

# — Practical ways to apply data analytics and AI for sustainability

Process industries' imperatives

1. Energy management case in steel
2. Emission control case in cement

Advances 2021 | Digitalisation of the process industries



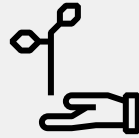
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# Strong action imperatives for energy-intensive process industries



Tight regulations



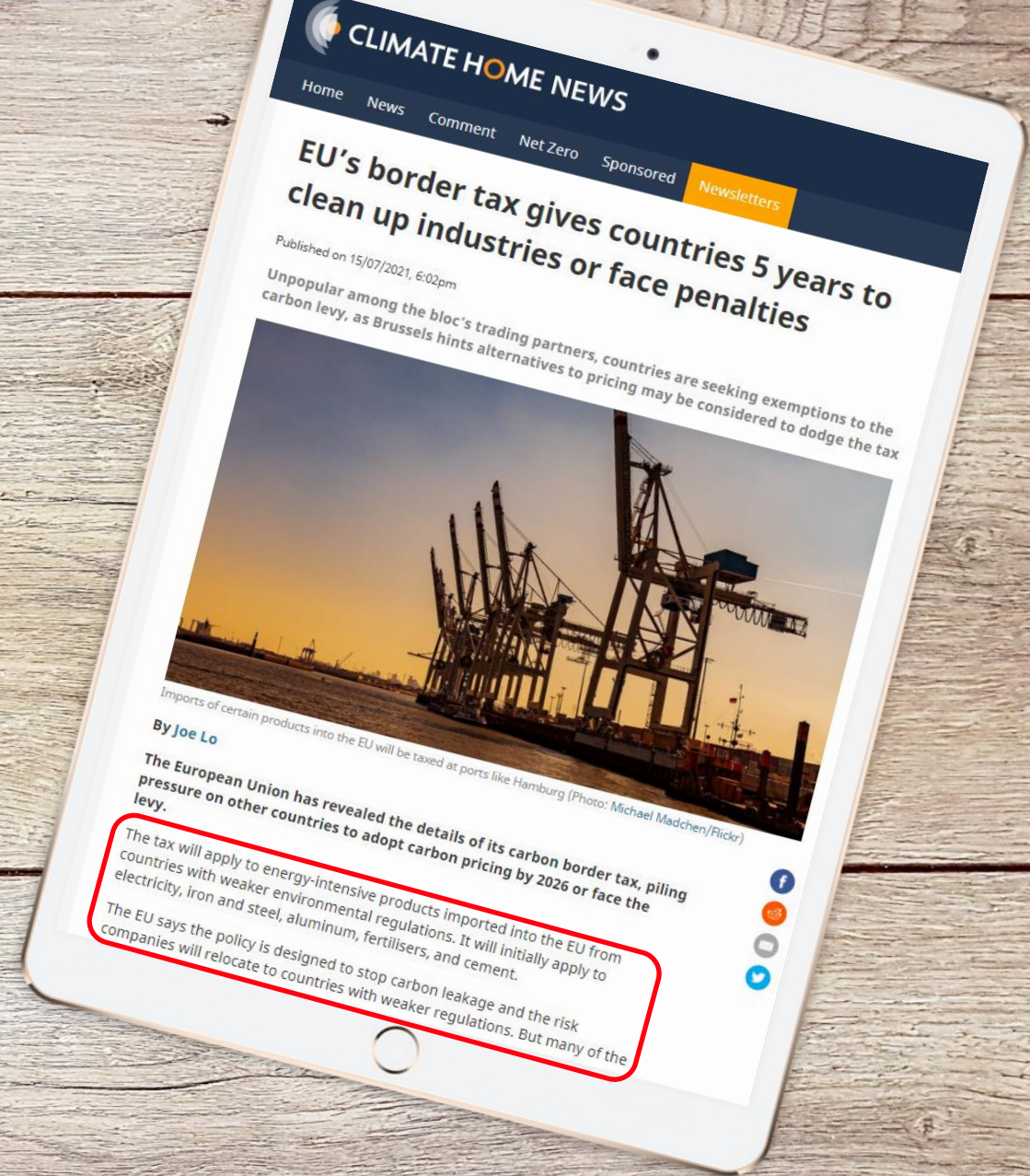
Social & environmental reputation



Technology advances



# New EU carbon border tax will apply to electricity, iron and steel, aluminium, fertilisers, and cement



# The race is on to earn a spot among the sustainable companies

## Corporate Knights

THE VOICE FOR CLEAN CAPITALISM

SINCE 2002

### 2021 Global 100 ranking

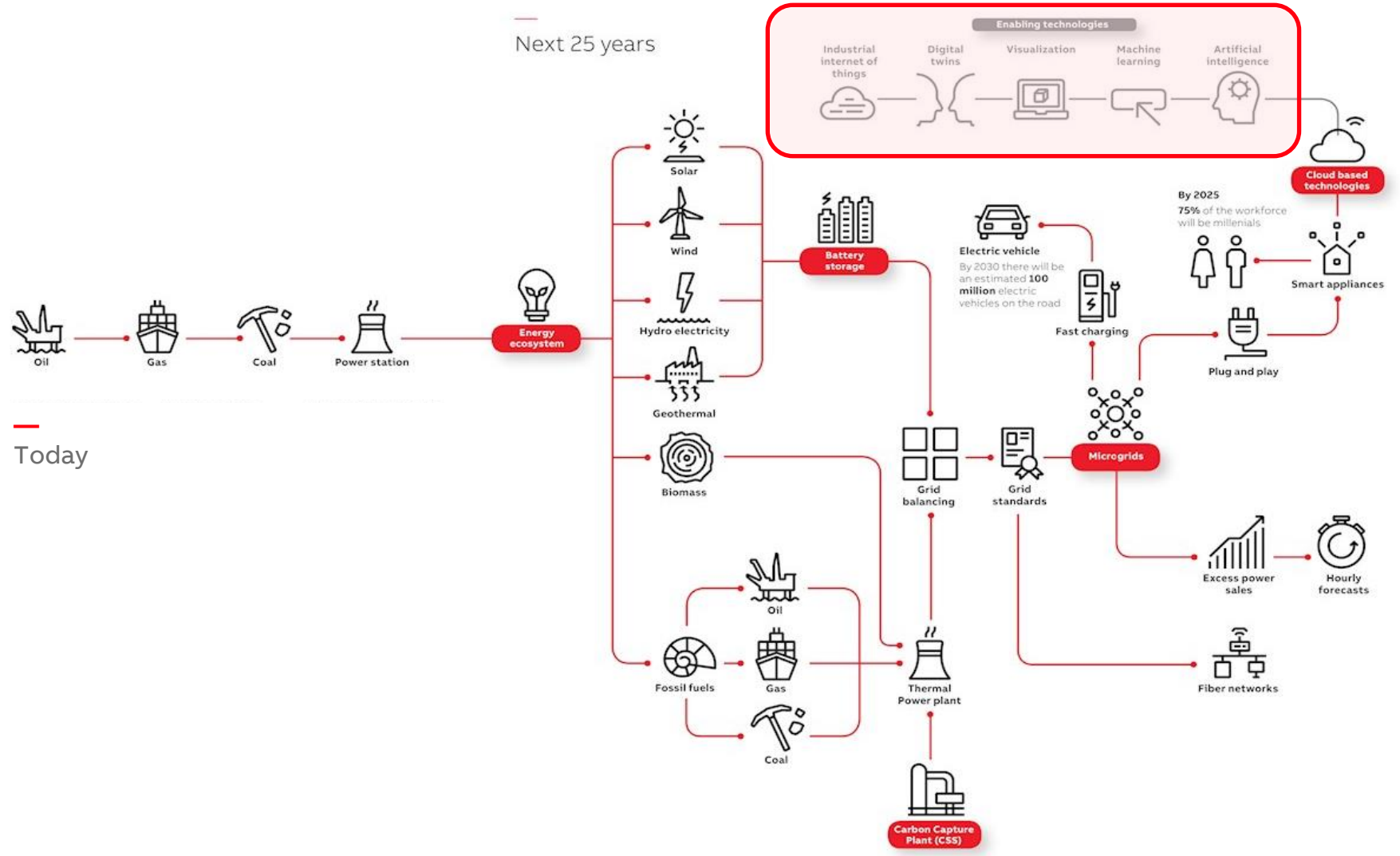
Which companies earned a spot on Corporate Knights' index of the world's most sustainable corporations?

BY CK STAFF  
JANUARY 25, 2021



