

MAY 18, 2022

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# Decarbonisation with AI & Digital Transformation

OYAK Cement 4.0 Project «IndustrAI»

Presented By: Berkan Fidan

**AVEVA**

# About CIMPOR Global Holdings BV

CIMPOR Global Holdings is a group of companies established by Ordu Yardımlaşma Kurumu (OYAK) and Taiwan Cement Corporation (TCC) that operates in the field of Cement, Concrete, Kraft Paper, and Bag.



CIMPOR Global Holdings operates in the Netherlands, Turkey, Portugal, Romania, Ivory Coast, and Cape Verde; incorporates the OYAK Cement, CIMPOR Portugal & Cape Verde and CIMPOR Côte d'Ivoire brands.

# Cement Operations of CIMPOR Global



## OYAK Cement

Turkey's largest cement and concrete brand

Production capacity:  
22.5M tons of cement  
12.4M tons of clinker



## CIMPOR Portugal & CV

The leader of the cement industry in Portugal and Cape Verde

Production Capacity:  
5.5M tons of cement  
8.4M tons of clinker



## CIMPOR Côte d'Ivoire

World's first greenfield calcined clay integrated cement plant

Production Capacity:  
0.8M tons of cement  
0.4M tons of calcined clay

# Digital Transformation Journey of CIMPOR GH

## OYAK Cement 4.0 Project

| Challenge  | Solution   | Benefits   |
|--|--|--|
| <ul style="list-style-type: none"> <li>• Online visualization of cement, concrete and aggregate operations on 3 different continents</li> <li>• AI Supported Industrial Ops – Priority Use Cases               <ul style="list-style-type: none"> <li>• In-process predictions to improve efficiency, productivity and quality of products</li> <li>• High reliability with predictive and prescriptive maintenance methodologies</li> <li>• Tracking CO<sub>2</sub> emissions and predictive approach on NOx emissions</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Main architecture was developed by PI AF with standardized formats</li> <li>• Drill-down original visualization structure was generated with PI Vision</li> <li>• Classified tags and calculated artificial data are filtered, validated and transferred simultaneously to AI engine by the help of PI Integrator for BA</li> <li>• AI supported predictions are collected in PI System, monitored and analyzed at PI Vision as actual, past and future data</li> </ul> | <ul style="list-style-type: none"> <li>• Improved capacities, less energy consumptions and higher overall equipment efficiencies</li> <li>• High accuracy and efficiency on pyro-processing and grinding stages with frequent F.CaO and fineness data</li> <li>• Anomaly detections on equipments before failures, and predicting potential failures</li> <li>• Predicting upcoming NOx emissions and managing the process &amp; managing reducing actions</li> <li>• Monitoring actual CO<sub>2</sub> levels and actual effects of actions</li> </ul> |

# The Motivation of Digitalization in Cement Industry

## Potentials with adaptive, compatible and manageable data infrastructure

- Operational activities in 18 different cement plants, +100 RMX concrete plants and +10 aggregate plants on 3 different continents
- Comparably high amount of data with high frequency (nearly 800 billions of individual records per year)
- Unique quality evaluation principles, and optimization & management of future results
- Continuous processes and relational efficiency effects
- Energy-intensive operations – direct effect of high efficiency on performance and the costs
- Low maintenance & service costs with high reliability and preventive actions
- Lastly but most importantly; **potentials on CO<sub>2</sub> reduction and the sustainability**



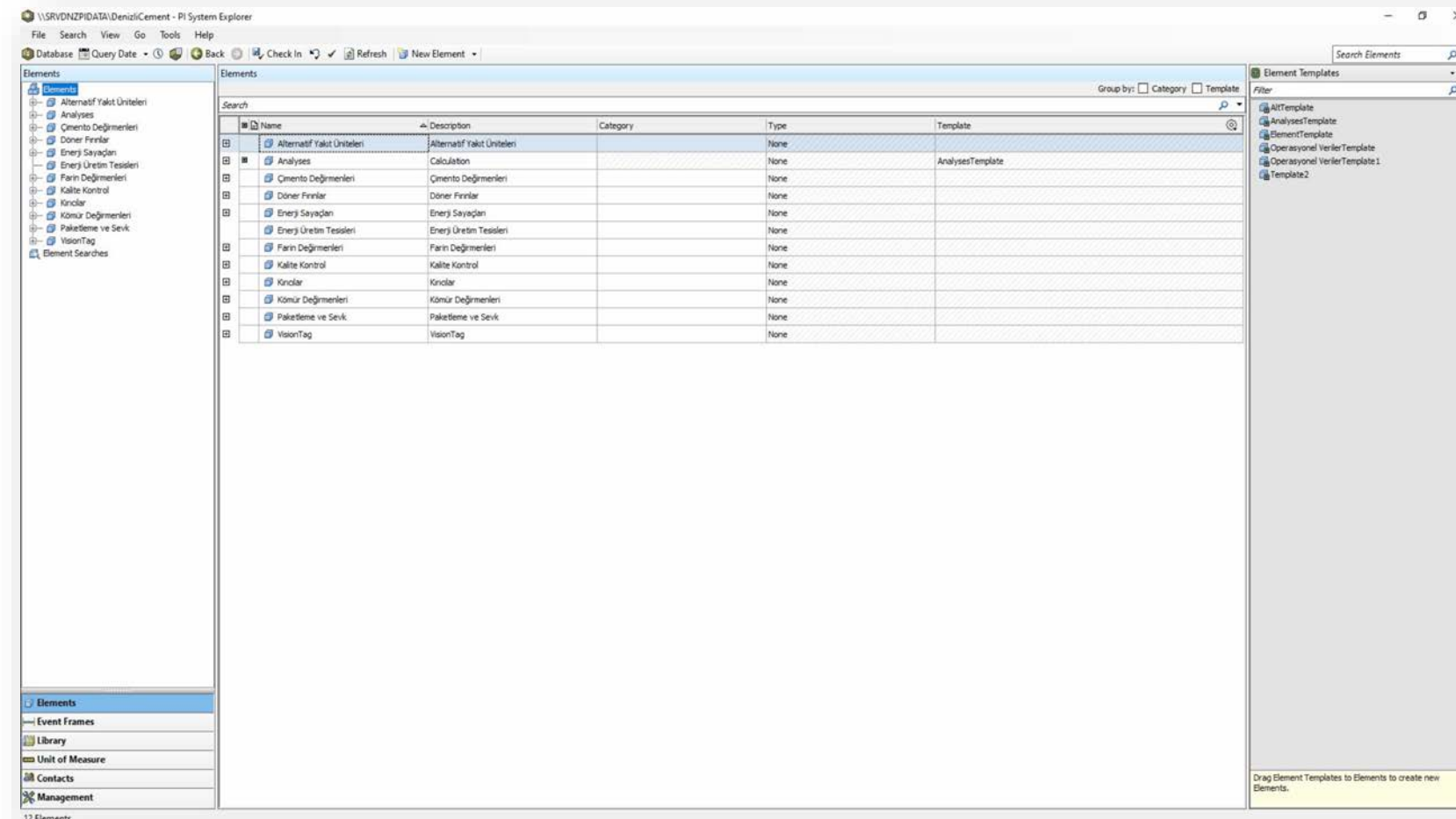
# The Challenges

## Collection of messy data and evaluation with a standard vision

- Well-organized and globally connected monitoring structure
- Standardizing hierarchical formation and designing a well-classified digital asset library
- Variety of data sources, connections and attributes
- Matching time-stamps of process, quality and maintenance data
- Dynamic editing options to revise, generate or derive without losing the raw data
- AI compatibility on both proper data transfers and analytical investigations on live data, and notifications

# Sophisticated Architecture with PI Explorer and PI AF

## Standardized hierarchy



The screenshot displays the PI System Explorer application window. The main pane shows a table of elements with columns: Name, Description, Category, Type, and Template. The elements are organized in a hierarchical tree on the left. The table lists various elements such as 'Alternatif Yakıt Üniteleri', 'Analyses', 'Çimento Değerimleri', 'Döner Fırınlar', 'Enerji Savaşları', 'Enerji Üretim Tesisleri', 'Fırın Değerimleri', 'Kalite Kontrol', 'Kırklar', 'Kömür Değerimleri', 'Paketleme ve Sevki', and 'VisionTag'. The 'Template' column shows 'AnalysesTemplate' for several elements. The right pane shows 'Element Templates' with a list of templates like 'AltTemplate', 'AnalysesTemplate', 'ElementTemplate', 'Operasyonel VerilerTemplate', 'Operasyonel VerilerTemplate1', and 'Template2'.

| Name                       | Description                | Category | Type | Template         |
|----------------------------|----------------------------|----------|------|------------------|
| Alternatif Yakıt Üniteleri | Alternatif Yakıt Üniteleri |          | None |                  |
| Analyses                   | Calculation                |          | None | AnalysesTemplate |
| Çimento Değerimleri        | Çimento Değerimleri        |          | None |                  |
| Döner Fırınlar             | Döner Fırınlar             |          | None |                  |
| Enerji Savaşları           | Enerji Savaşları           |          | None |                  |
| Enerji Üretim Tesisleri    | Enerji Üretim Tesisleri    |          | None |                  |
| Fırın Değerimleri          | Fırın Değerimleri          |          | None |                  |
| Kalite Kontrol             | Kalite Kontrol             |          | None |                  |
| Kırklar                    | Kırklar                    |          | None |                  |
| Kömür Değerimleri          | Kömür Değerimleri          |          | None |                  |
| Paketleme ve Sevki         | Paketleme ve Sevki         |          | None |                  |
| VisionTag                  | VisionTag                  |          | None |                  |

- Originally designed and structured by the project team
- Several artificial tags with complicated calculations
- Standardized formation and hierarchal structure on AF

# Visualization of OYAK Cement 4.0 Project with PI Vision



- Unique visual design
- Drill-down formation
- ERP and Web based data integrations



