

MAY 18, 2022

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# Decarbonisation with AI & Digital Transformation

OYAK Cement 4.0 Project «IndustrAI»

Presented By: Berkan Fidan

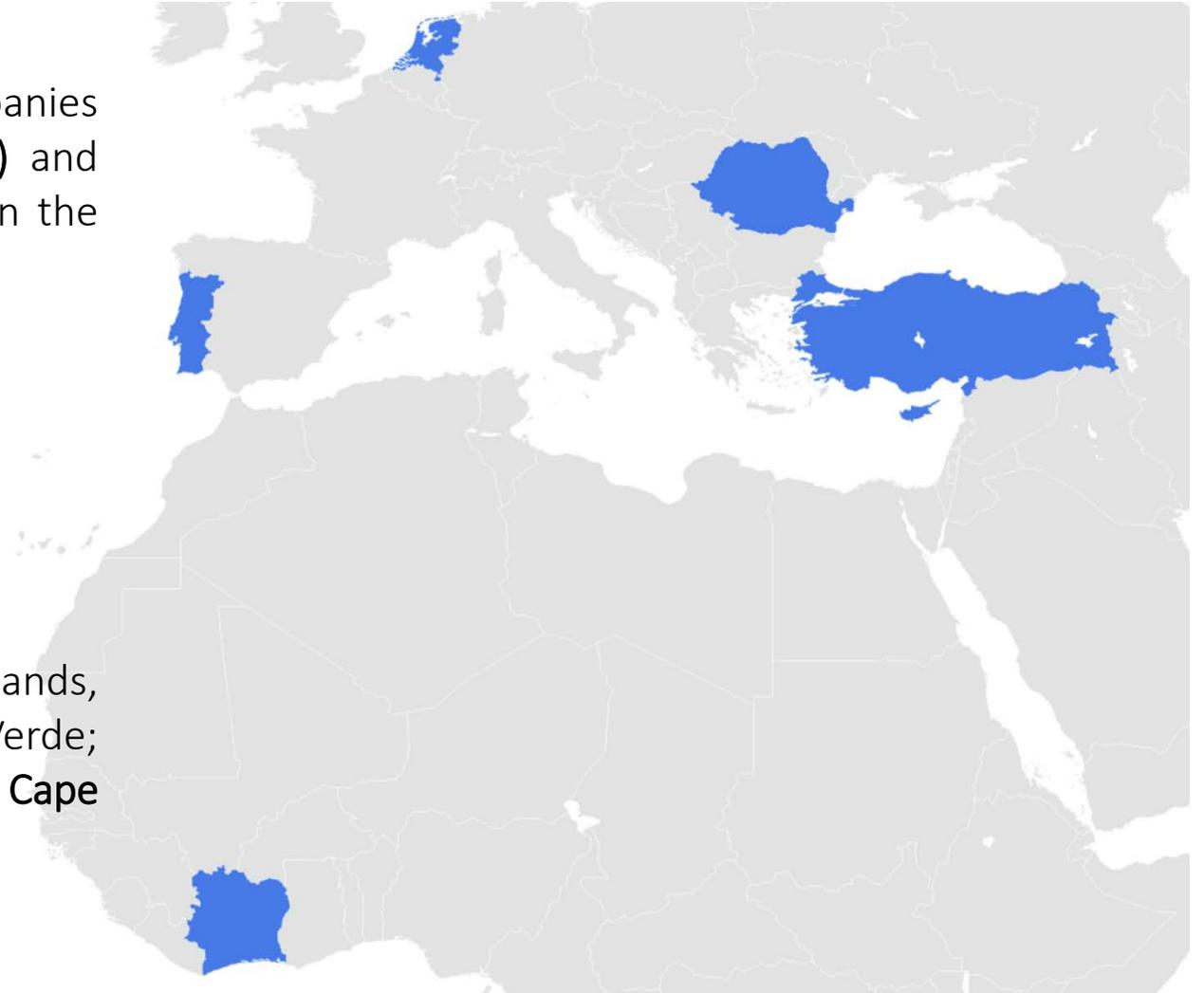
**AVEVA**

# 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**

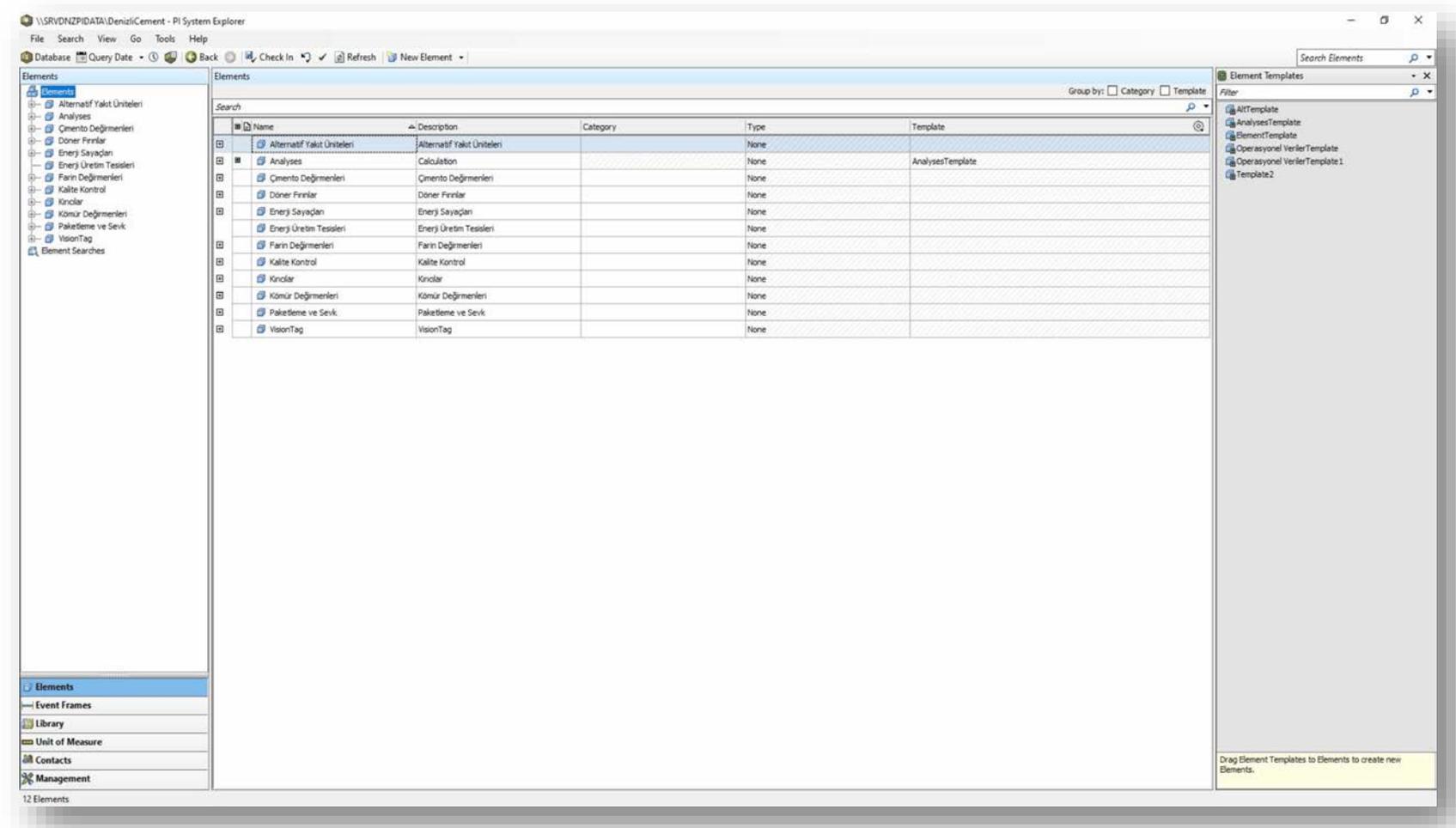
# The Challenges

## 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



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 Sayaçları	Enerji Sayaçları		None	
Enerji Üretim Tesisleri	Enerji Üretim Tesisleri		None	
Faalin Değerimleri	Faalin Değerimleri		None	
Kalite Kontrol	Kalite Kontrol		None	
Kinolar	Kinolar		None	
Kömür Değerimleri	Kömür Değerimleri		None	
Paketleme ve Sevkiyat	Paketleme ve Sevkiyat		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