Rank 2021	Rank 2020	Company	Country	Climate Commitments	Overall Score
1	29	Schneider Electric SE	France	1.5°C, SBTi	83.2%
2	1	Ørsted A/S	Denmark	1.5°C, SBTi	82.7%
3	9	Banco do Brasil SA	Brazil		81.7%
4	3	Neste Oyj	Finland		80.7%
5	57	Stantec Inc	Canada	1.5°C, SBTi	80.5%
6	22	McCormick & Company Inc	USA	SBTi	79.3%
7	23	Kering SA	France	SBTi, FCCA	78.4%
8	18	Metso Outotec	Finland	SBTi	78.4%
9	16	American Water Works Company Inc	USA		77.1%
10	54	Canadian National Railway Co	Canada	SBTi	77.1%
11		Rexel SA	France	SBTi	76.6%
12		Atlantica Sustainable Infrastructure PLC	UK		76.5%
13	4	Cisco Systems Inc	USA	SBTi	75.8%
14	13	Storebrand ASA	Norway	1.5°C, SBTi, NZAO	75.2%
15		Owens Corning	USA	SBTi	74.6%
16		Eisai Co Ltd	Japan	SBTi	74.3%
17	49	Cascades Inc	Canada		73.4%
18		Brambles Ltd	Australia	1.5°C, SBTi	72.9%
19	17	Iberdrola SA	Spain	1.5°C, SBTi	72.8%
20	25	Taiwan Semiconductor Manufacturing Co Ltd	Taiwan		72.8%

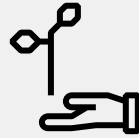
# Digital technologies enabling the new energy ecosystem