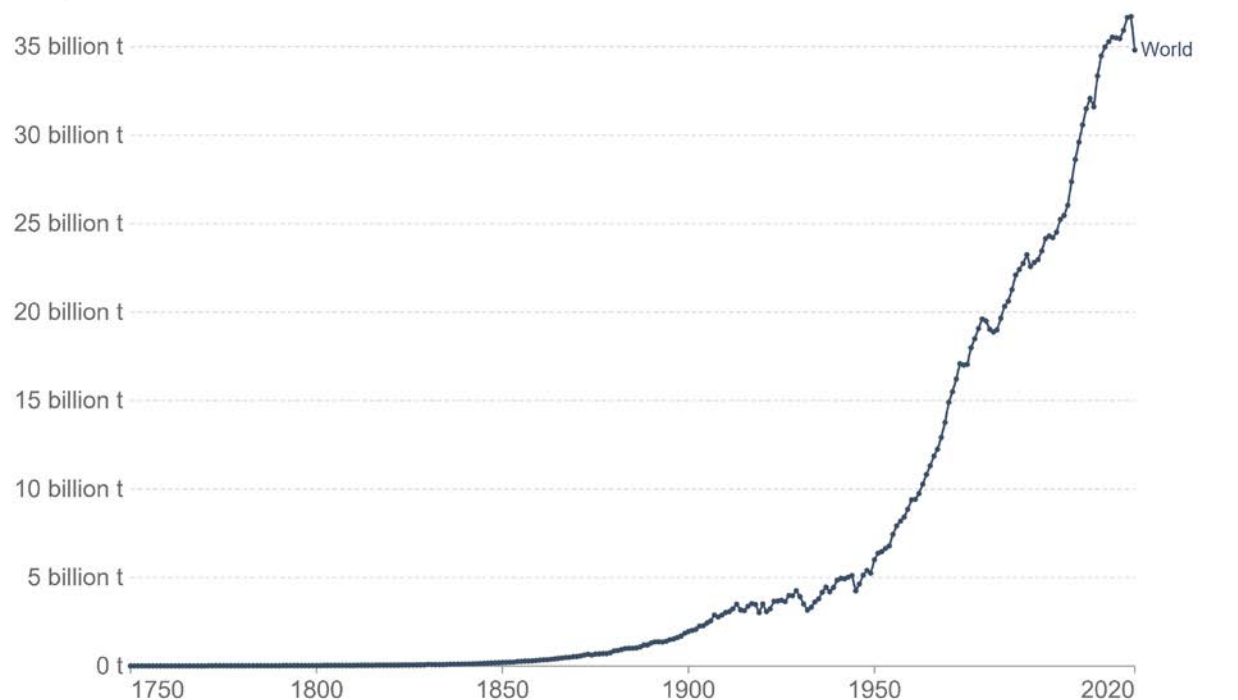


# CO<sub>2</sub> & Cement Industry

## Responsibility of Cement Industry on CO<sub>2</sub> & GHG reduction

### Annual CO<sub>2</sub> emissions

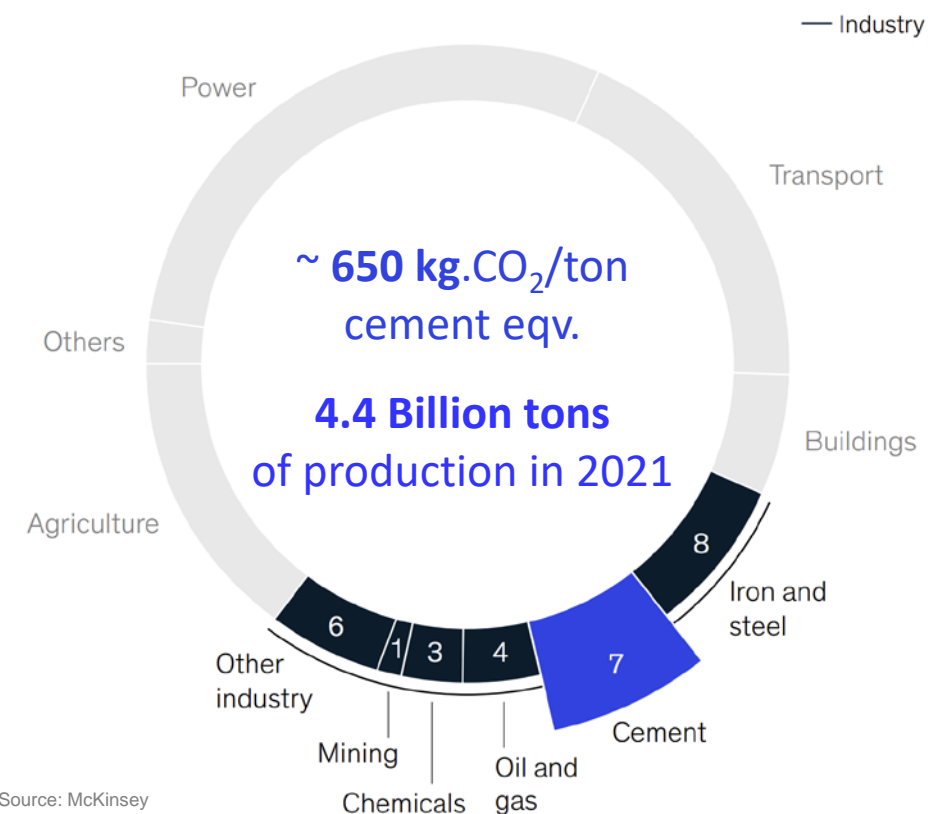
Carbon dioxide (CO<sub>2</sub>) emissions from the burning of fossil fuels for energy and cement production. Land use change is not included.



Source: Global Carbon Project

OurWorldInData.org/co2-and-other-greenhouse-gas-emissions/ • CC BY

### Share of global CO<sub>2</sub> emissions, %



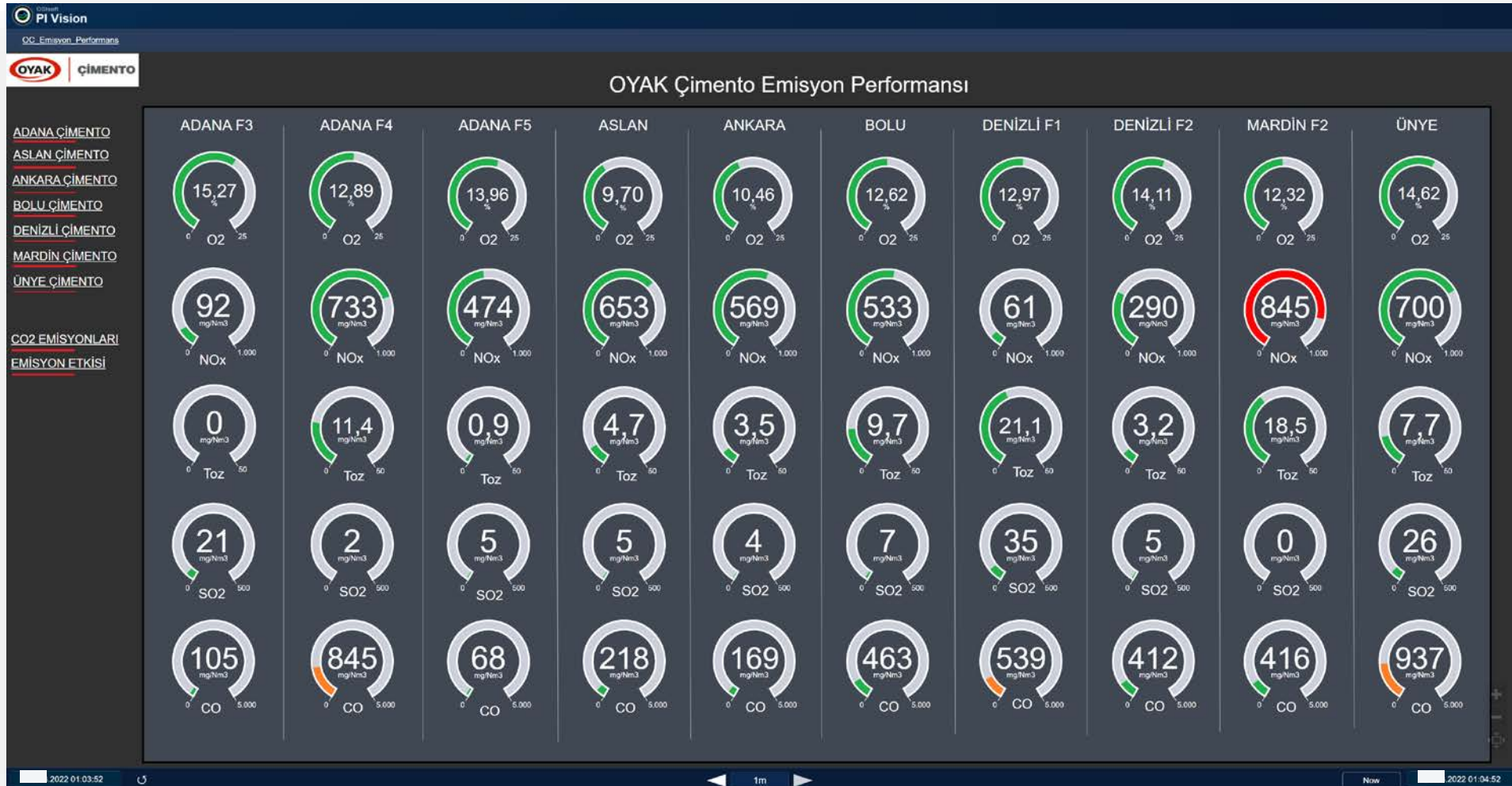
# Low CO<sub>2</sub> & GHG Emissions with Digitalisation

## Role of PI in our decarbonisation strategies

- Online Monitoring and Analyzing Capability
- Predicting Emissions & Guiding Process Control
- Higher Combustion Efficiency with Less Fossil Fuels
- High Energy Efficiency on Grinding Process with Predicted Fineness
- Reducing CO<sub>2</sub> Footprints with Improved Quality
- High Productivity and Efficiency on Renewable Energy Systems

