience formats.

ABB Smart Motion

ABB Smart Motion

Understanding what's the smart motion and where you can experience it

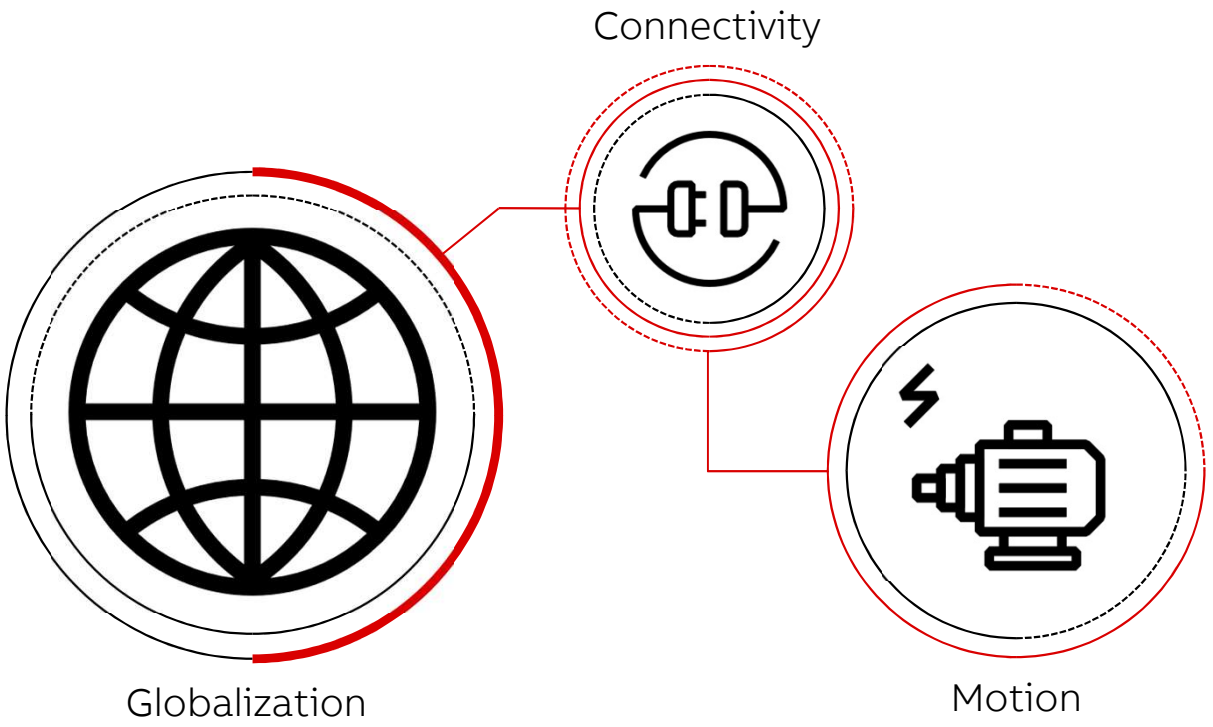
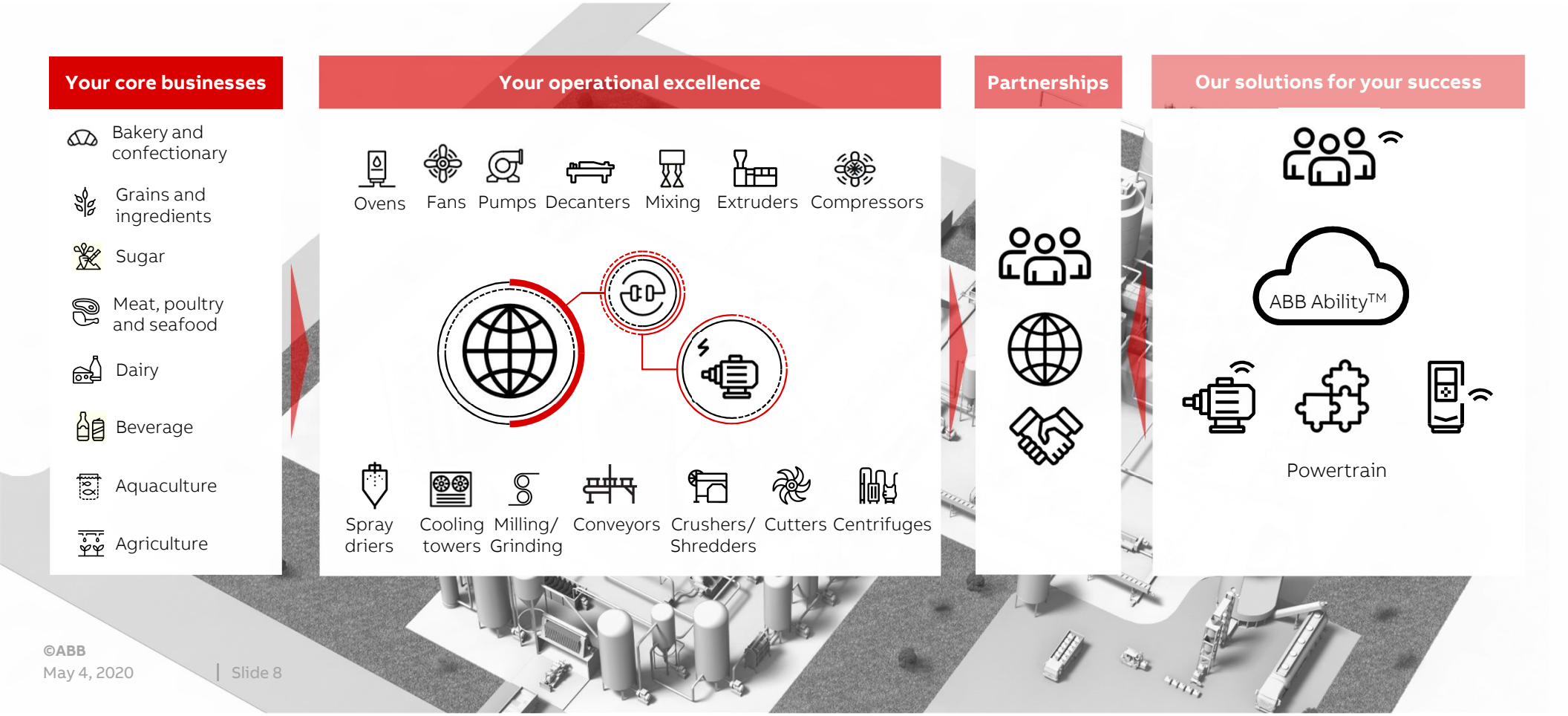