# But many energy savings and emission reduction opportunities remain untapped



Tight regulations



Social & environmental reputation



Technology advances



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# Energy Management

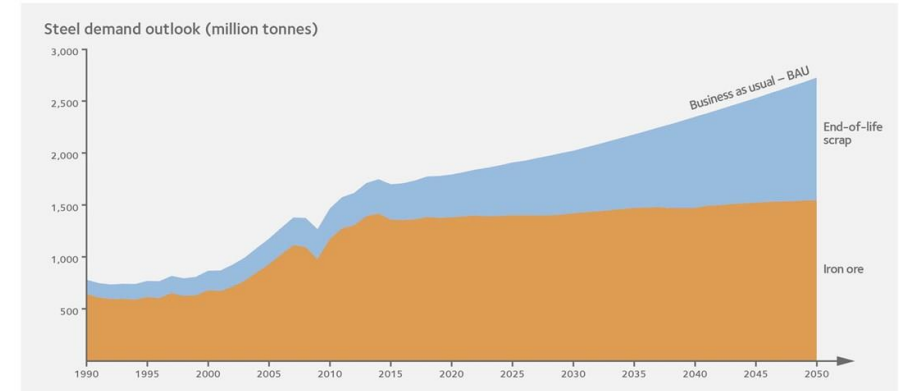
## Steel case

# At a steel plant with annual capacity of up to 5 million tons of steel

Complex distribution networks for **electricity, steam, by-product gases and imported fuels** make up to

**20%** of production cost

« Iron ore reduction is where the vast majority of carbon emissions come from in steelmaking. Transforming how we make steel depends on the **energy sources** available.»





# Site-wide optimization: managing energy purchase and production including site power plants and turbines

- Assists gas dispatching, calculates optimal power production based on real-time data and adapted to power market
- Optimizes energy consumption and secures energy availability considering steam yield, consumption of by-product gases, energy purchase and production including site power plants and turbines



**10%** less flaring of gases thanks to data and optimization model



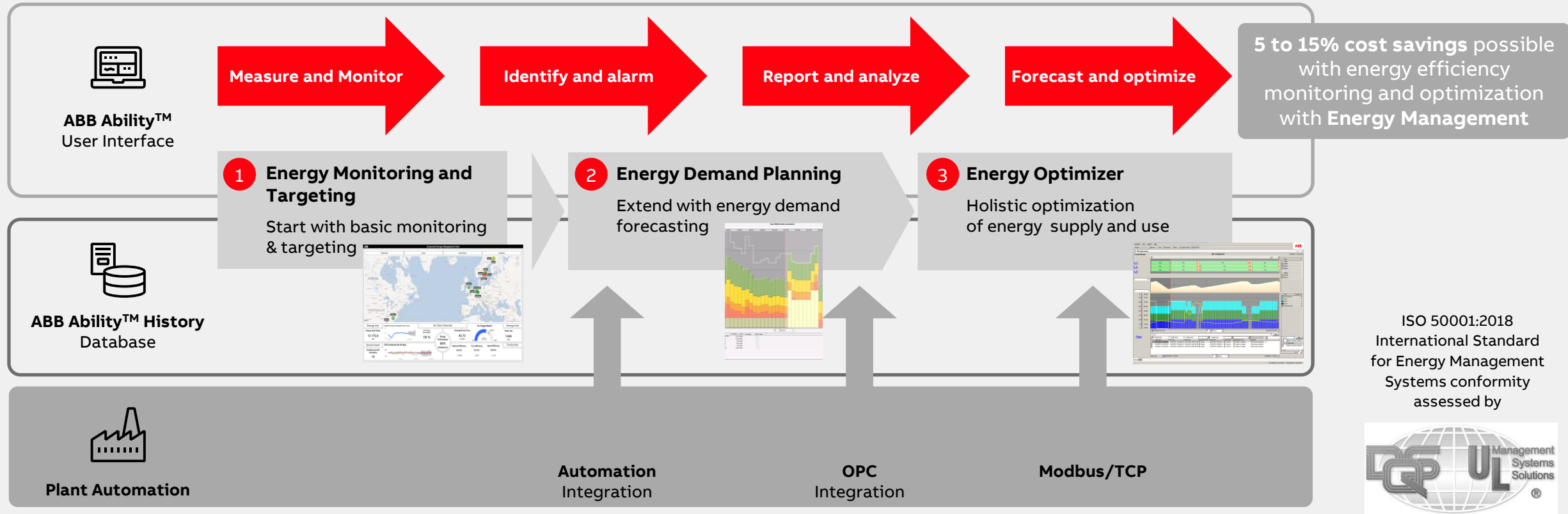
**15%** accuracy improvement of electricity procurement forecasts



