

Carbon^{Re}

DeltaZero[®]

— CEMENT —

State-of-the-art process optimization

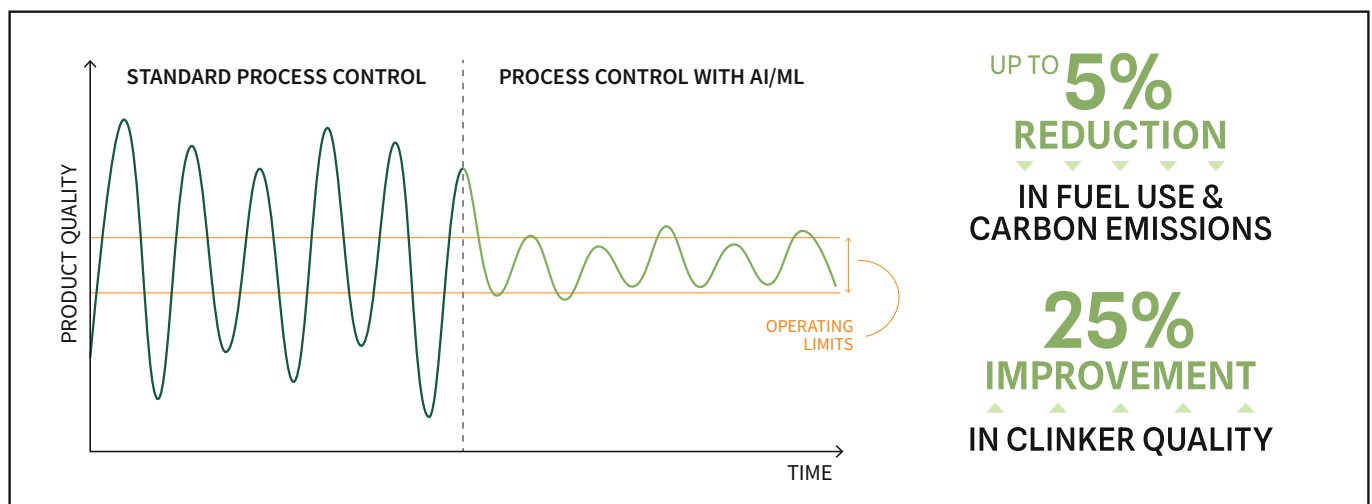
Powered by AI & Machine Learning

Enhances kilns run manually or by an expert system

AI-powered decarbonization

Delta Zero Cement is an AI-powered advanced process control platform designed for the cement industry. Developed in conjunction with cement industry experts and world-leaders in AI & Machine Learning, Delta Zero Cement targets the pyroprocess stage of cement production to reduce fuel consumption and carbon emissions. Delta Zero is powered by deep learning, a powerful branch of AI that can efficiently interact with complex systems to solve process optimization issues.

Delta Zero delivers continuously updating AI models, as digital twins, for each individual stage of production. These models simulate the highly complex, interconnected chemical and physical processes, enabling our AI agents to find solutions tailored to each plant and across all plant conditions.



KEY FEATURES & FUNCTIONS

Software sensors

On the Delta Zero platform, you will have access to software sensors for product quality and process parameters. Software sensors are virtual sensors that can simulate an installed sensor or sample measurement. Additionally, they can be built from corresponding data for metrics where no sensors have been deployed or where the environment restricts availability.