ABB Smart Motion

We keep your production running safely, reliably and energy efficiently

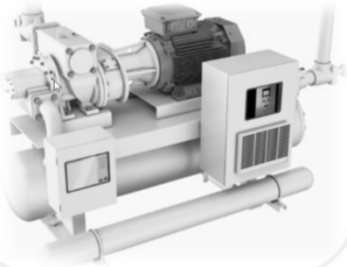


Overall equipment effectiveness

Overall equipment effectiveness

Total cost of ownership plays a vital role in your lifetime profitability

Pump system

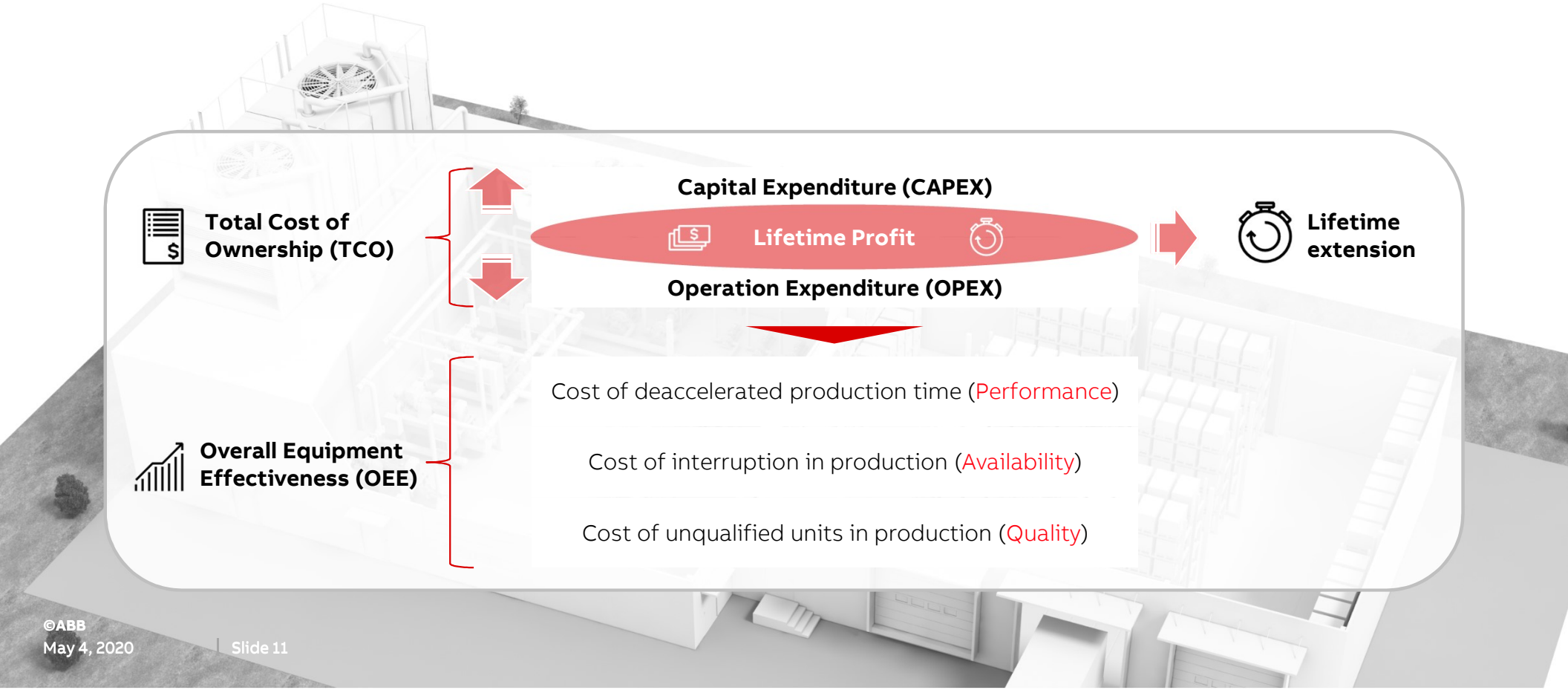


Total Cost of Ownership (TCO) = **Capital expenditure (CAPEX)**
- investment
- start-up

\+ **Operational expenditure (OPEX)**
- (un)planned maintenance
- (un)expected changeovers
- energy consumptions
- end of life decommissioning

Overall equipment effectiveness

How to improve lifetime profit in your production?



Overall equipment effectiveness

How OEE impacts your production?

Case: Bakery

If we assume that our packaging system has a theoretical maximum speed of 60 units per minute (ppm), the ideal cycle time is 1 second per product, and we know that at the end of a 480 minutes shift there should be 28.800 products. In this case the production had been operating at a slower speed (cycle time = 1,053 sec) and 2% of production does not meet specification.

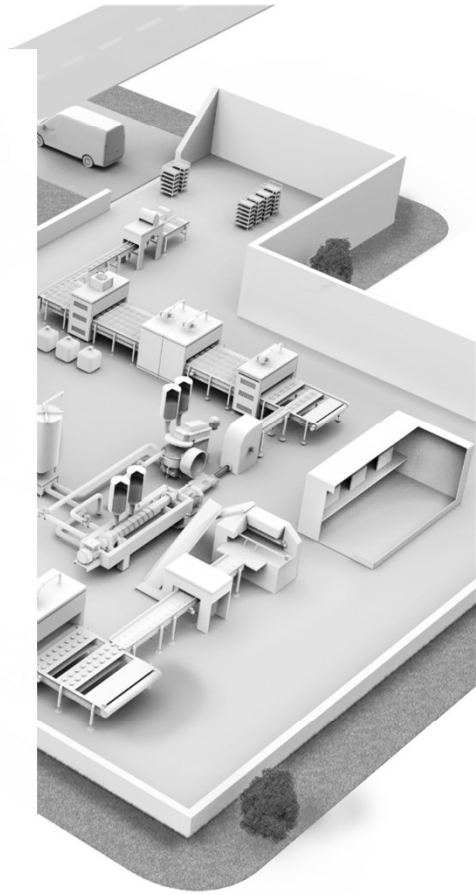
Then we need to count what we produced at the end point in the production process, such as what's on the pallet going to the warehouse. For example, if there are only 25.632 products on the pallet, our overall equipment effectiveness was 89 %.

If we lose 19 minutes of machine downtime during the shift, the uptime of the machine would be: 480 min – 19 min = 461 min, and therefore availability (461 / 480) x 100 = 96%.

This means in the remaining 461 min, the system can wrap 461 min x 60 ppm = 27.660 products and therefore performance. Because the production had been at a slower speed, we wrapped 461 x 60 / 1,053 sec = 26.268 products, and therefore performance (26.268 / 27.660) x 100 = 95% (equals to 5 % x 461 = 23 minutes lost performance).