**15k€** per month saved (yearly average)

Results achieved with rule-based energy management algorithms

# Deploying digital energy management system – modular approach

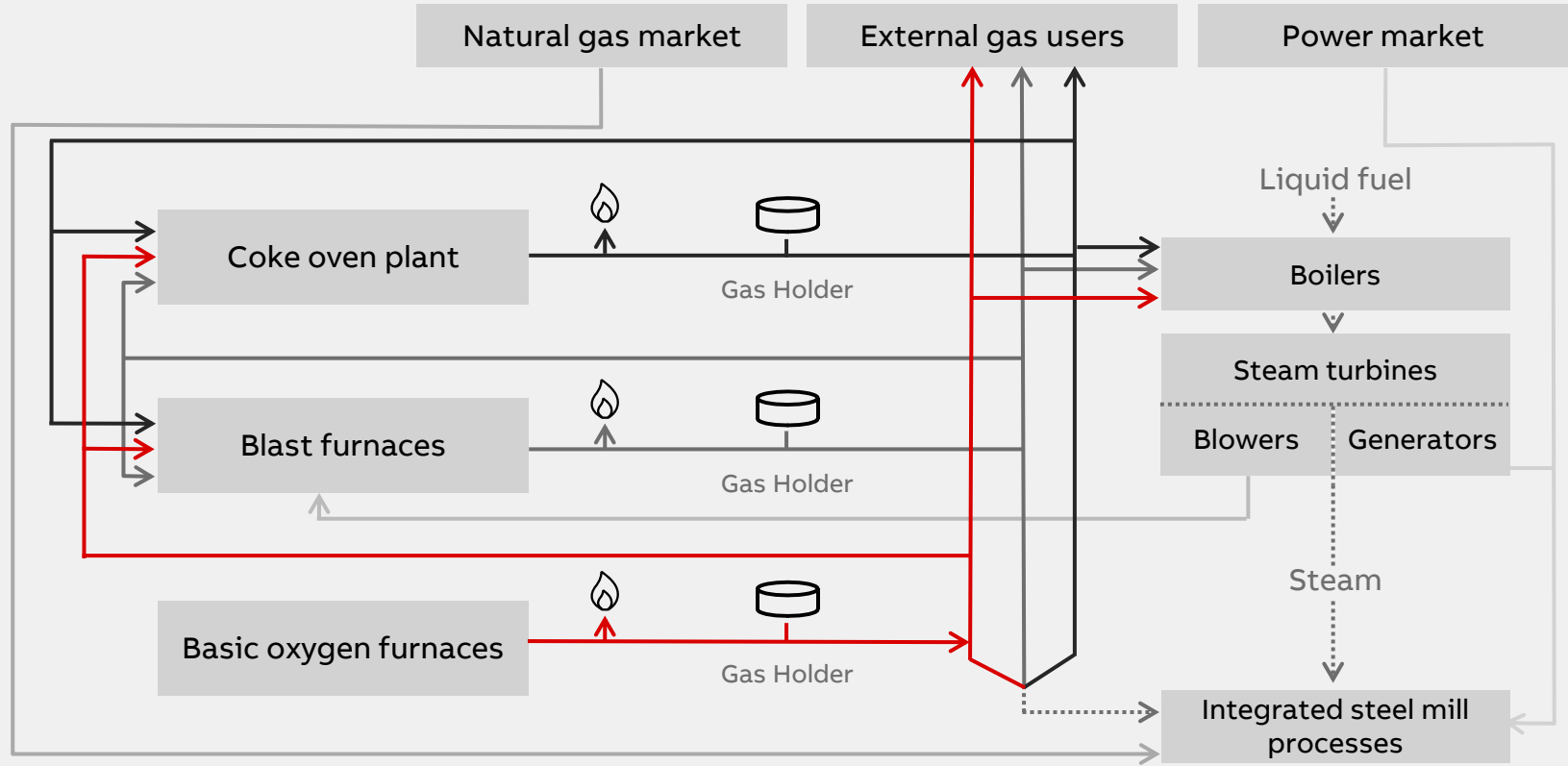


# Byproduct Gases Network Optimization

Energy Recovery    Energy Reduction    Energy Substitution

Energy Management Optimization

- Energy-rich (~ 700 – 4300 Kcal/Nm<sup>3</sup>) byproduct gases are generated in large volumes during iron and steel making processes
- Byproduct gases are consumed by processes and also to generate power in captive power plants



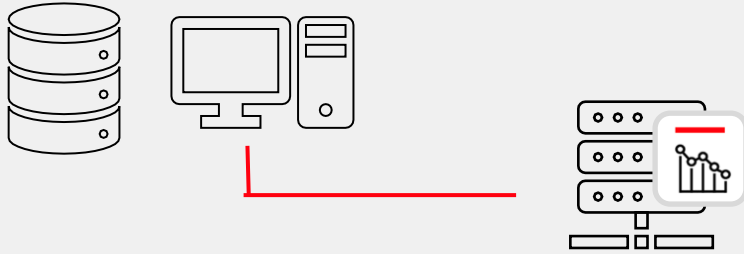
**Up to 5% savings from optimal allocation of gas and recommendations for utility production + savings from finding root cause of increased gap in supply & demand and improved power purchase forecast**

# A perfect use case for AI/ML : Integrated decision support system to drive continuous performance improvements

Reporting  
Monitoring &  
Optimization

Plant and  
Sensors

IT/ET systems



- ✓ Reduce energy consumption per product over years
- ✓ Improve profitability and sustainability footprint

## Industrial Analytics & AI

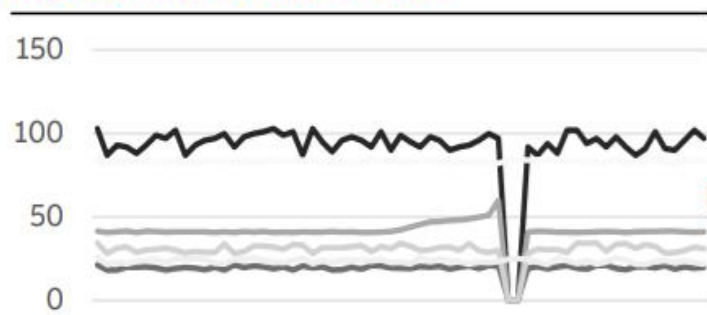
### ABB Ability™ Genix Sustainability Suite