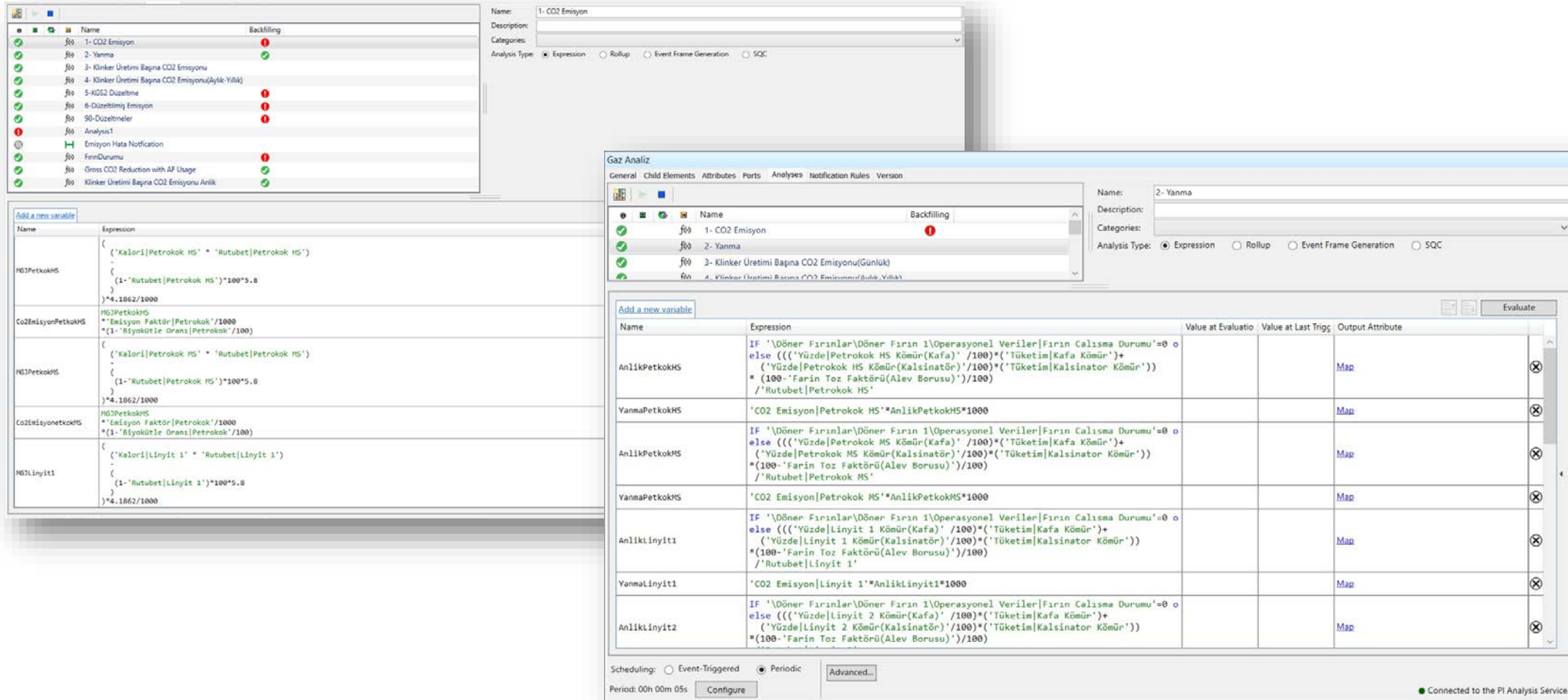
# Online Monitoring & Analyzing Capability

Tracking emissions instantly



# Online Monitoring & Analyzing Capability

## Complicated calculations and generation of artificial tags



The screenshot displays the AVEVA online monitoring and analyzing interface, showing a list of variables and their definitions, along with a detailed view of a specific variable's calculation logic.

**Variable List (Left Panel):**

| Name   | Backfilling |
|--|-------------|
| 1- CO2 Emisyon                                       | 1           |
| 2- Yanma   | 1           |
| 3- Klinker Üretimi Başına CO2 Emisyonu               | 1           |
| 4- Klinker Üretimi Başına CO2 Emisyonu(Aylık-Yıllık) | 1           |
| 5-KGS2 Düzeltme                                      | 1           |
| 6-Düzeltilmiş Emisyon                                | 1           |
| 90-Düzeltilmeler                                     | 1           |
| Analysis1  | 1           |
| Emisyon Hata Notification                            | 1           |
| FırınDurumu  | 1           |
| Gross CO2 Reduction with AF Usage                    | 1           |
| Klinker Üretimi Başına CO2 Emisyonu Anlık            | 1           |

**Variable Definition (Bottom Left Panel):**

| Name                | Expression   |
|---------------------|--|
| H03Petrokoks        | $\left( \frac{('Kali Petrokok\ HS' * 'Rutubet Petrokok\ HS')}{(1 - 'Rutubet Petrokok\ HS') * 100 * 5.8} \right) * 4.1862 / 1000$ |
| Co2EmisyonPetrokoks | $\frac{H03Petrokoks * 'Emisyon\ Faktör Petrokok' / 1000}{(1 - 'Biyokütle\ Oranı Petrokok' / 100)}$                               |
| H03Petrokoks        | $\left( \frac{('Kali Petrokok\ HS' * 'Rutubet Petrokok\ HS')}{(1 - 'Rutubet Petrokok\ HS') * 100 * 5.8} \right) * 4.1862 / 1000$ |
| Co2EmisyonPetrokoks | $\frac{H03Petrokoks * 'Emisyon\ Faktör Petrokok' / 1000}{(1 - 'Biyokütle\ Oranı Petrokok' / 100)}$                               |
| H03Linyit1          | $\left( \frac{('Kali Linyit\ 1' * 'Rutubet Linyit\ 1')}{(1 - 'Rutubet Linyit\ 1') * 100 * 5.8} \right) * 4.1862 / 1000$          |

**Variable Definition (Bottom Right Panel):**

| Name           | Expression  | Value at Evaluation | Value at Last Trigs | Output Attribute |
|----------------|---|---------------------|---------------------|------------------|
| AnlikPetrokoks | IF 'Döner Fırınlar\Döner Fırın 1\Operasyonel Veriler\Fırın Çalışma Durumu'=0 o<br>else (((('Yüzde Petrokok HS Kömür(Kafa)' / 100) * ('Tüketim Kafa Kömür') +<br>(('Yüzde Petrokok HS Kömür(Kalsinatör)' / 100) * ('Tüketim Kalsinatör Kömür'))<br>* (100 - 'Farin Toz Faktörü(Alev Borusu)' / 100)<br>/ 'Rutubet Petrokok HS' |                     |                     | Map              |
| YanmaPetrokoks | 'CO2 Emisyon Petrokok HS' * AnlikPetrokoks * 1000   |                     |                     | Map              |
| AnlikLinyit1   | IF 'Döner Fırınlar\Döner Fırın 1\Operasyonel Veriler\Fırın Çalışma Durumu'=0 o<br>else (((('Yüzde Linyit 1 Kömür(Kafa)' / 100) * ('Tüketim Kafa Kömür') +<br>(('Yüzde Linyit 1 Kömür(Kalsinatör)' / 100) * ('Tüketim Kalsinatör Kömür'))<br>* (100 - 'Farin Toz Faktörü(Alev Borusu)' / 100)<br>/ 'Rutubet Linyit 1'          |                     |                     | Map              |
| YanmaLinyit1   | 'CO2 Emisyon Linyit 1' * AnlikLinyit1 * 1000  |                     |                     | Map              |
| AnlikLinyit2   | IF 'Döner Fırınlar\Döner Fırın 1\Operasyonel Veriler\Fırın Çalışma Durumu'=0 o<br>else (((('Yüzde Linyit 2 Kömür(Kafa)' / 100) * ('Tüketim Kafa Kömür') +<br>(('Yüzde Linyit 2 Kömür(Kalsinatör)' / 100) * ('Tüketim Kalsinatör Kömür'))<br>* (100 - 'Farin Toz Faktörü(Alev Borusu)' / 100)                                  |                     |                     | Map              |

**General Settings (Top Right Panel):**

Name: 2- Yanma  
Description:  
Categories:  
Analysis Type: ☒ Expression ☐ Rollup ☐ Event Frame Generation ☐ SQC

**Scheduling (Bottom):**

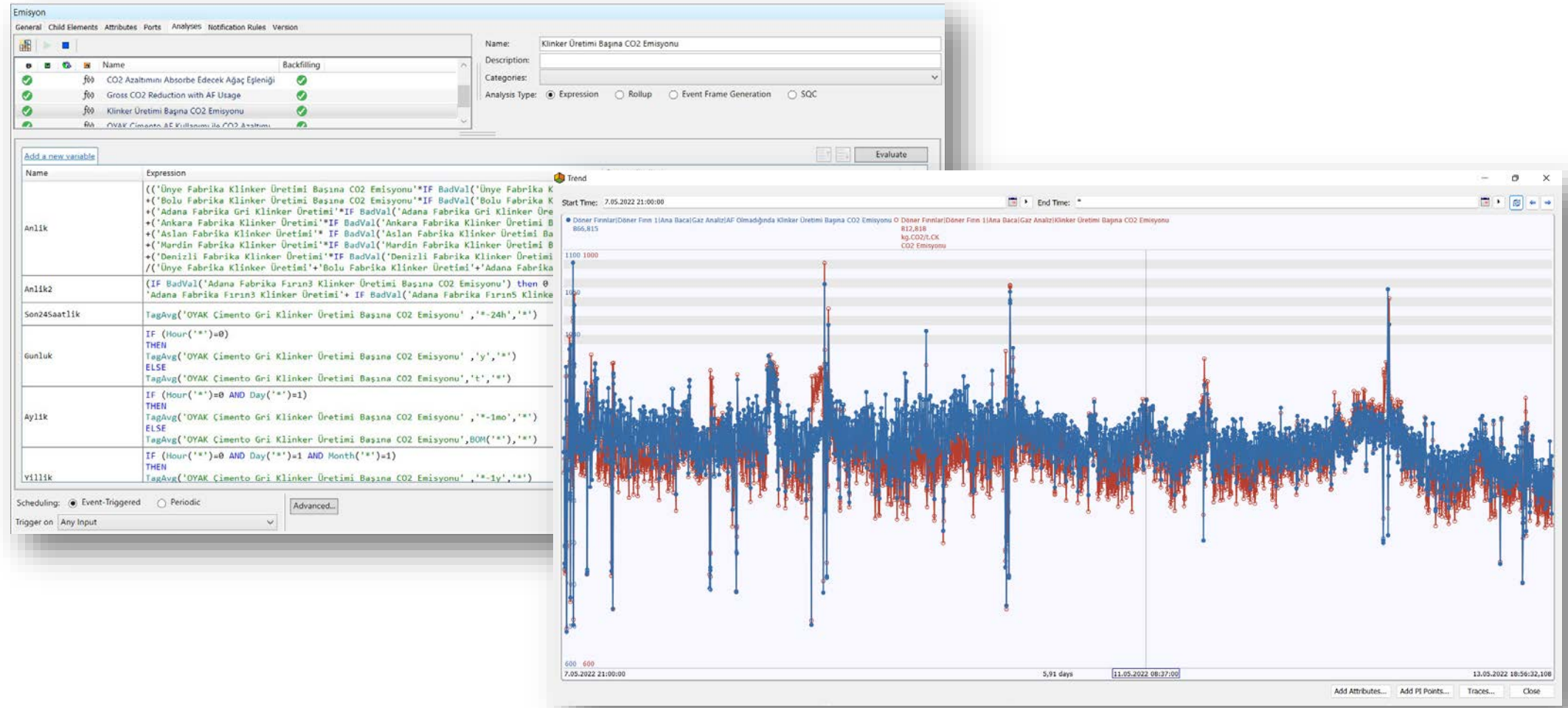
Scheduling: ☐ Event-Triggered ☒ Periodic  
Period: 00h 00m 05s [Configure](#) [Advanced...](#)