At this point if from the 26.268 products, there were 576 out of specification, the quality rate of those products would be (26.268 - 576) / 26.268 = 98% (576 scraps at 60 ppm = 9 minutes lost quality).

OEE = Availability x Performance x Quality = 96% x 95% x 98% = 89%



Overall equipment effectiveness

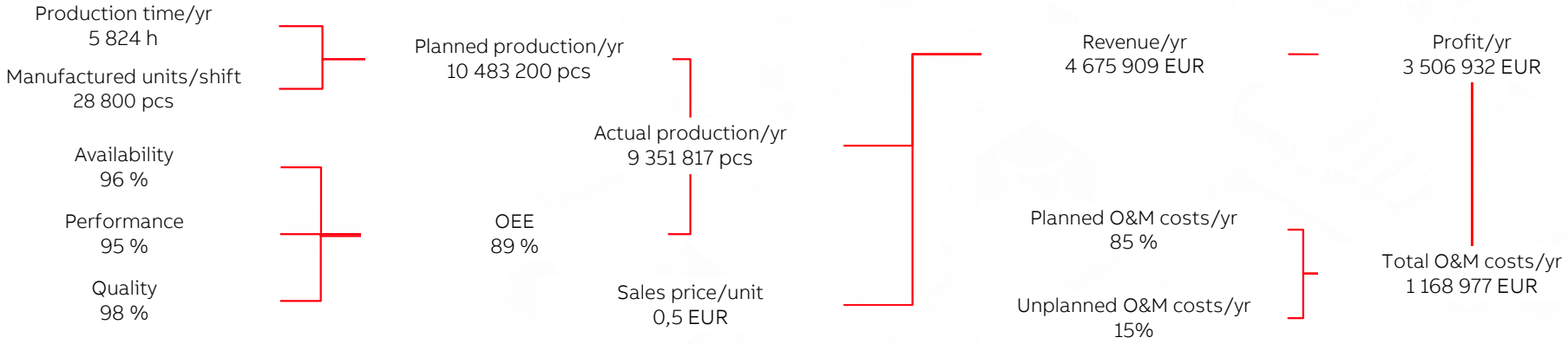
How OEE impacts your production?

Case: Bakery (cont'd)

Time over the year for production:	5 824 h (52 weeks, 8 hours/shift, 2 shifts/day)
Unplanned downtime over the year (breakdowns):	629 h (26 days)
Planned downtime over the year (scheduled maintenance):	111 h (5 days)
Total downtime over the year:	739 h (31 days)
Availability (A):	0,96
Performance (P):	0,95
Quality (Q):	0,98
Overall Equipment Effectiveness (OEE):	0,89

* Contribution to average time lost is 52 min per shift

Performance, availability and quality have a strong influence on OPEX and lifetime profitability.



Energy efficiency

Energy Efficiency

Complex regulatory landscape with changing emissions standards and health and safety rules is a fact.

- Pressures to reduce energy consumption and lower carbon dioxide emissions come from everywhere.
- You may soon be forced into action by energy prices that rise rapidly with or without government interference.
- Plants must become more energy efficient.
- Energy prices are becoming much more volatile.

>60%

electricity demand is expected to grow 2016 – 2040

>40

energy intensive industrial sectors have been conducted climate change agreement negotiations