On premise or Cloud or hybrid

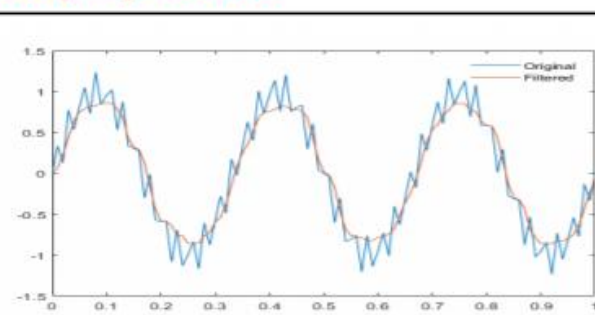


# Complementary AI-based app: System Anomaly detection on asset or system energy consumption deviations & alerts

Input: Time Series Data



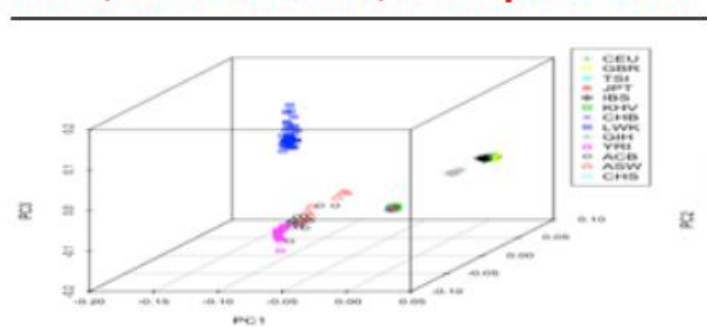
Data preparation



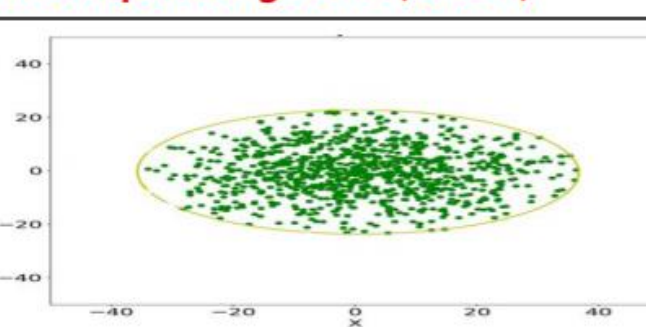
Determining dynamic threshold



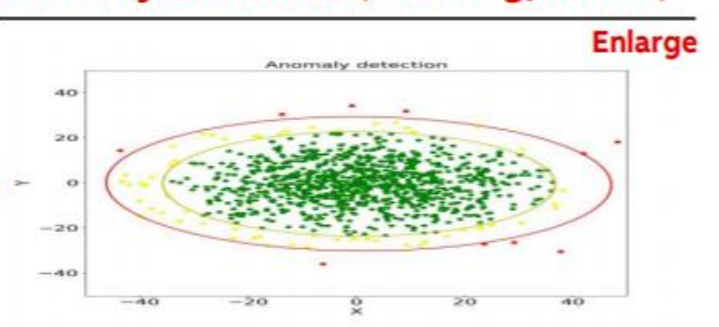
PCA (85% Variation) of all parameter



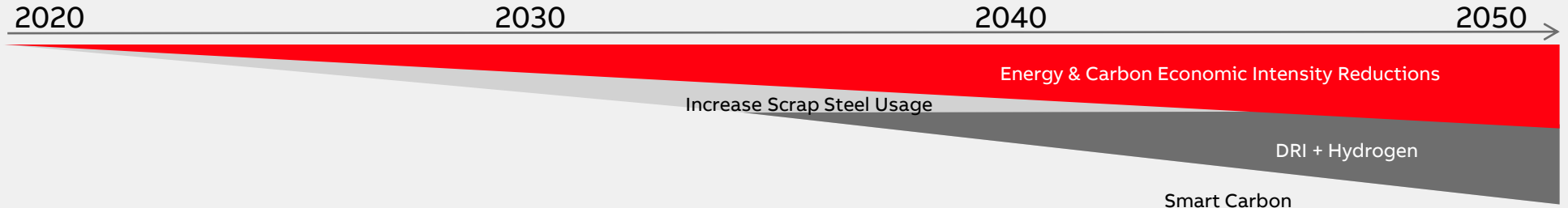
Stable Operating Zone (Green)



Anomaly Detection (Warning/Alarm)



# Decarbonization options ahead of hydrogen revolution



## Top steelmakers' Strategic Road Map

Available Energy Management Responses

Smart & safe operations

- Collaborative remote services
- Industrial Data Analytics and AI
- Lean value chain optimization
- Process optimization
- Plant Asset Management
- Data management Cyber security

ABB Innovations & Core Technologies

<b>1</b> Energy Recovery Minimize energy waste & work required by core process	<b>2</b> Energy Reduction Minimize energy supply needed to deliver core process work	<b>3</b> Energy Substitution Maximize energy & carbon efficiency of energy supply	<b>5</b> Hydrogen H2 replacing C, and carbon storage strategies	<b>6</b> Smart Carbon	
<b>4</b> Energy Management Optimization					
<b>APC Pelletizing</b>  1 2 4	<b>Demand-side Energy M.</b>  4	<b>Byproduct gases</b>  1 2 3 4	<b>Autonomous Stockyard</b>  2 3	<b>Conveyor Performance</b>  2 3	<b>Advanced Analytics &amp; AI</b>  1 2
<b>Smart Melt Shop</b>  2	<b>ArcSave® EAF-EMS</b>  1 2 4	<b>Consteerrerr™</b>  1 2 4	<b>Optimized rolling, etc.</b>  1 2 4	<b>Hydrogen pilot plant</b>  5	<b>Carbon capture pilot plant</b>  6