**Status:** Connected to the PI Analysis Service.



# Online Monitoring & Analyzing Capability

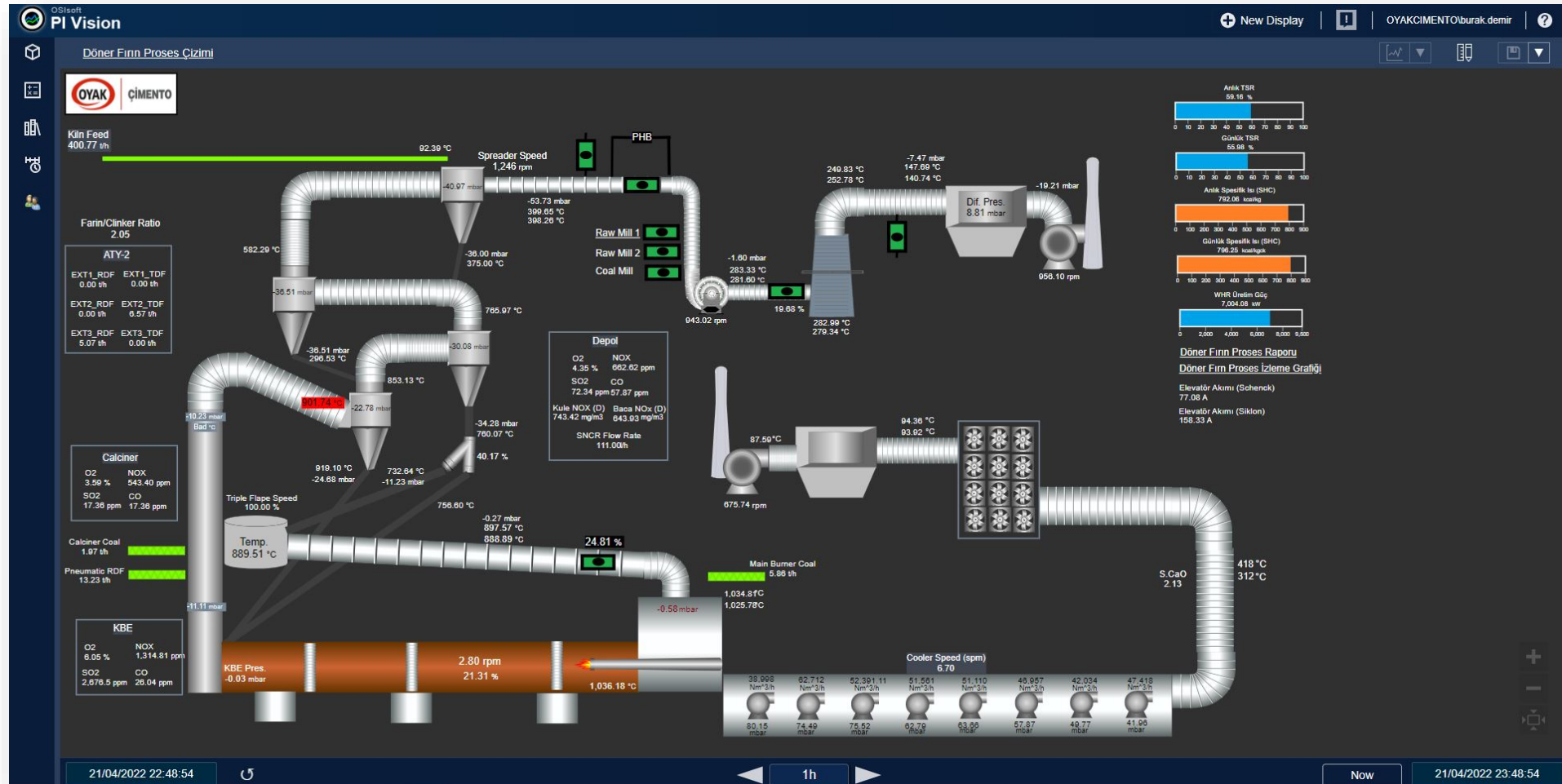
## Complicated calculations and generation of artificial tags





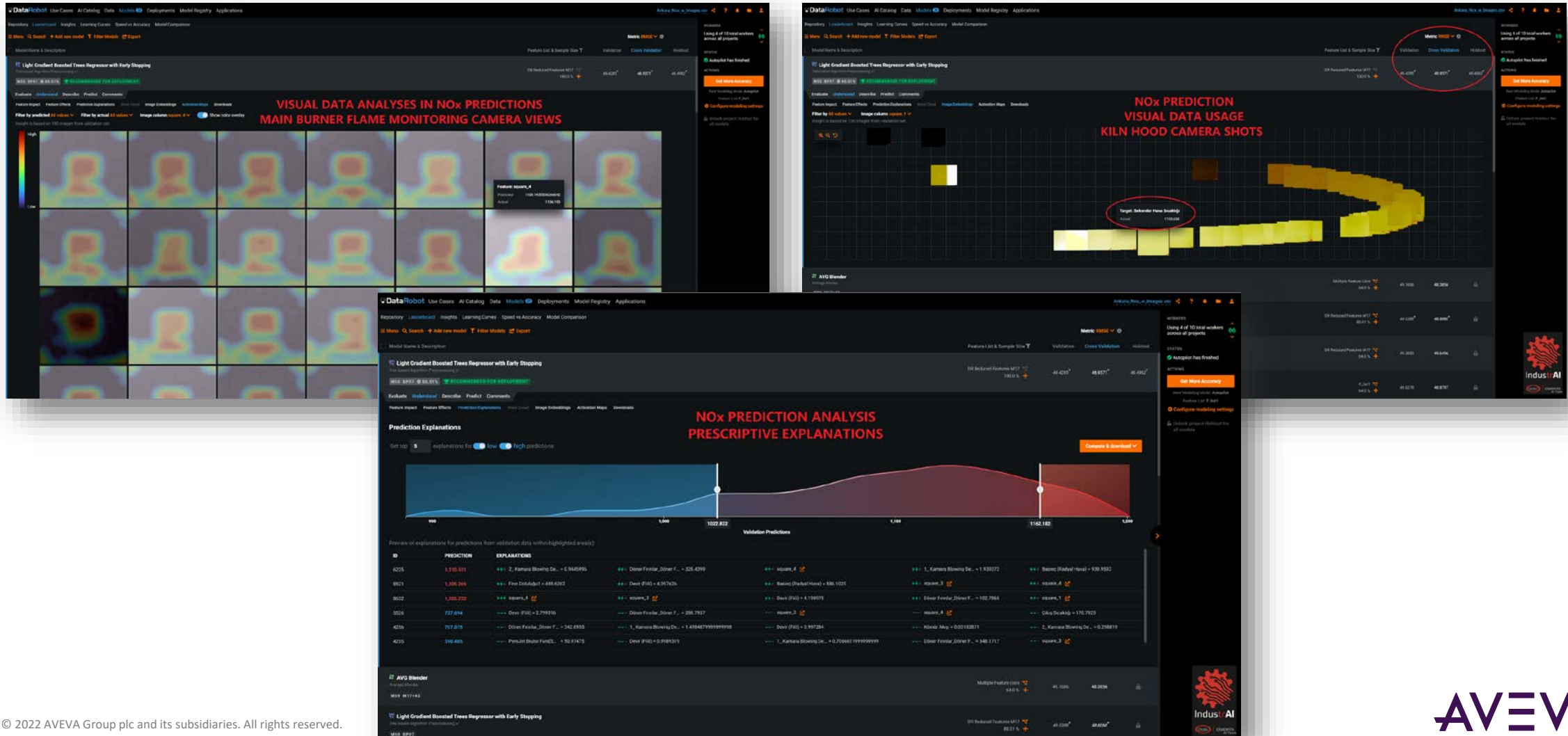
# Predicting Emissions & Guiding Process Control

Process control adaptations – includes online heat&mass balance pages



# Predicting Emissions & Guiding Process Control

Not only numbers, also visuals are being used in AI models – to predict near future emissions



# Predicting Emissions & Guiding Process Control

Not only numbers, also visuals are being used in AI models – to predict near future emissions