>40%

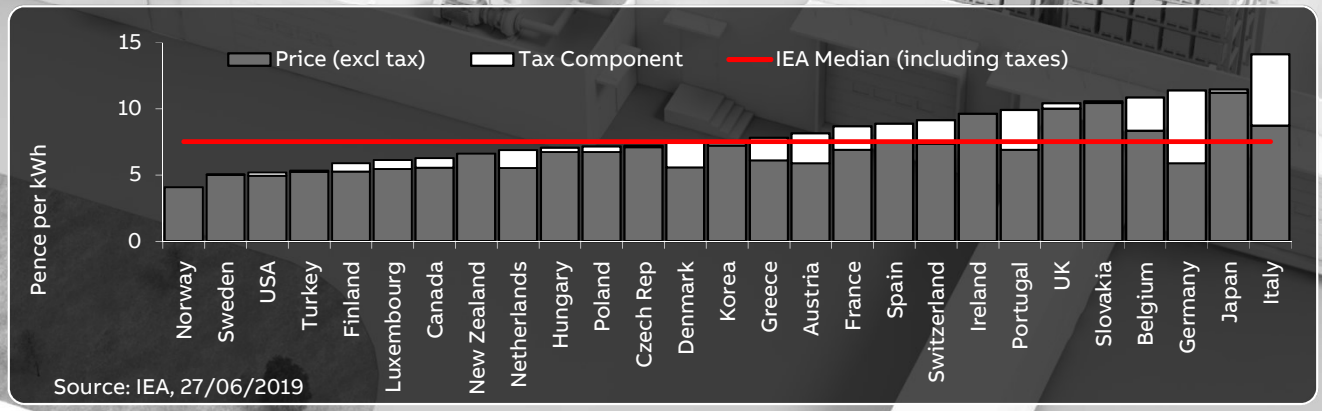
of all electricity is used by industry

2/3

of this is used by electric motors

1/3

resulting total electricity consumption globally



Energy Efficiency

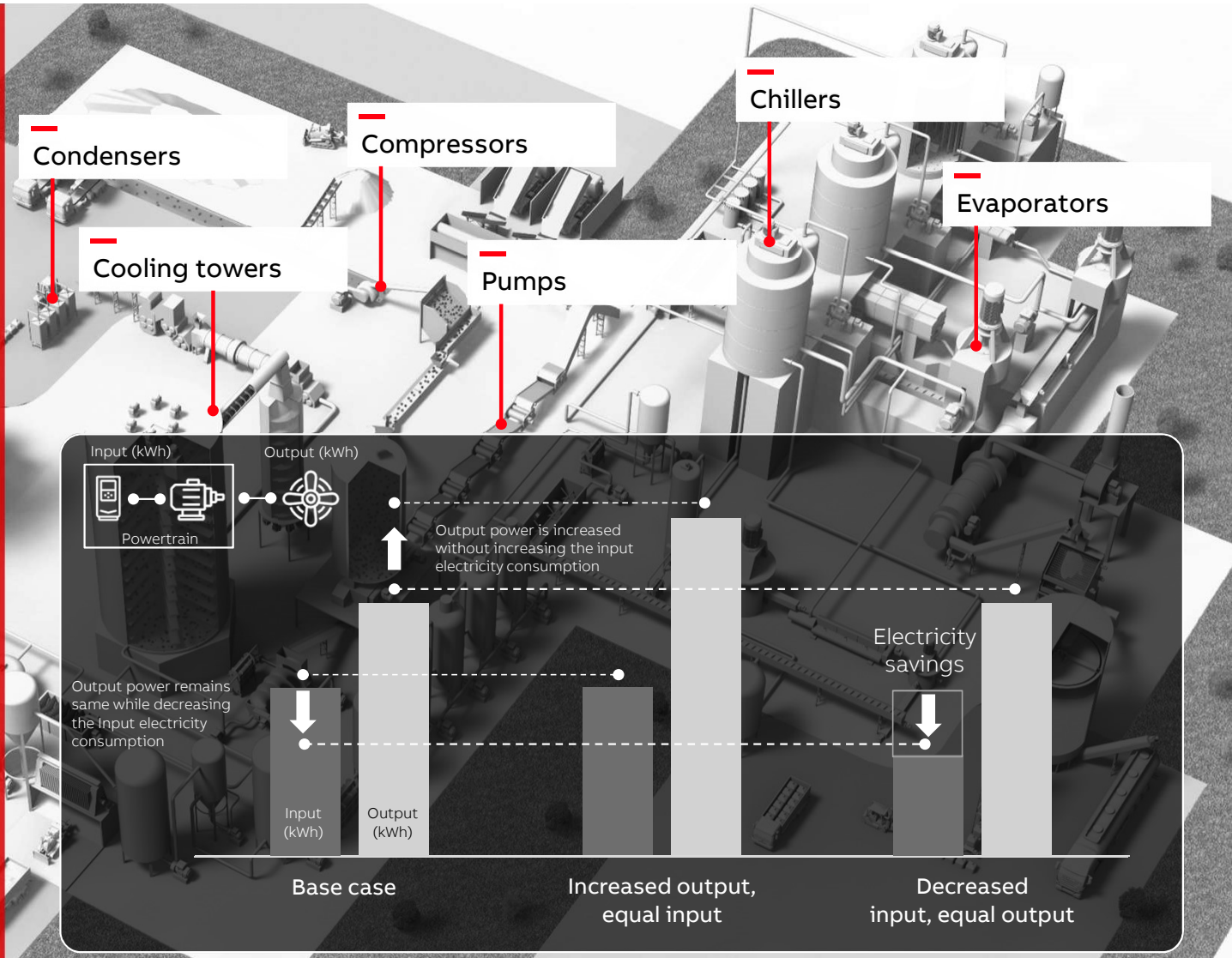
Using powertrains intelligently increases energy efficiency providing financial, operational and environmental excellence, and smart motion.

Application

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

Powertrain

- An electrical machine that converts electrical energy into mechanical energy.
- Devices that can vary the speed of a normally fixed speed motor.



Energy Efficiency

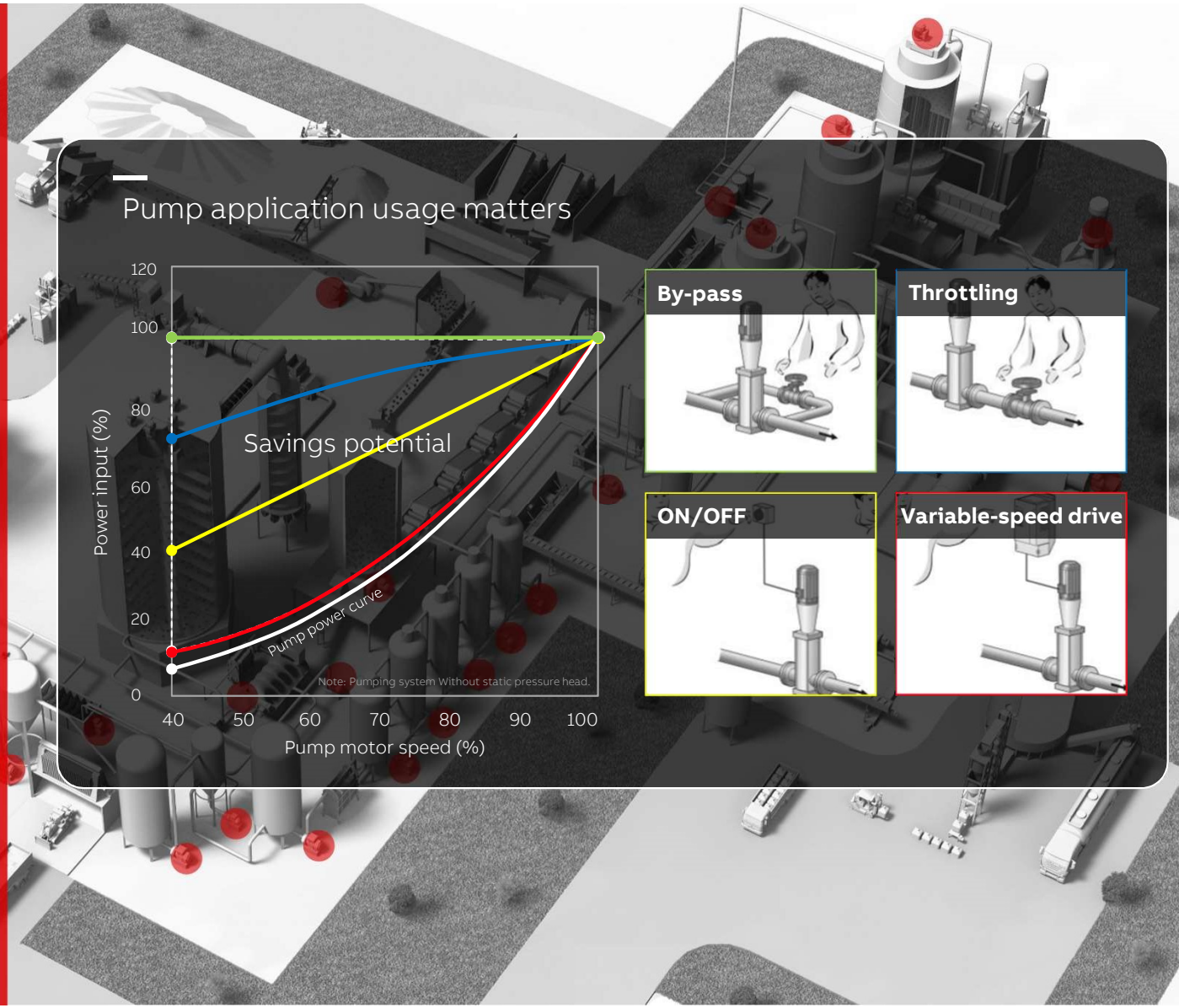
Today is time to modernize aeging rotating equipment systems by utilizing high efficient powertrains equipped with motors, variable-speed drives and soft-starters.

The importance of rotating equipment?

- There are typically hundreds or even thousands of electric motors in plant, rotating virtually everything that moves.
- Every percentage point that the average motor efficiency can be improved by is therefore of the greatest importance.

Calculating energy savings?