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# Emissions control

## Cement case

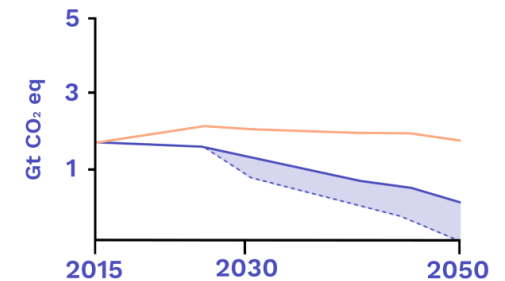
# A cement plant is constantly worried about deviating from daily SO<sub>2</sub> emissions limits and associated hydrate consumption

Due to **variability in feed and fuel sources**, coupled with complex dynamics, manual operators with PID control tend to **remain at “safe distances”** from process constraints, **at the cost of plant profitability.**

« We find it difficult juggling all the hydrate injection points with other pressing plant distractions. »



Emissions Trajectory for the Cement Industry From 2015 to 2050, in Gt of CO<sub>2</sub> eq



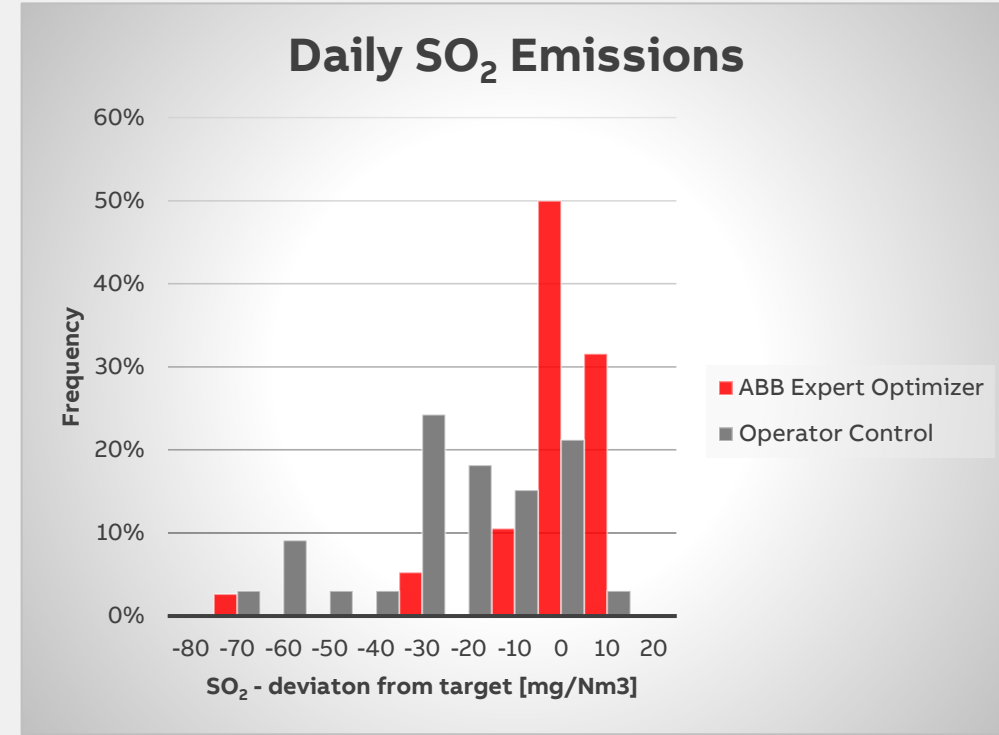
Source: [http://www3.weforum.org/docs/WEF\\_The\\_Net\\_Zero\\_Challenge.pdf](http://www3.weforum.org/docs/WEF_The_Net_Zero_Challenge.pdf)



# Advanced process control is successfully used to achieve zero violations of SO2 emissions while reducing hydrate consumption

- APC controller reduces operator workload by automatically optimizing the short-term exhaust SO2 target based on the current daily average
- Two optimization modes allow the operator to select either normal or aggressive optimization, the multiple feeder points of lime hydrate are automatically adjusted

Daily SO <sub>2</sub> Target: 340 mg/Nm <sup>3</sup>	Δ Target	STD	Eng. Unit
Operator Control	-27	21	mg/Nm <sup>3</sup>
ABB Ability™ Expert Optimizer	-6	14	mg/Nm <sup>3</sup>