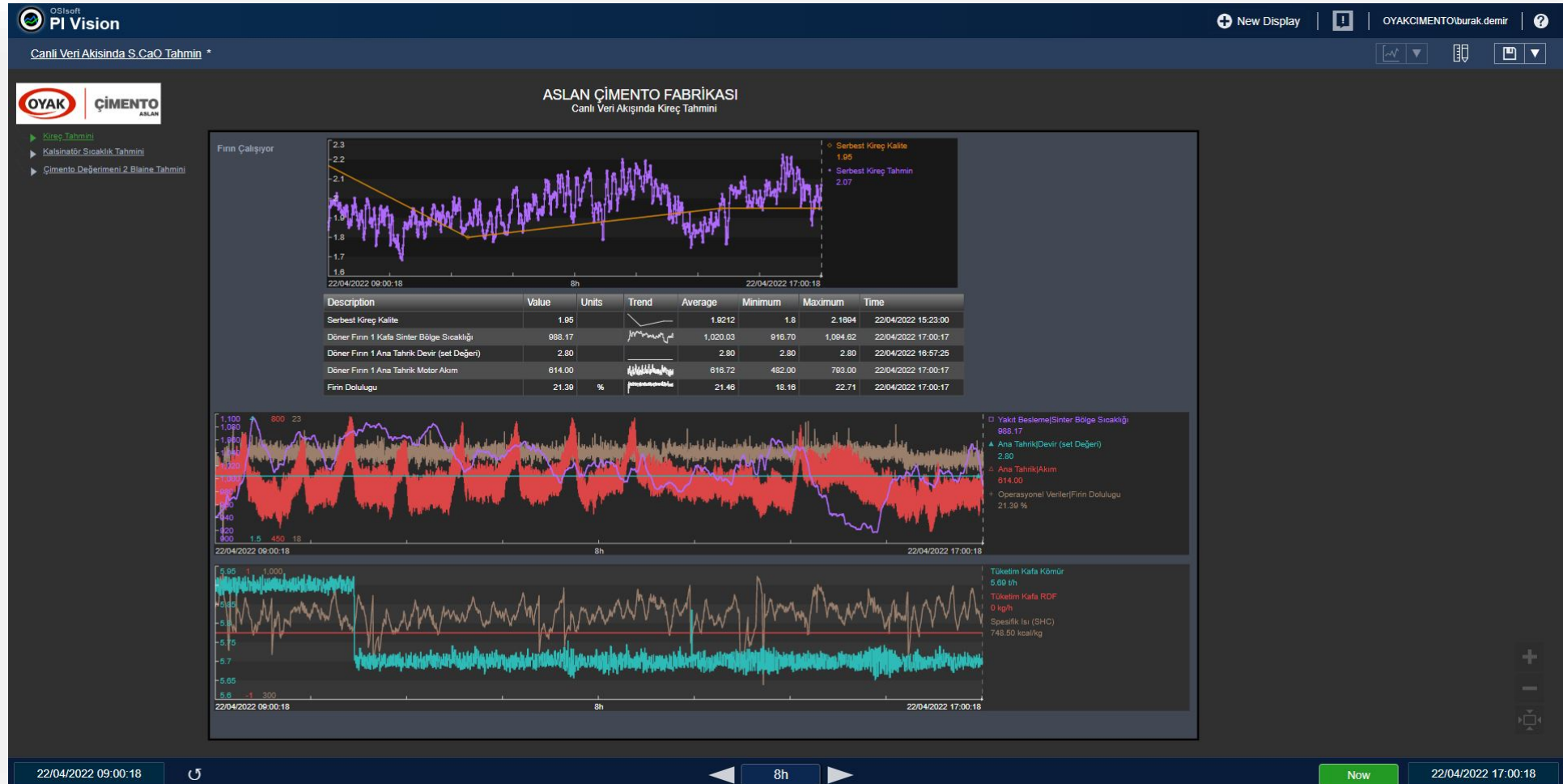
# Higher Combustion Efficiency with Less Fossil Fuels

## Online Free-Lime Monitoring with AI Supported Predictions



# Higher Combustion Efficiency with Less Fossil Fuels

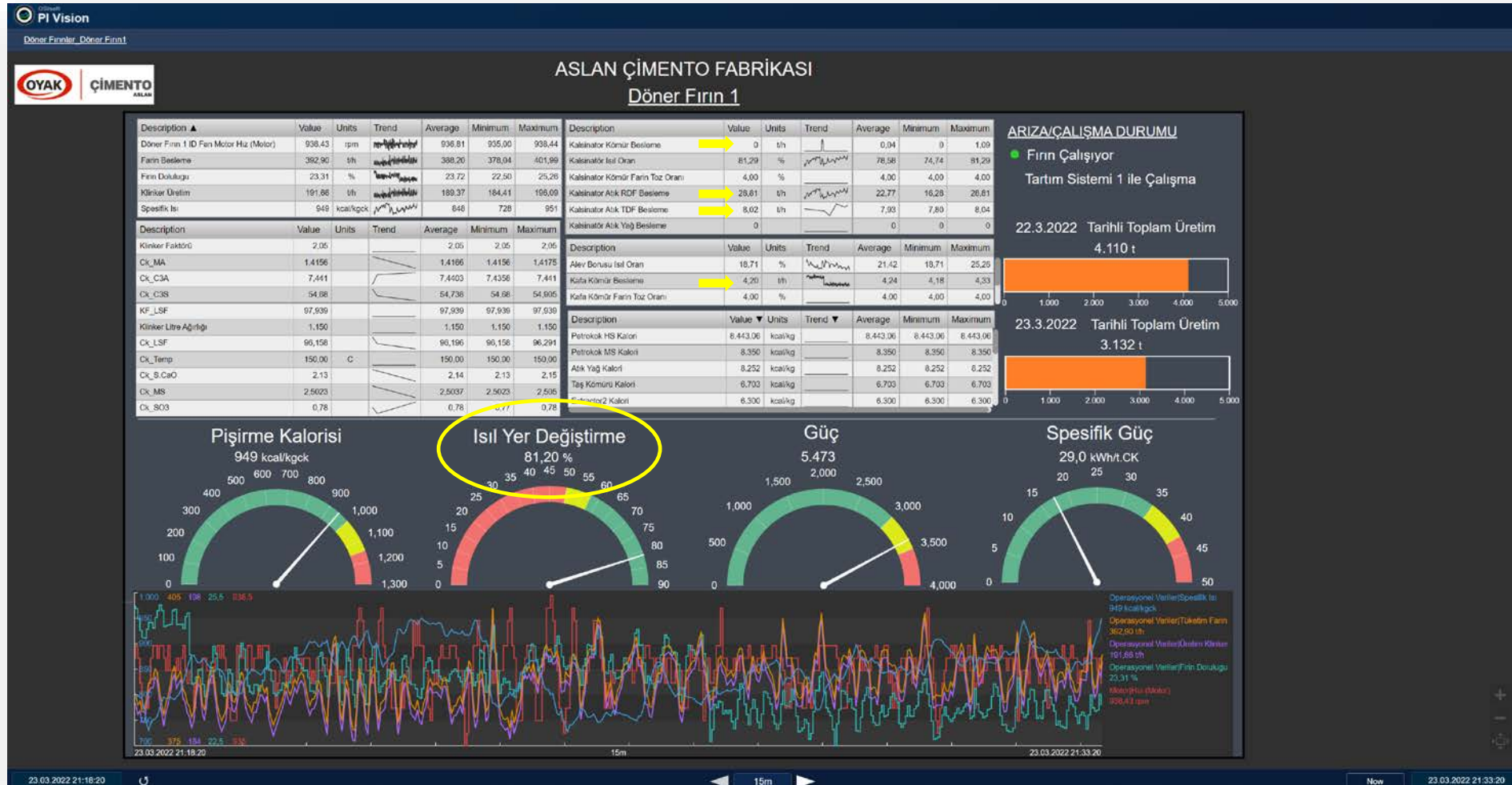
## Online Free-Lime Monitoring with AI Supported Predictions





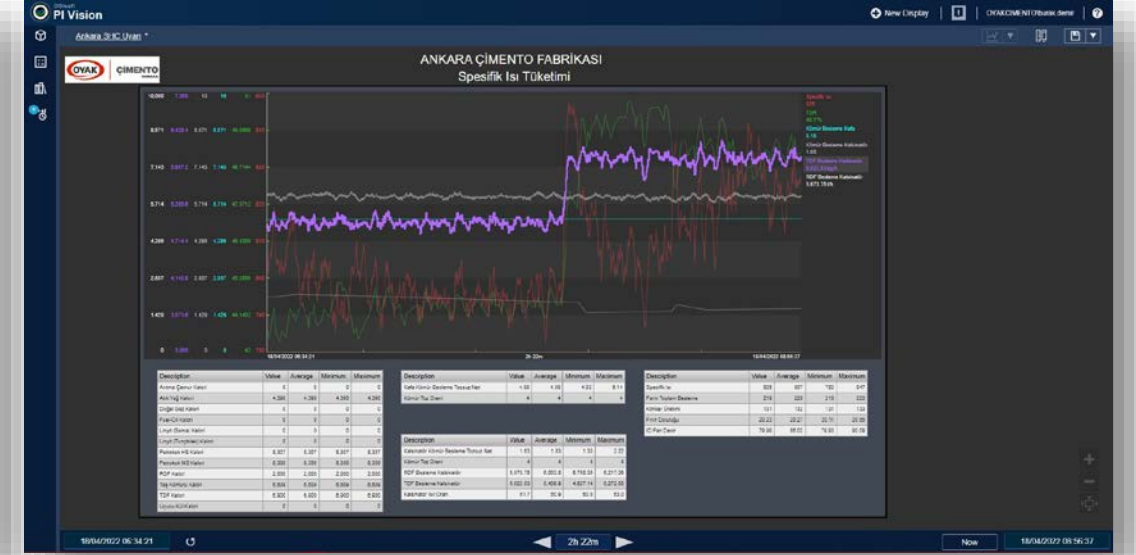
# Higher Combustion Efficiency with Less Fossil Fuels

## Less Fossil Fuels & More Secondary Fuels – means less CO<sub>2</sub> emissions



# Higher Combustion Efficiency with Less Fossil Fuels

## Continuous Monitoring and Automatic Notifications



Cum 15.04.2022 09:18  
bolu\_ankara@oyakpisystem.com  
Döner Fırın 1 Spesifik Isı Değeri Kontrolü (Başlangıç)

To [Redacted]

Sayın Yönetici,

Fırın Özgül Isı Tüketimi çok yüksek/düşük yakıt besleme kantarlarının kalibrasyonunu/kalori değerlerinin kontrol edilmesi gerekmektedir.