- Rotational equipment like centrifugal fans or pumps, by contrast, are variable-torque applications. The requirement for torque (and hence current) increases with the square of the speed. The voltage again varies in proportion to the speed, so power actually varies in proportion to the cube of the speed.
- Hence, by reducing the speed by a certain percentage, the power reduces by the cube of the speed change. So 80% speed results in (0.8)^3 = 51 percent power.

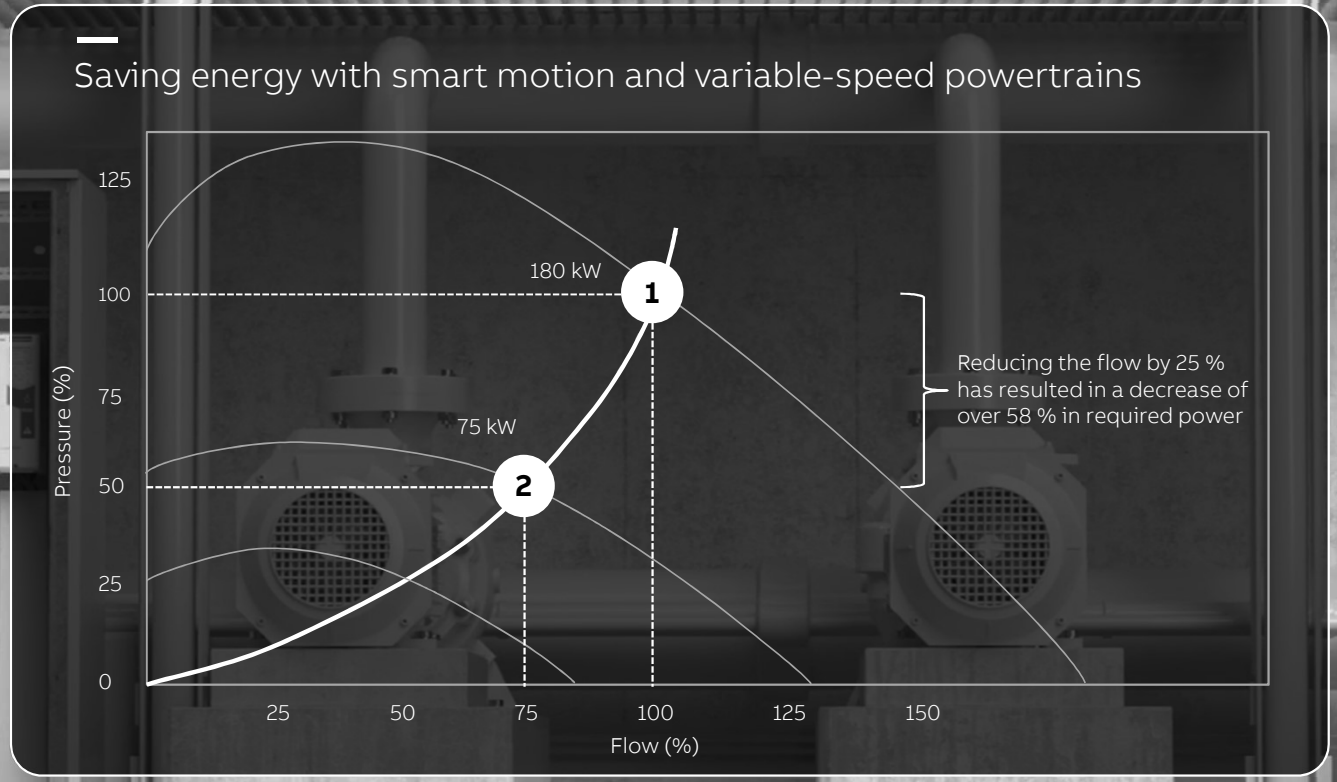


Energy Efficiency

Saving energy with powertrain equipped with variable-speed drives.

Benefits

- Energy optimization, CO_2 and money saved calculators built-in.
- Multi-Pump-Fan-Compressor Control as standard.
- Lower reactive power consumption and high efficiency of 98 percent.
- Excellent performance in abnormal situations including:
  - short supply voltage breakdown
  - heavy variations of torque
  - motor already rotating
  - cable short-circuits