Set point recommendations

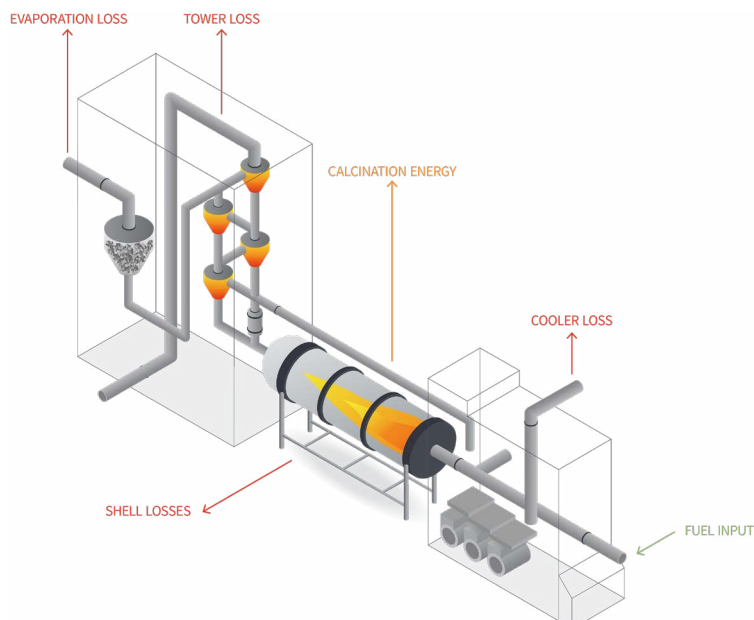
AI-modelled recommendations that provide real-time targets to the control room operators. No fixed models, the recommendations change as the plant conditions change and the models automatically retrain to match plant changes. Operators can action the recommendations directly or they can be input into an expert system in an open or closed loop process.

KPI monitoring

Important process metrics such as Specific Heat Consumption, or Product Quality can be visualised and tracked easily on the Delta Zero platform. Observation of these KPIs will show how your plant is tracking against target and highlight the improvement of plant operations using Delta Zero.

Daily heat balance map

A bespoke heat balance analysis automatically produced for your kiln on a daily basis.



BENEFITS

- Improved product quality
- Live, continuous data between real samples measured
- Flag a faulty physical sensor
- Identifies erroneous samples or measurements

- Real-time optimization capabilities
- Open or Closed loop integration with Expert System run kilns

- Real time visibility of key metrics such as specific fuel cost
- Customisable priorities between production and costs

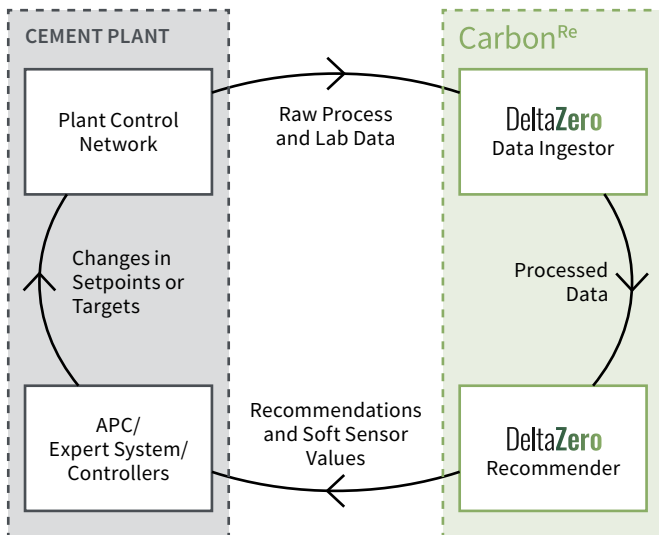
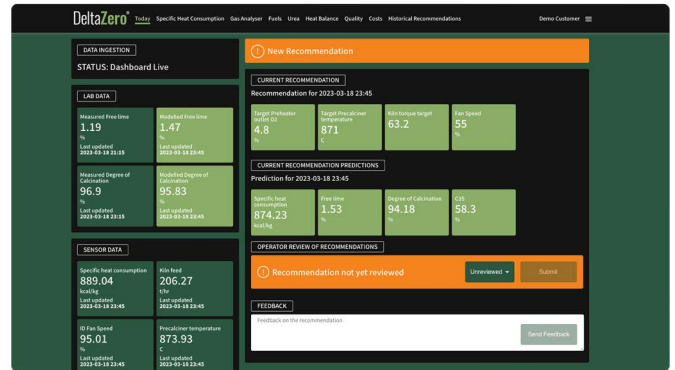
- Visibility of major sources of heat loss
- Shows causes of variation in performance as well as sources of loss
- Frees up process engineering resource for higher priorities

OPEN OR CLOSED LOOP

Open: “Human in the Loop”

Delta Zero can operate as a human-in-the-loop solution, where the plant operator maintains control over production processes. The dashboard displays specific and quantified predictions and recommendations to be actioned by the operator. Delta Zero simplifies a complex operating environment and uses the latest design tools to reinforce positive behaviours and augment human expertise.