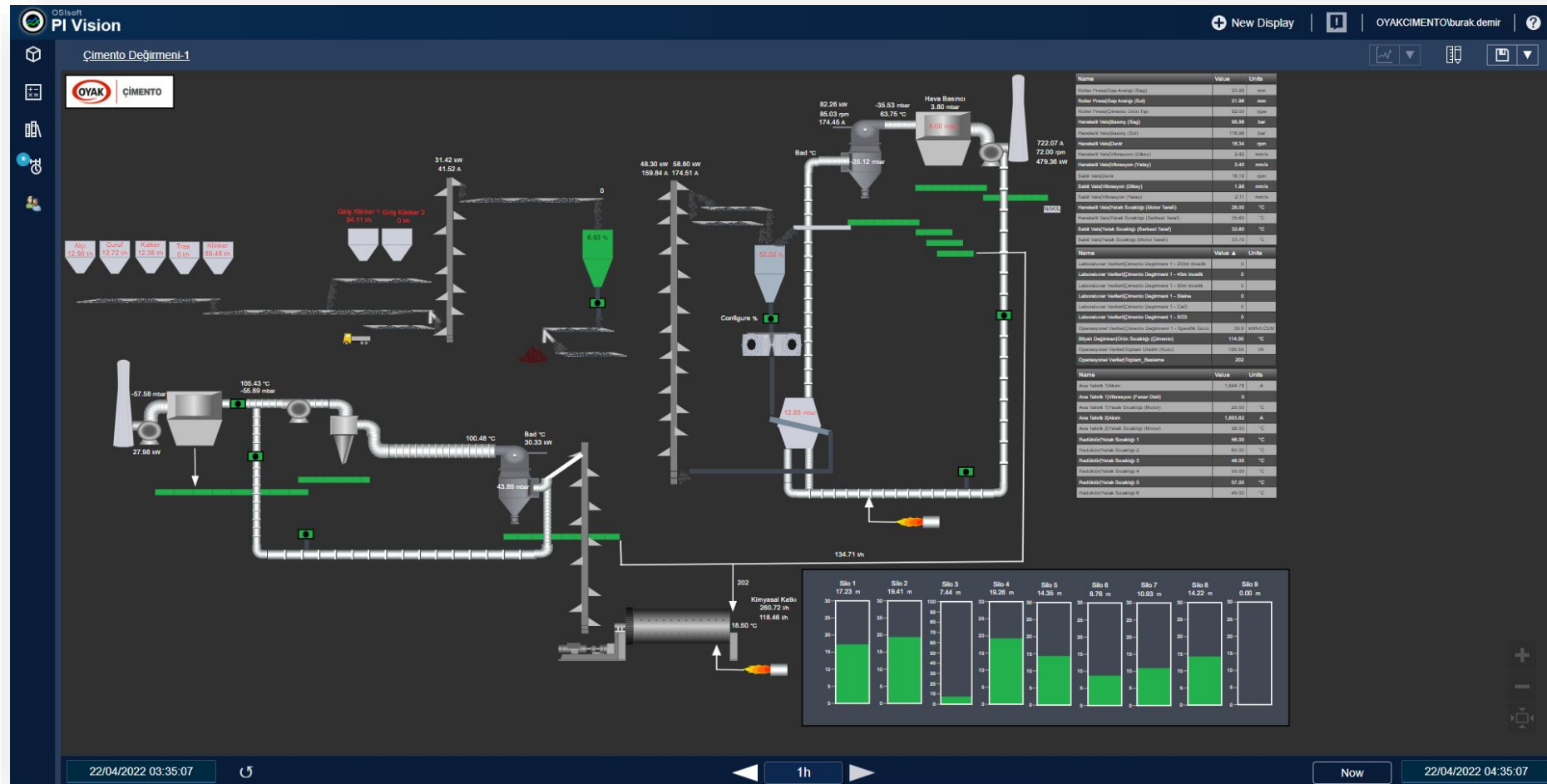
**Mail Gönderim Zamanı:** 4/15/2022 9:18:22 AM Turkey Standard Time (GMT+03:00:00)

**Fırın Durumu** : Fırın Çalışıyor  
**Spesifik Isı** : 670  
**TSR** : 30.0%

Bu e-mail ve ekleri OYAK Cement AI platformu tarafından, tarafınıza otomatik olarak paylaşılmıştır.

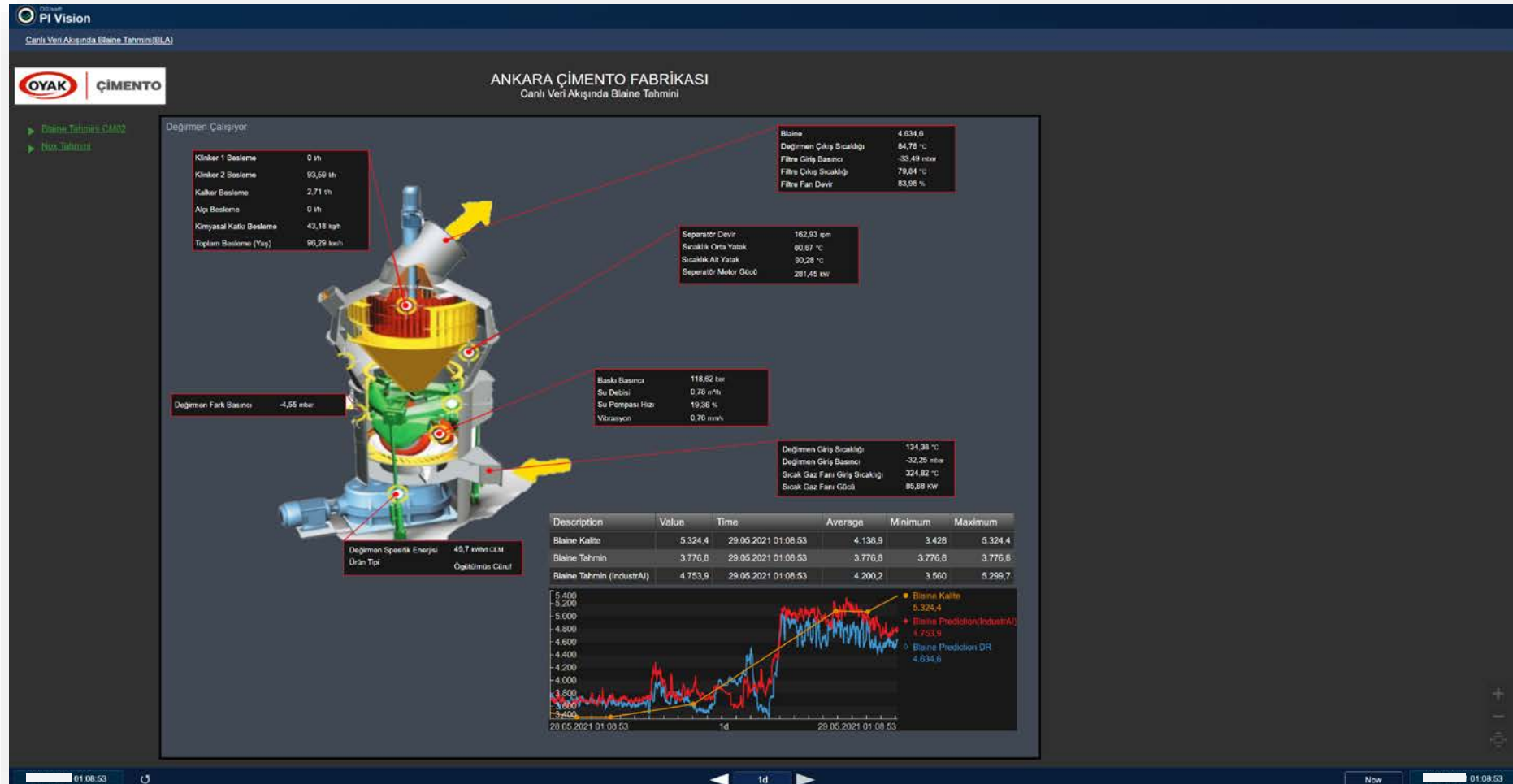
# Boosted Energy Efficiency on Cement Grinding

## Monitoring Actual Parameters and Predicted Values



# Boosted Energy Efficiency on Cement Grinding

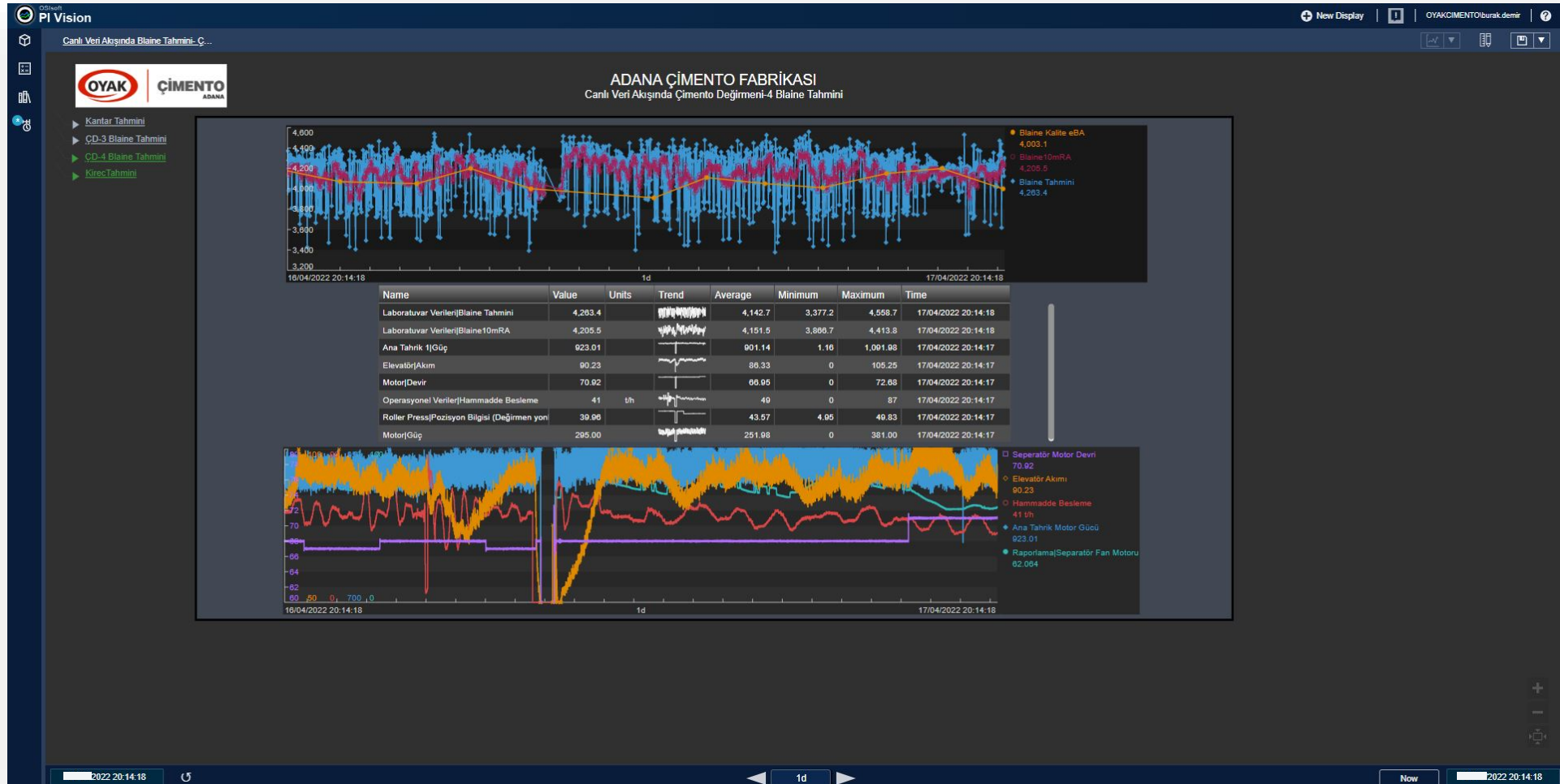
## Predicting Particle Size Characteristics