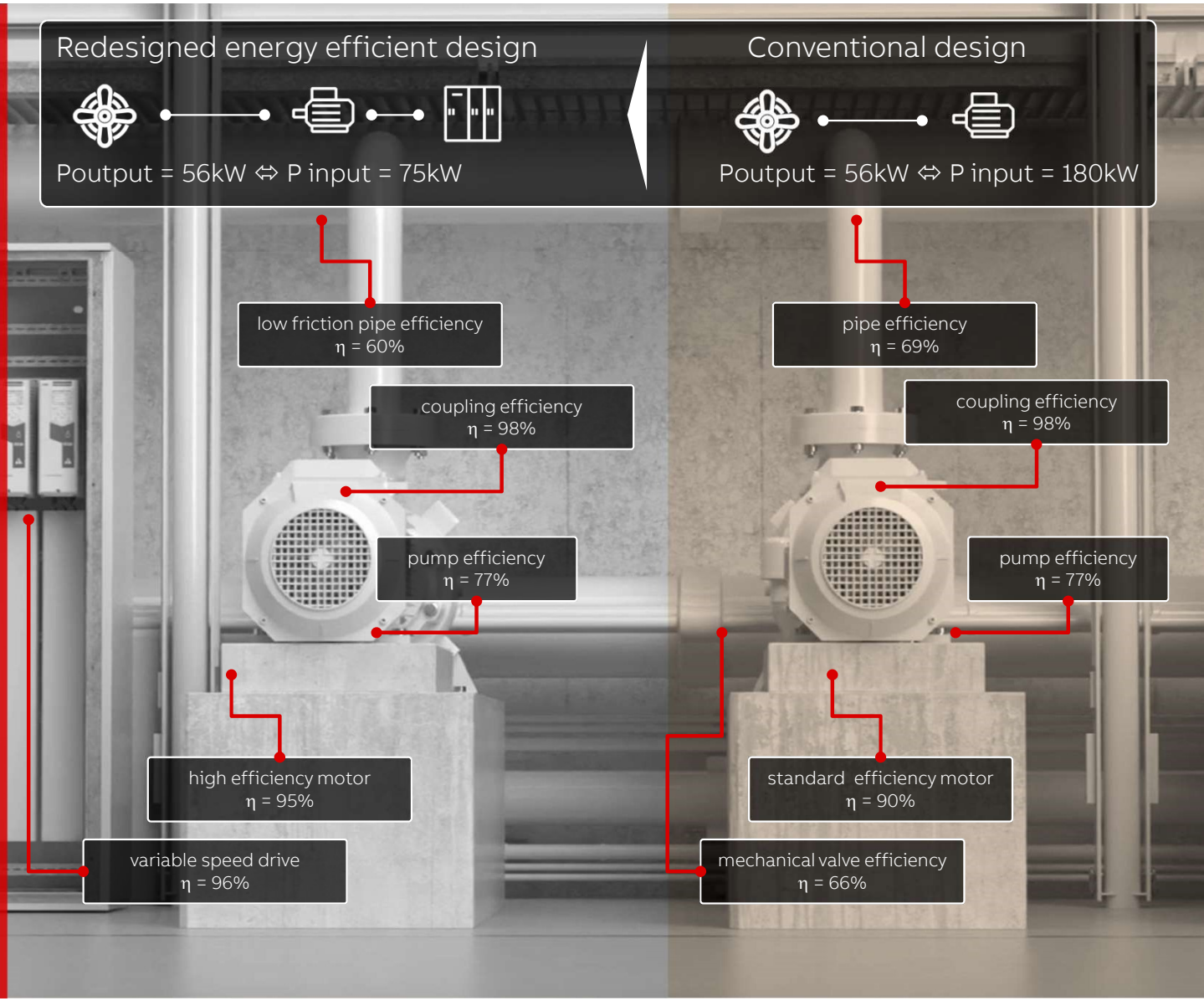


Energy Efficiency

Saving energy with powertrain equipped with variable-speed drives.

Considerations

- The conventional design shown in the right figure is operated to deliver 75 per cent of the rated fluid flow of the pumping system. The system efficiency is the product of the efficiencies of individual components, which in this example equals 31 per cent (e.g. 0.90 x 0.98 x 0.77 x 0.66 x 0.69 = 0.31).
- The left figure shows a redesigned system for delivering the same fluid flow. A variable-speed powertrain, rather than a mechanical throttle, varies the flow. The old motor and mechanical valve, have been replaced with higher efficiency variable-speed powertrain. The new system efficiency is the product of the efficiencies of individual components, which in this example equals 72 per cent (e.g. 0.96 x 0.95 x 0.77 x 0.98 x 0.69 = 0.47).
- In the energy-efficient design, the input power required reduces from 180 kW to 75kW, thus giving a system efficiency of 42 per cent.



Energy Efficiency

Real life example how to evaluate savings opportunities via energy efficiency assessments (1/2).

Industry: Food and Beverage Industry

Application: Various Process Pump and Fan Applications

Customer needs

- Reduce operation cost and utility bill
- Optimize pump and fan operations
- Extend lifetime and reduce maintenance cost of ageing production assets

Solution

- Energy efficiency assessment
- Supply high-efficiency motor and variable-speed drive technology for new investment
- Commissioning and start up support
- Training & Maintenance recommendations
- Lifecycle support

Energy Efficiency services simplifies complex challenges

Review Application

- Identify rotating equipment and centrifugal loads (typically pumps/fans)
- Select high hour operation processes with variable flow requirements
- Look for process control improvements
- Look for mechanisms that control motor on/off and pressure reduction or mechanical valves
- Select best candidates for further analysis

Typical information collected

- Motor rating plate data (kW & Voltage)
- Pump/Fan rating plate data
- Annual operating hours
- Load duty cycle
- Electricity cost EUR/kWh

Energy Efficiency

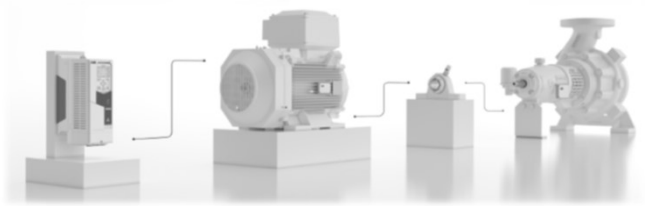
Real life example how to evaluate savings opportunities via energy efficiency assessments (2/2).

Assessment

- "Running costs" is the estimated energy cost for running the application in the old configuration.
- "Annual savings" is the estimated amount of electricity that is saved in one year for this application, compared to the old configuration.
- "Budgetary investment" is a budgetary indication for the potential costs of motors and/or drives to realize the solution for each application.
- "Payback time" is the amount of time it takes for the accumulated savings to exceed the initial investment.
- CO_2 reduction/yr converts the estimated yearly energy savings to CO_2 using the formula [1kWh = 0.5 kg CO_2].
- "Net present value" (NPV) is calculated over a 10 year period, by discounting the estimated yearly savings by the given interest rate. The energy bill is paid yearly at the end of the year.
- Interest rate in this assessment is 6 % and electricity cost 0.1 EUR/kWh.

Outcomes

- Utility bill savings >2,2 MEUR/year, return of investment 6 months, CO_2 emissions reduced >11 ktons/year and net present value >15 MEUR.



Application	Qty	Running costs/year	Investment	Savings/year**	Energy saved/year	Payback time	CO2 reduction/year	Net present value****
TC1,2 A5/A7 (A9/A1 Standby)	2	688 635 EUR	143 000 EUR	211 583 EUR	2 116 MWh	8 Months	1 058 t	1 453 931 EUR
TC1,2 S2 S4	2	228 436 EUR	38 400 EUR	49 983 EUR	500 MWh	9 Months	250 t	338 851 EUR
TC1,2 F3/F4/F5/F7	1	331 906 EUR	71 500 EUR	120 765 EUR	1 208 MWh	7 Months	604 t	839 980 EUR
TC1,2 F8/F9/F10	3	937 569 EUR	315 000 EUR	580 049 EUR	5 800 MWh	6 Months	2 900 t	4 062 934 EUR
TC1,2 VAI 1/2/3	1	79 407 EUR	14 500 EUR	17 804 EUR	178 MWh	9 Months	89 t	119 880 EUR
TC1,2 K	1	51 697 EUR	10 500 EUR	19 116 EUR	191 MWh	6 Months	96 t	133 781 EUR
TC1,2 M7-M15	5	689 294 EUR	127 500 EUR	259 909 EUR	2 599 MWh	5 Months	1 300 t	1 834 171 EUR
OLD AC 1/2/3	2	182 380 EUR	21 000 EUR	27 405 EUR	274 MWh	9 Months	137 t	185 840 EUR
OLD Ep B2-B6	2	544 059 EUR	114 000 EUR	121 170 EUR	1 212 MWh	11 Months	606 t	800 535 EUR
OLD Ep F1	1	340 670 EUR	67 000 EUR	102 144 EUR	1 021 MWh	7 Months	511 t	703 936 EUR
OLD HP 3/HP 7	1	178 466 EUR	16 000 EUR	26 817 EUR	268 MWh	7 Months	134 t	186 400 EUR
OLD HS1+2	2	104 556 EUR	32 000 EUR	39 394 EUR	394 MWh	9 Months	197 t	265 330 EUR
OLD L3+L4+L6	3	201 778 EUR	58 500 EUR	119 124 EUR	1 191 MWh	5 Months	596 t	840 589 EUR
OLD L8+L9	2	143 400 EUR	47 000 EUR	93 023 EUR	930 MWh	6 Months	465 t	655 090 EUR
TC4 I1+I3	2	200 162 EUR	38 000 EUR	120 350 EUR	1 203 MWh	3 Months	602 t	870 343 EUR
TC4 C1+C3	2	360 942 EUR	52 000 EUR	82 696 EUR	827 MWh	7 Months	413 t	572 150 EUR
TC L1+L3	2	217 263 EUR	31 000 EUR	59 190 EUR	592 MWh	6 Months	296 t	415 740 EUR
TC4 S1+S3+S4	3	320 188 EUR	64 500 EUR	113 431 EUR	1 134 MWh	6 Months	567 t	791 625 EUR
TC1,2 G3 +G7	2	213 459 EUR	38 400 EUR	75 766 EUR	758 MWh	6 Months	379 t	533 446 EUR
Total		**6 014 268 EUR**	**1 299 800 EUR**	**2 239 720 EUR**	**22 397 MWh**	**6 Months**	**11 199 t**	**15 604 553 EUR**