**dramatic improvement** thanks to data, alternative optimization models



**Less hydrate consumption** With automatic adjustments of multiple feeder points

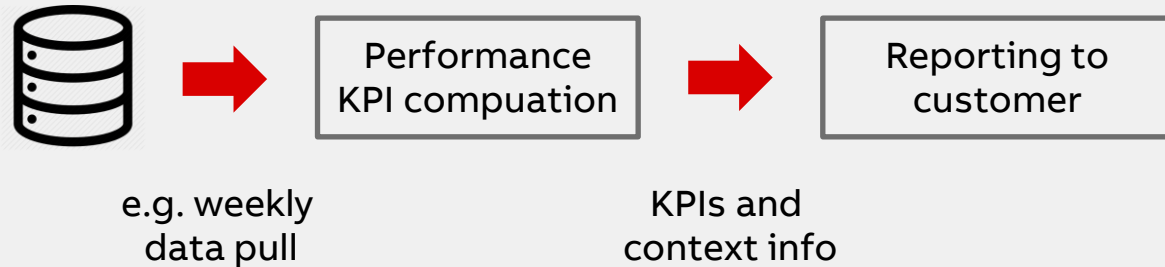


**Emission controller utilization** – high operator confidence

Results achieved with a “classic” APC solution and periodic evaluation of APC performance

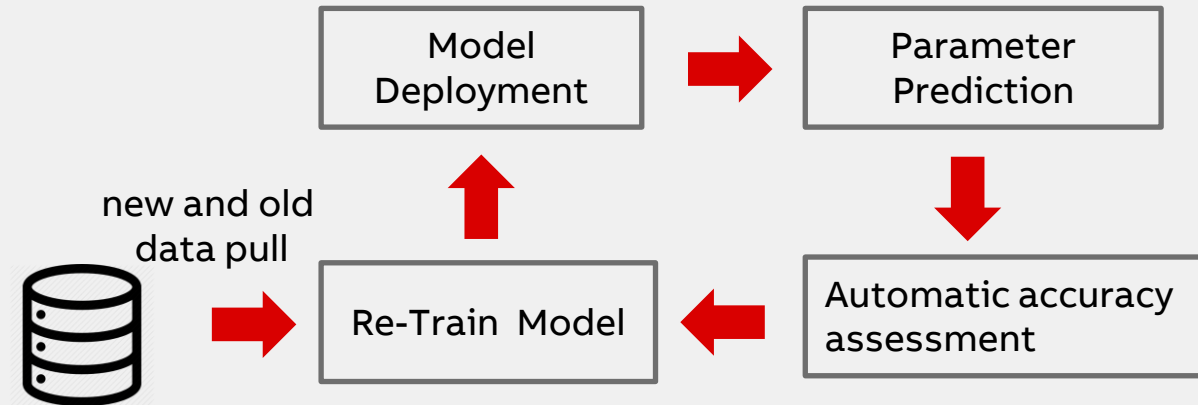
# A perfect use case for AI/ML: move towards **adaptive APC** for re-modelling & tuning, optimizing additional variables

## Periodic evaluation of APC performance



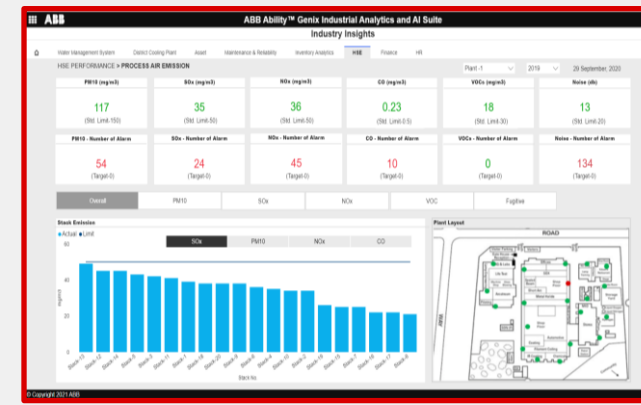
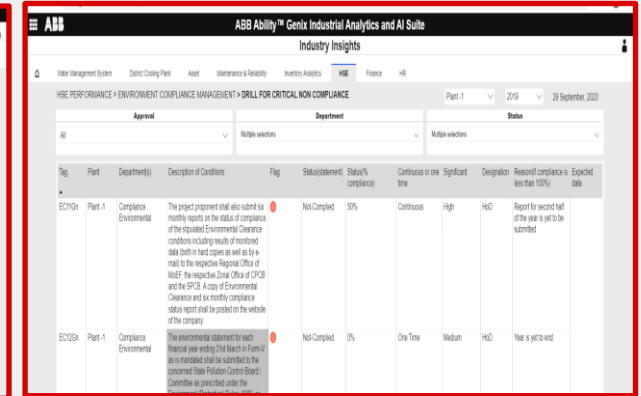
- The performance KPIs can be used to assess the solution over time.
- Performance KPIs:  
Control: IAE, ISE  
Estimation: measurement-model mismatch
- If critical thresholds are hit, re-identification can be triggered automatically

## Machine Learning component



- Automatic re-identification based on new and old data
- KPI comparison for old and new model
- Automatic assessment