# Boosted Energy Efficiency on Cement Grinding

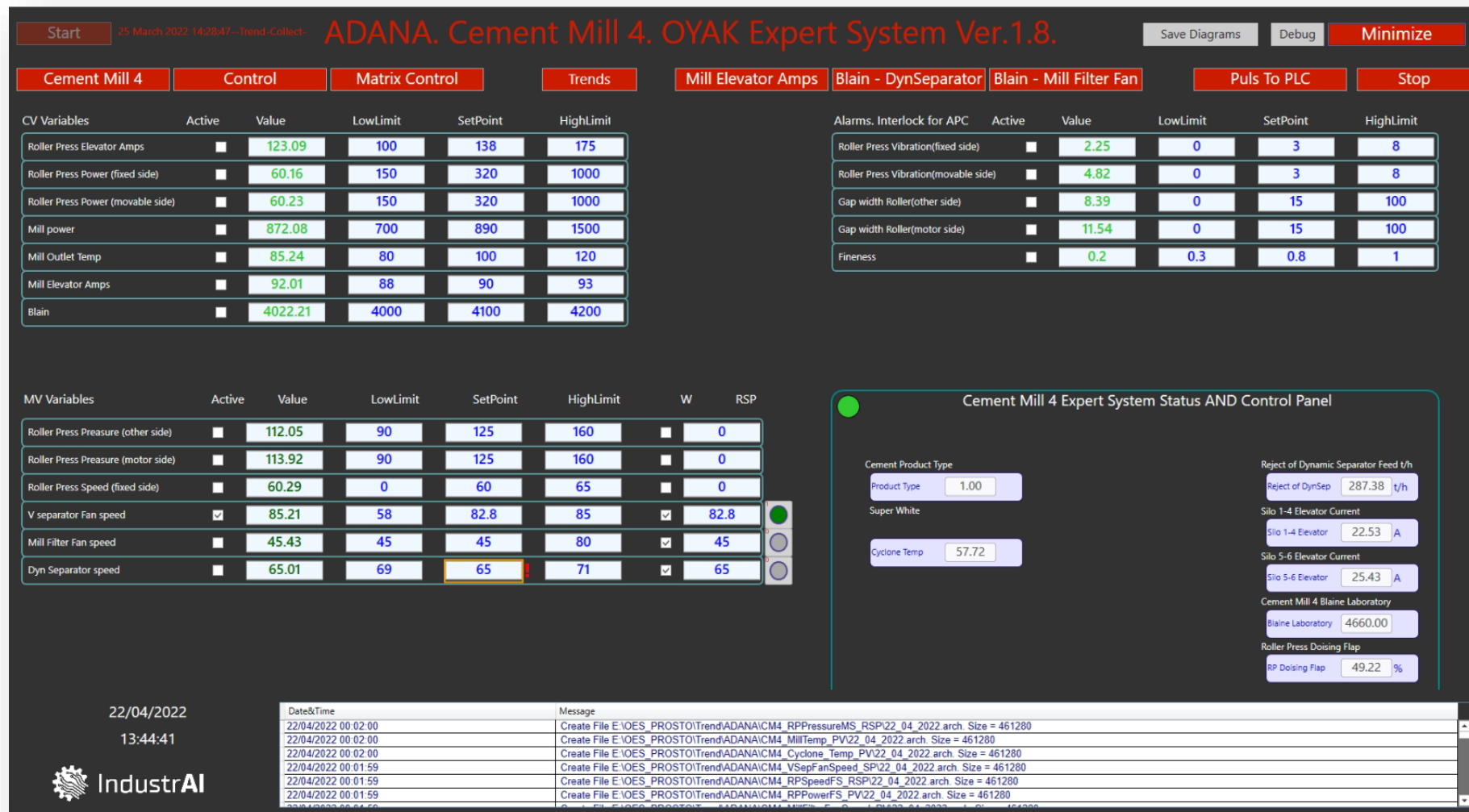
## Predicting Particle Size Characteristics





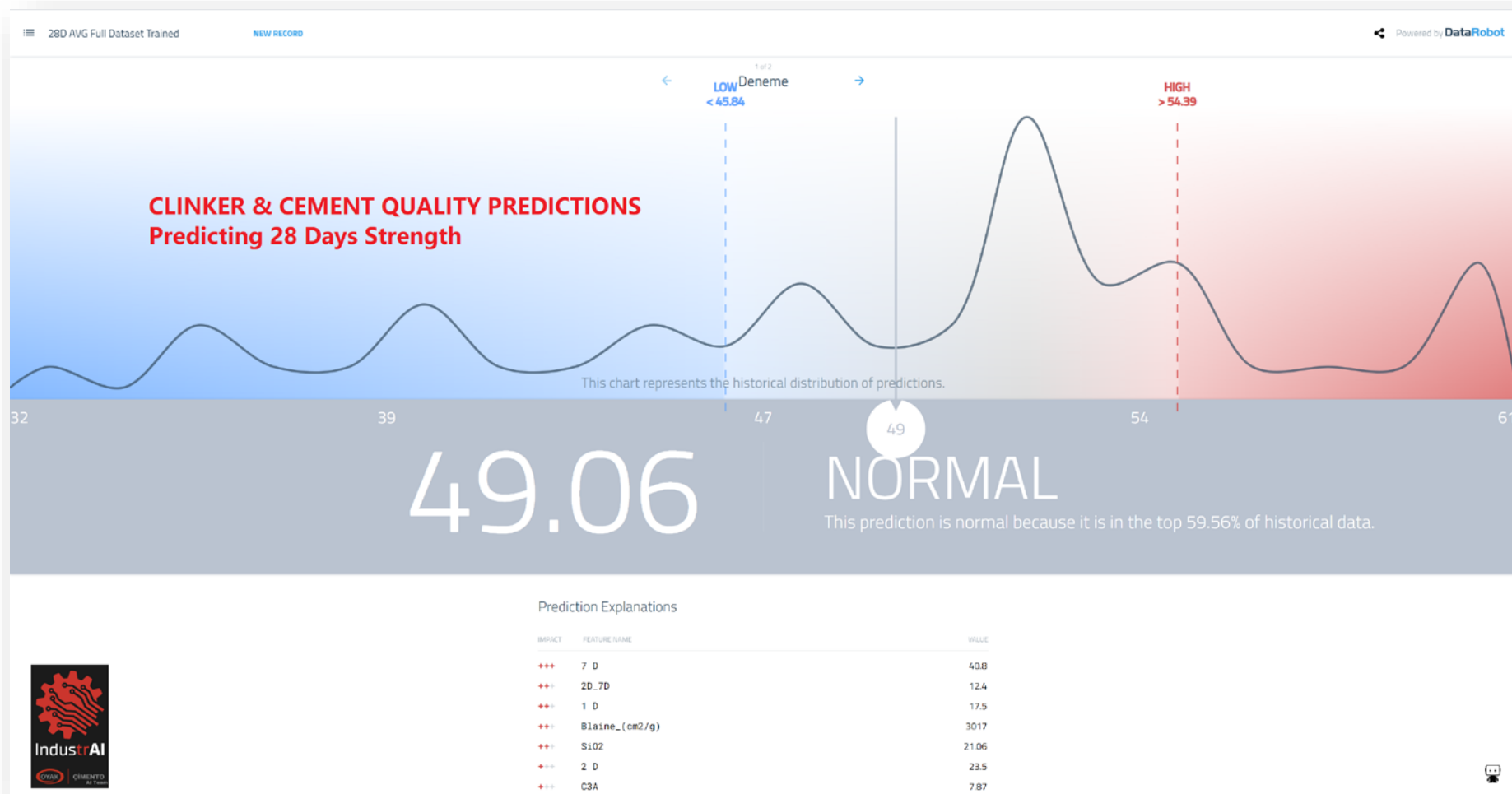
# Boosted Energy Efficiency on Cement Grinding