Energy Efficiency

How OEE impacts your production?

Case: Bakery (cont'd)

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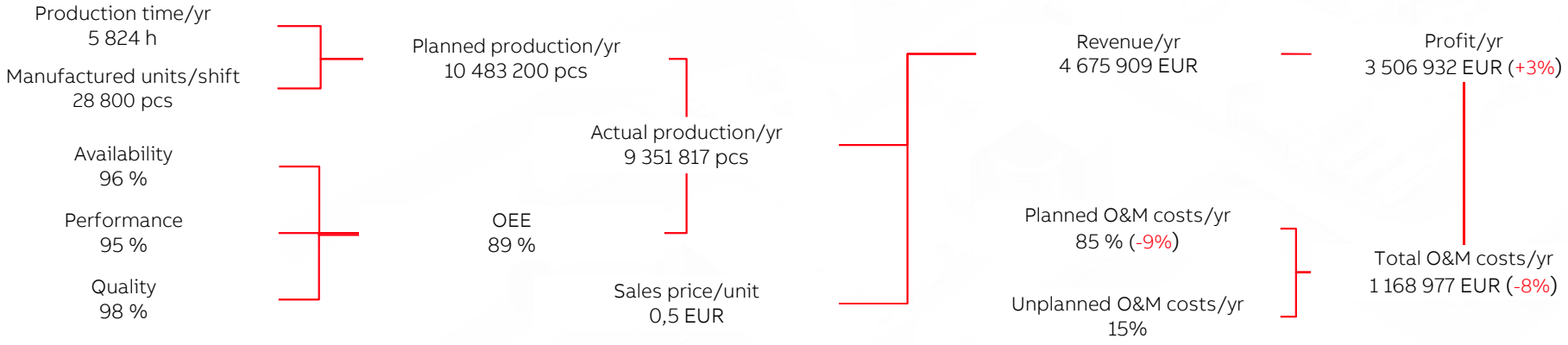
* Contribution to average time lost is 52 min per shift

Energy efficiency have a direct influence on OPEX and lifetime profitability.