# Examples of Industrial analytics for Environmental Monitoring and Compliance (GHG)

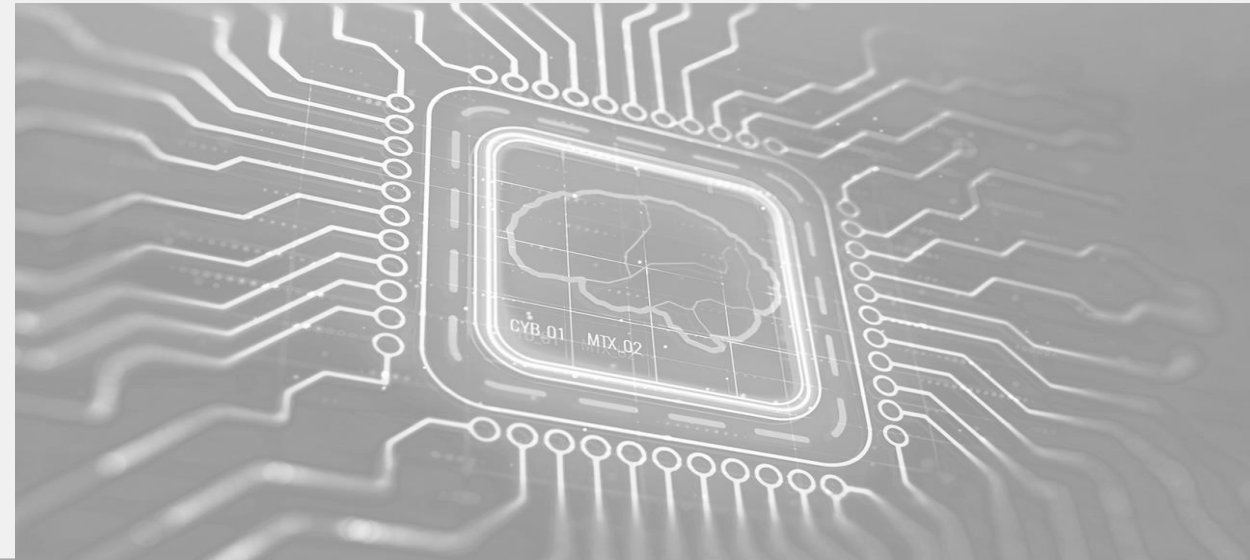


**Most of the cement-related CO2 reduction actions are good use cases for leveraging digital technologies and AI/ML**

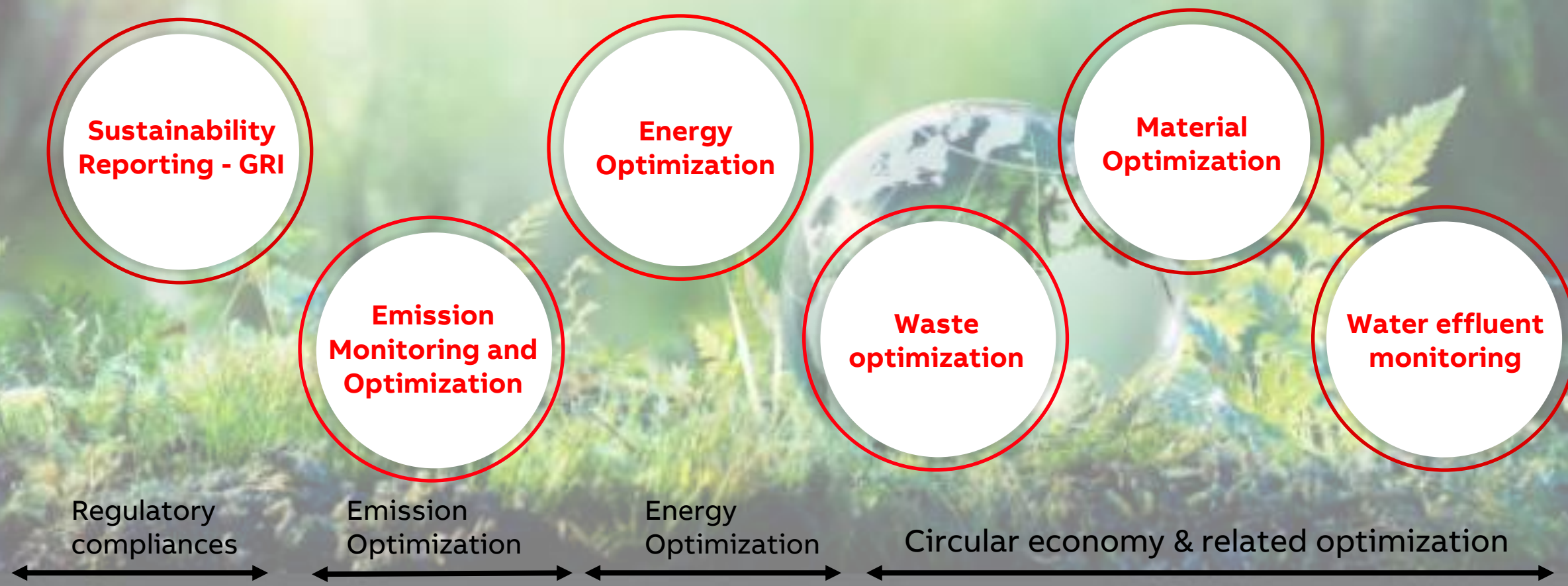
## Action and the possible impact on cement-related CO2 (% reduction in emissions)

Carbon capture and storage	<b>95-100%</b>
Novel cements	<b>90-100%</b>
Clinker substitution	<b>70-90%</b>
Alternative fuels	<b>40%</b>
Energy efficiency	<b>4-8%</b>

Source: Chatham House



# Industrial analytics & AI for sustainability - focus areas

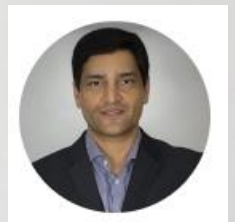




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# ABB Industrial AI Accelerator

[www.abb.com](http://www.abb.com)



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