On the Delta Zero platform homepage, users can review the real-time operations of their plant and review the AI-modelled recommendations. ▶



Closed loop integration

Where desired by the customer, Delta Zero predictions and recommendations can be directly fed into the expert system by the customer to optimize the process. For example, every 15 minutes Delta Zero will feed a new Clinker Free Lime (%) prediction directly into the expert system. The PC Temperature recommendation from Delta Zero can then be provided to the control room operator every 2 hours (configurable with the customer).

Equally, all predictions and recommendations can be fed fully and directly to the expert system with no action required by the control room operator.

◀ For APC run kilns, Delta Zero can integrate in a closed loop process, changing set-points and targets directly through the control system.

DeltaZero[®] CORE

Capabilities

- Precalcriner temperature target recommendation
- Live product quality sensor e.g. free lime
- Live degree of calcination soft sensor
- Open or closed loop integration with the kiln control system
- Online dashboard with unlimited number of authorized users
- Daily heat balance analysis
- Visualization and analytics on plant metrics
- Live connection to secure cloud hosting platform

DZLaunchpad

Low-cost access to AI optimization

DZ Launchpad is a limited offer for digitally mature plants to introduce Carbon Re's state-of-the-art AI platform, Delta Zero. The program accelerates access to our Delta Zero platform, boasting a **heavily discounted set-up fee** with 8 weeks of access to the platform.

After the completion of DZ Launchpad, our team can work with you to conduct bespoke modelling to prioritize your plant's needs.



Learn more at www.carbonre.com/dz-launchpad

STEPS FOR A SUCCESSFUL INTEGRATION

Signing up for the programme is straightforward and simple

From kick-off, we expect the core capabilities of Delta Zero to be live in 3 months.

PROGRAMME ONBOARDING	DATA DISCOVERY	ANALYTICS & MODELLING	IMPROVEMENT DELIVERY	ONGOING ENHANCEMENT
<ul style="list-style-type: none"> Identify plant(s) Confirm viability with Plant Questionnaire Provide list of all DCS tags and chemistry samples e.g. kiln feed, clinker, fuel Define plant baseline performance 	<ul style="list-style-type: none"> Connect live plant data feed Receipt of historic plant data Data mapped to Delta Zero framework Plant data analysis 	<ul style="list-style-type: none"> Review & analysis of data anomalies Verification of data visualisations AI agent training Creation of Digital Twin for the cement plant Models deployed to the cloud 	<ul style="list-style-type: none"> Initial daily review of predictions and recommendations Review & tailor recommendations Adjustments & any additional control limits 	<ul style="list-style-type: none"> Regular performance review Ongoing training & development programme for Control Room Operators Continuous model development

Carbon Re is transitioning the cement industry from reactive to predictive

With Delta Zero's cloud-based technology, unlike on-premise solutions, continuous improvement from regular monitoring of data distributions and subsequent automatic retraining of models, is delivered as part of the subscription price, with minimal upfront capital expenditure. And because of the savings we produce, the initial investment is recovered within months. What's more, Carbon Re's support and great service doesn't end upon integration. We work closely with your plant team to ensure the successful implementation and utilisation of the software.



**FAST TO
DEPLOY**



**NO SHUTDOWN
NEEDED**



**NO NEW LOCAL
IT SYSTEMS NEEDED**



**NO EXTRA HARDWARE
NEEDED**

About Carbon Re

Carbon Re is an AI for materials company on a mission to reduce carbon emissions by gigatonnes every year through the use of AI technology. A joint spin-out of Cambridge University and UCL, we are focusing on decarbonizing cement and other foundational materials (such as steel and glass) which are responsible for more than 20% of global emission. Carbon Re has a world class interdisciplinary team with expertise in AI, industrial processes, software engineering, mathematics, fluid dynamics, innovation, organisation change and product development. Delta Zero Cement uses machine learning to optimize fuel use and quality in cement production.

FIND OUT MORE:



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www.carbonre.com/delta-zero