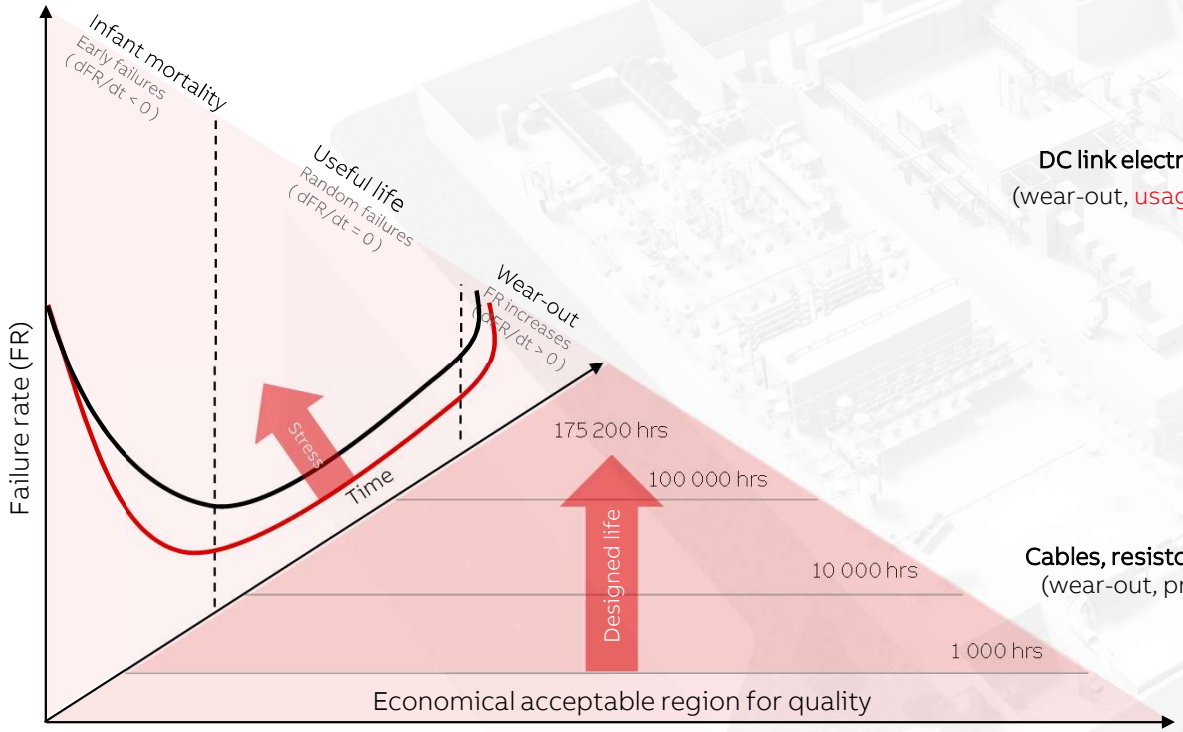


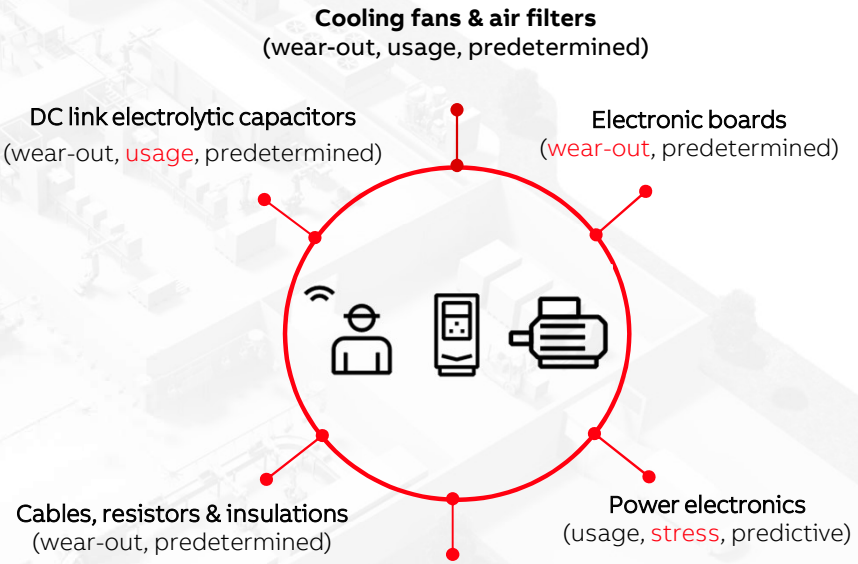
Sustainable solutions

Sustainable solutions

Reliability, availability and maintainability is key for operational excellence

Ageing assets needs tailored solutions

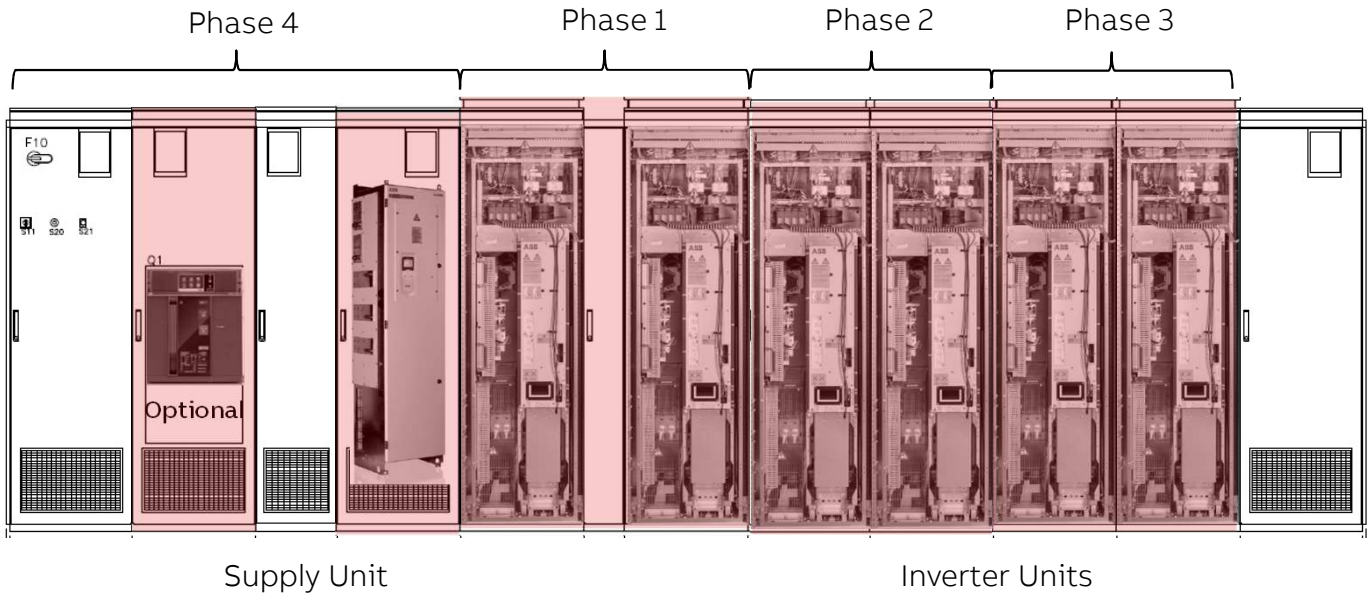




Sustainable solutions

Extending the lifetime of your powertrain

Example of modernization project



1. Step-by-step installation

- If you have a large base of installed drives, the ABB Retrofit Service can be implemented in phases to avoid lengthy shutdowns.

2. Optimizing planned downtime

- The Modernization Service can be carried out in line with your own production schedules, to minimize the interruption to operations.

3. Rapid deployment

- Certified engineers are trained and available to carry out retrofits rapidly.

4. Reduced wastage and investment

- By re-using the existing drive's cabinet, cables and motors, the Retrofit service helps you retain more of your original investment and modernize more efficiently.

Sustainable solutions

How modernization impacts your production?

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Modernization can have a direct influence on OPEX and lifetime profitability.

Production time/yr
5 824 h

Manufactured units/shift
28 800 pcs

Availability
96 %

Performance
95 %

Quality
98 %

Planned production/yr
10 483 200 pcs

OEE
89 %

Actual production/yr
9 351 817 pcs

Sales price/unit
0,5 EUR

Revenue/yr
4 675 909 EUR

Planned O&M costs/yr
85 % (-25%)

Unplanned O&M costs/yr
15% (-15%)

Profit/yr
3 506 932 EUR (+8%)

Total O&M costs/yr
1 168 977 EUR (-24%)

Sustainable solutions

Improving profitability by modernizing ageing assets economically

Solutions tailored throughout assets lifecycle

Quick and easy deployment

Ensure the best modernization solution tailored to suit your needs and schedule economically.

Reduced operational risks

Our expertise and global operations can significantly reduce risks of unexpected interruptions in your production.

Manage your assets' obsolescence economically

Minimize your operational risks

Improve your safety and sustainability

Extend the lifetime of your assets'

Secure availability and improve performance of your

Enable digitalization

Sustainable solutions

Lifecycle and energy efficiency assessment is a smart way to make a sustainability plan.

Outcome

- Identify your process and the highest energy saving potential
- Increase your process availability
- Reduce your utility bills by ensuring optimized total cost of ownership
- Reduce greenhouse gas emissions and enhance your assets energy security
- Know exact payback period of your investment
- Ensure lowest lifecycle cost

Improve your process productivity and energy efficiency

1

Assess the assets' of production processes

2

Increase overall equipment effectiveness & energy efficiency of processes by the smart motion

3

Start building your carbon-neutral economy plans and optimize your total cost of ownership

Summary

Achieving operational excellence in industry requires to remain agile, improve productivity and efficiency at the plant level.

- Leveraging the best engineering technologies and innovations can improve equipment reliability, improve maintenance standards, extend equipment longevity, reduce unscheduled and scheduled downtime, reduce energy and water consumption costs, as well as and reduce emissions and waste.
- With the right information and technical data, you can remain agile and improve operational excellence, ensuring that you are not only profitable, but operating as efficiently, productively, and as safely as possible.

So let’s talk

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