## Autonomous Cement Mill Process Control with Authentic APC Concept «IndustrAI»



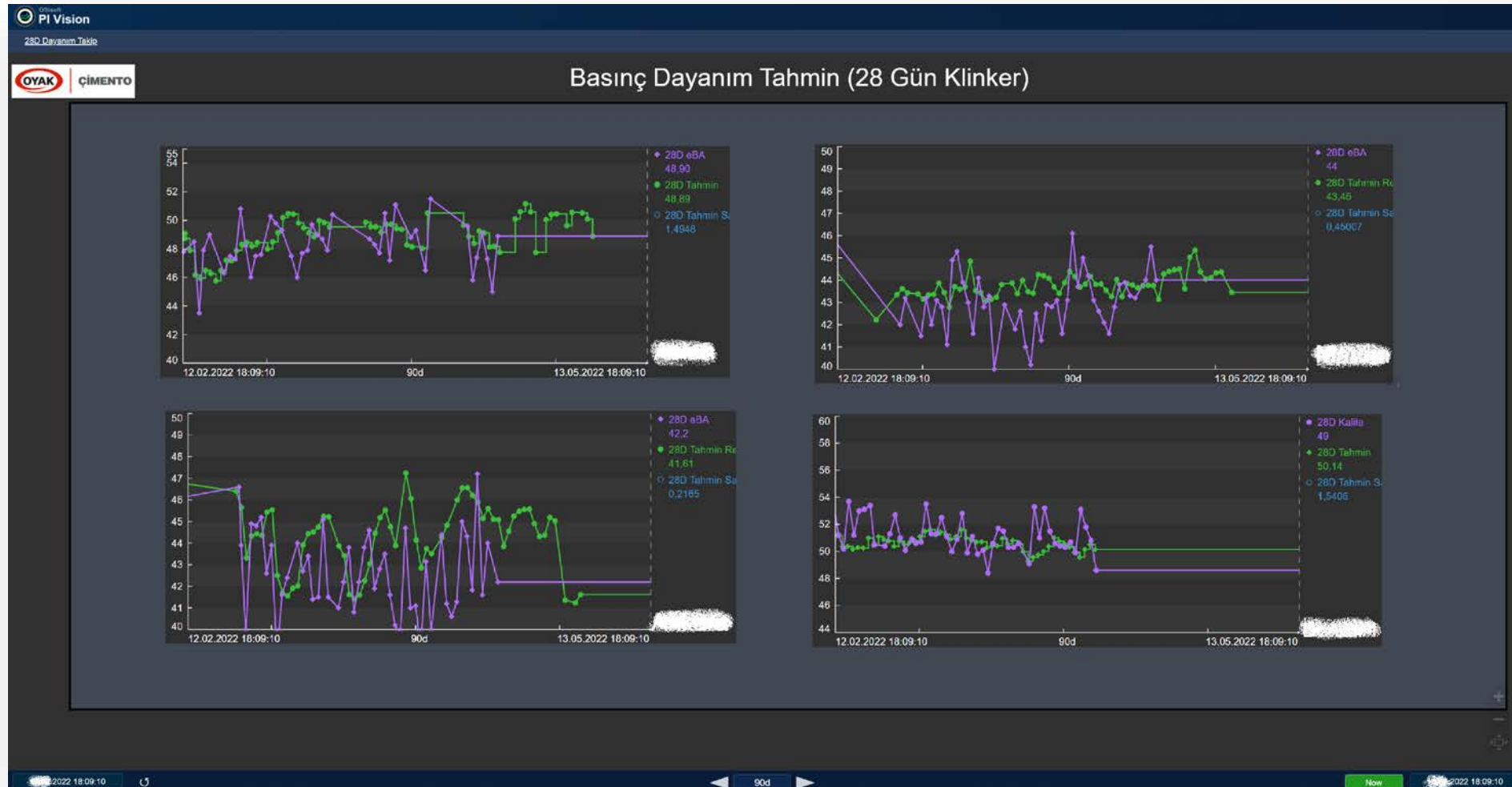
# Reducing CO<sub>2</sub> Footprints with Improved Quality"

## Predicting 28 Days Strengths on Clinker and Cement Production «with high accuracy»



# Reducing CO<sub>2</sub> Footprints with Improved Quality"

Predicting 28 Days Strengths on Clinker and Cement Production «with high accuracy»



# High Productivity & Efficiency on Renewable Energy Units

## Increased Efficiency with Detailed Monitoring of PhotoVoltaic Solar Energy Plants



# Wrap Up

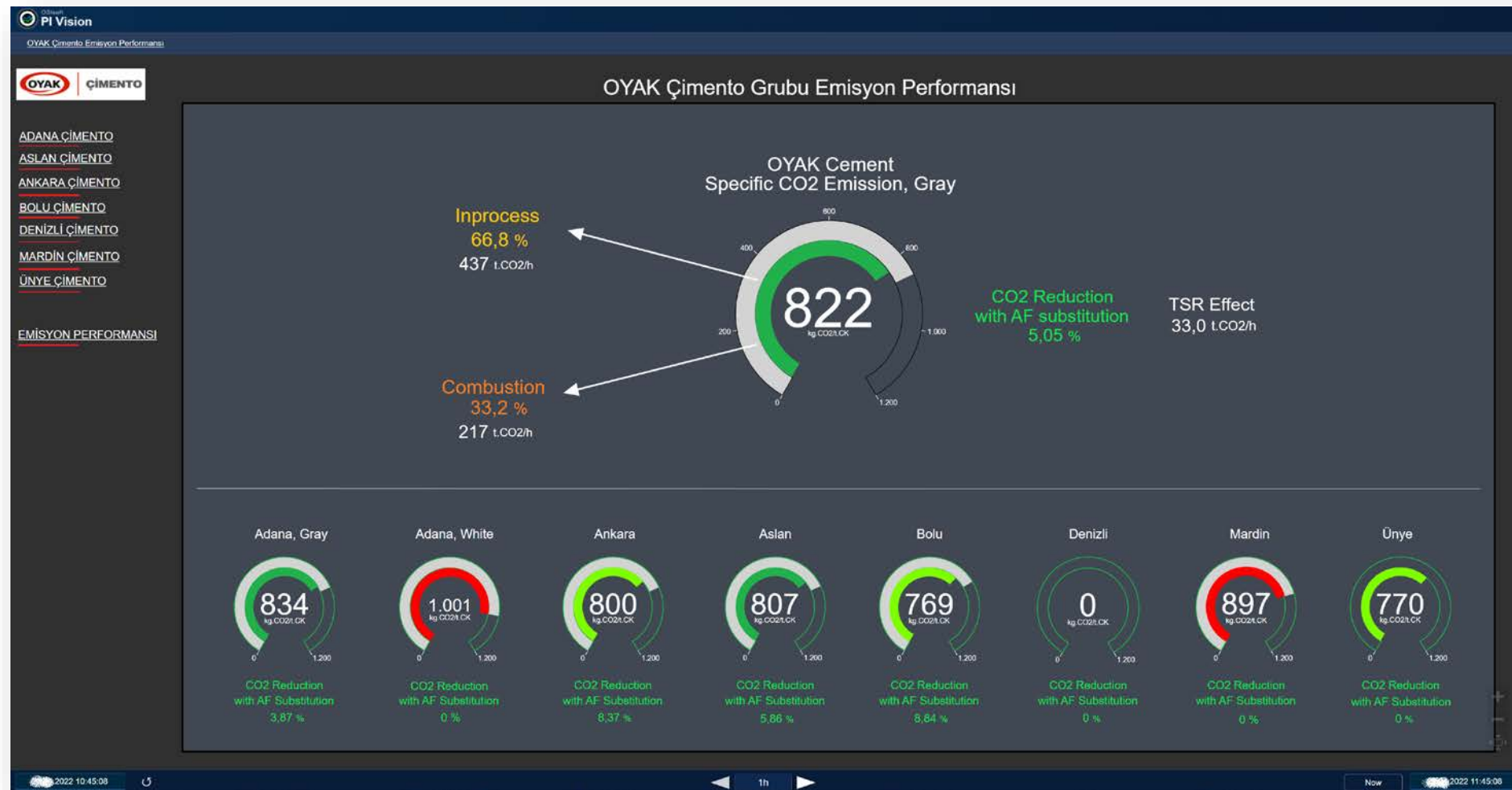
## Role of PI on Our Decarbonisation Strategies

- Visualization and Spontaneous Analyzing Capability
- Online CO<sub>2</sub> emission calculations and visualization
- Predicting NOx emissions – reduction & also high efficiency on SNCR process
- Online free lime predictions – stable kiln process, less heat consumption, minimized efficiency losses, higher thermal efficiency, stable combustion conditions, higher AF usage and less fossil fuels
- Higher quality on mid-product «clinker» and getting low CO<sub>2</sub> foot-printed final products as cement and also as concrete
- Fineness prediction to improve quality and specific energy consumption
- High efficiency on renewable energy sources WHRs and PV Solar Plants



# The Result: Visualizing and Monitoring CO<sub>2</sub> Actions

## Following the Results Instantly to Take the Actions Instantly






# The Result: Visualizing and Monitoring CO<sub>2</sub> Actions

## Following the Results Instantly to Take the Actions Instantly



# Annual Effect of OYAK Cement 4.0 on CIMPOR Global

## Decarbonisation with AI & Digital Transformation

- Each **1% of heat energy saving** equals to **17,500 tons less coal consumption** per year →  **X 9,500/year**
- Each **1% of electrical energy saving** equals to **12,600 MWh less energy consumption** per year →  **X 3,900/year**
- Each **2% increase on TSR** equals to **30,000 tons less fossil fuel consumption** per year →  **X 3,500/year**
- Each **1% decrease on clinker incorporation rate** in cement means **nearly 110,000 tons of clinker saving**
- Each 3% reduction on maintenance costs equal to nearly **1,5 Million € saving** per year

Total financial effect of all those potential savings equal to more than  
**9 Million € per year**

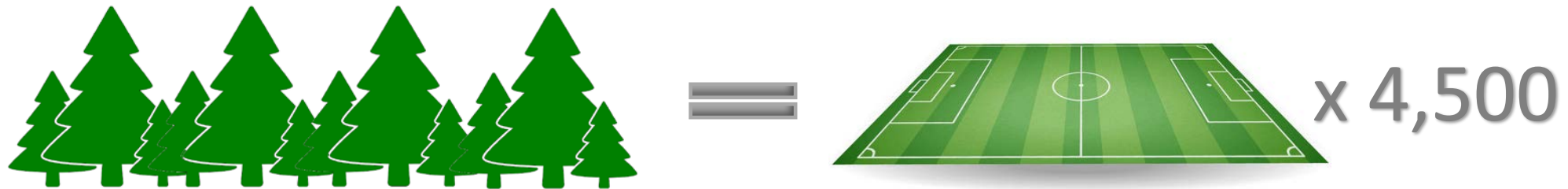
# Annual Effect of OYAK Cement 4.0 on CIMPOR Global

## Decarbonisation with AI & Digital Transformation

All those savings mean more than financial advantages

Nearly **140,000 tons of CO<sub>2</sub> reduction** in a year

which equals to carbon dioxide absorption of **6.5 Million trees** in a year.



Still additional use cases and potentials are available,

we are just in the beginning of **Digitalized and AI-Assisted Industrial Ops Transformation**



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# Berkan Fidan

## Performance & Process Director

- OYAK Cement Concrete Paper
- [bfidan@oyakcimento.com](mailto:bfidan@oyakcimento.com)





# Questions?

Please wait for the microphone

- State your name and company



## Please remember to...

Complete the survey!

- Navigate to this session in the mobile agenda for the survey

“Digitalization is a strong and effective tool to achieve Low-Carbon products in cement & concrete manufacturing – its potential is much more than assumed”


B.Fidan




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