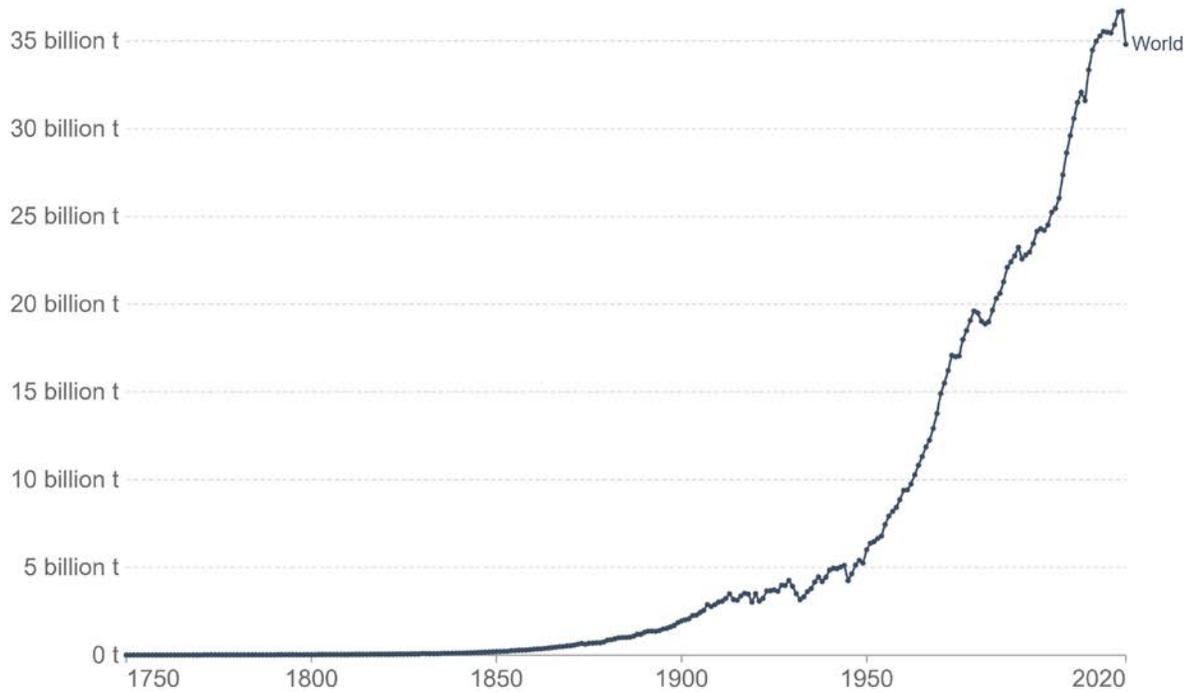
# CO<sub>2</sub> & Cement Industry

## 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.

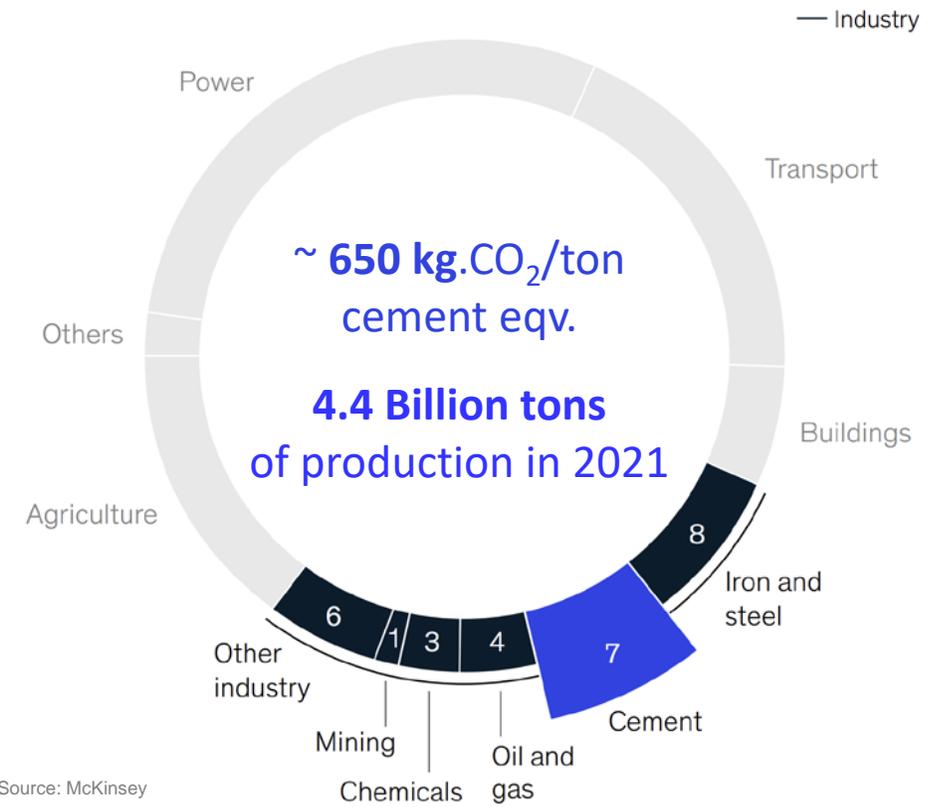
Our World in Data



Source: Global Carbon Project

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

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



Source: McKinsey

# 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

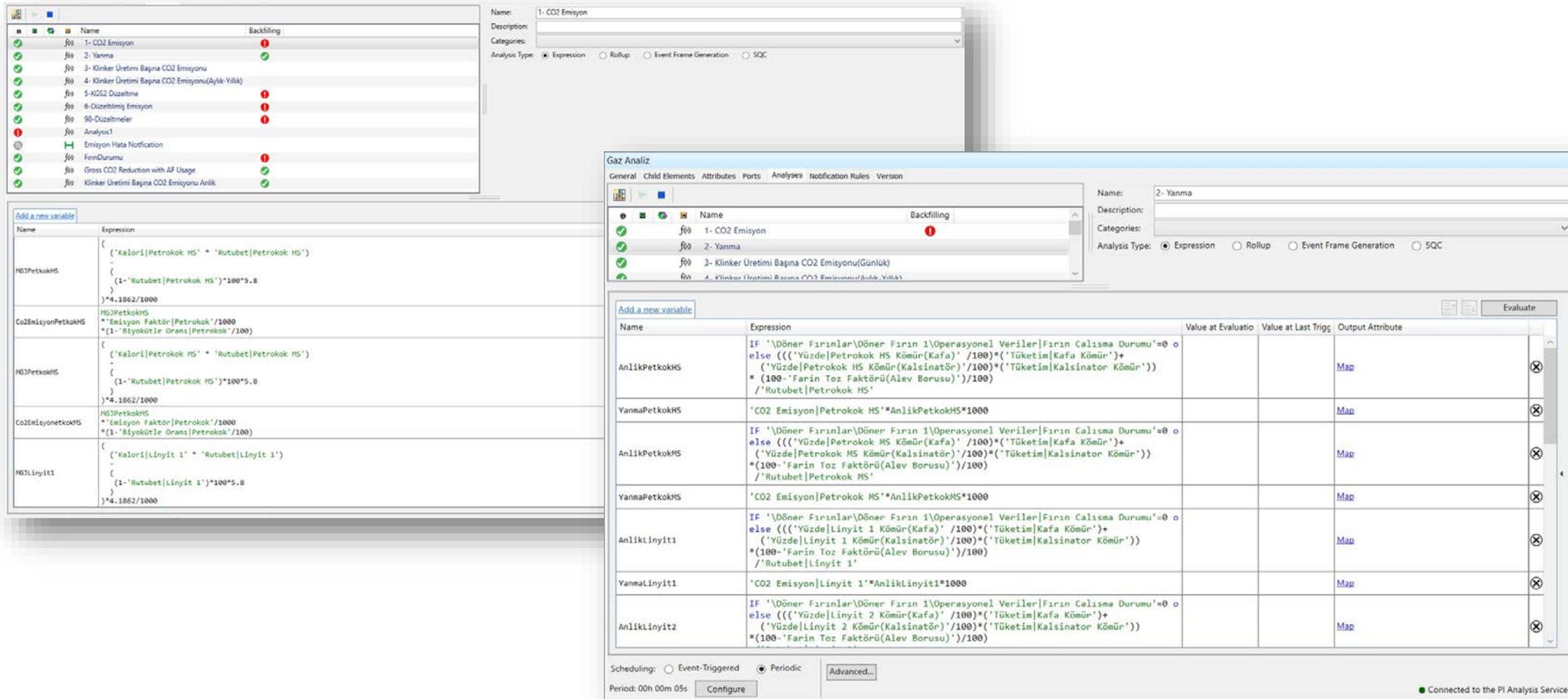
# Online Monitoring & Analyzing Capability

Tracking emissions instantly



# Online Monitoring & Analyzing Capability

## Complicated calculations and generation of artificial tags



The screenshot displays the AVEVA software interface for configuring and analyzing tags. It is divided into several sections:

- Tag List (Top Left):** A table listing various tags with their names and backfilling status.
 

Name	Backfilling
1- CO2 Emisyon	❌
2- Yanma	✅
3- Klinker Üretimi Başına CO2 Emisyonu	✅
4- Klinker Üretimi Başına CO2 Emisyonu(Aylık-Yıllık)	✅
5-KGS2 Duzeltme	❌
6-Duzeltmiş Emisyon	❌
90-Duzeltmeler	❌
Analysis1	❌
Emisyon Hata Notification	✅
FirinDurumu	❌
Gross CO2 Reduction with AF Usage	✅
Klinker Üretimi Başına CO2 Emisyonu Anlık	✅
- Tag Configuration (Top Right):** A form for configuring a specific tag.
  - Name: 1- CO2 Emisyon
  - Description: (empty)
  - Categories: (empty)
  - Analysis Type:  Expression  Rollup  Event Frame Generation  SQC
- Expression Editor (Bottom Left):** A table for defining expressions for new variables.
 

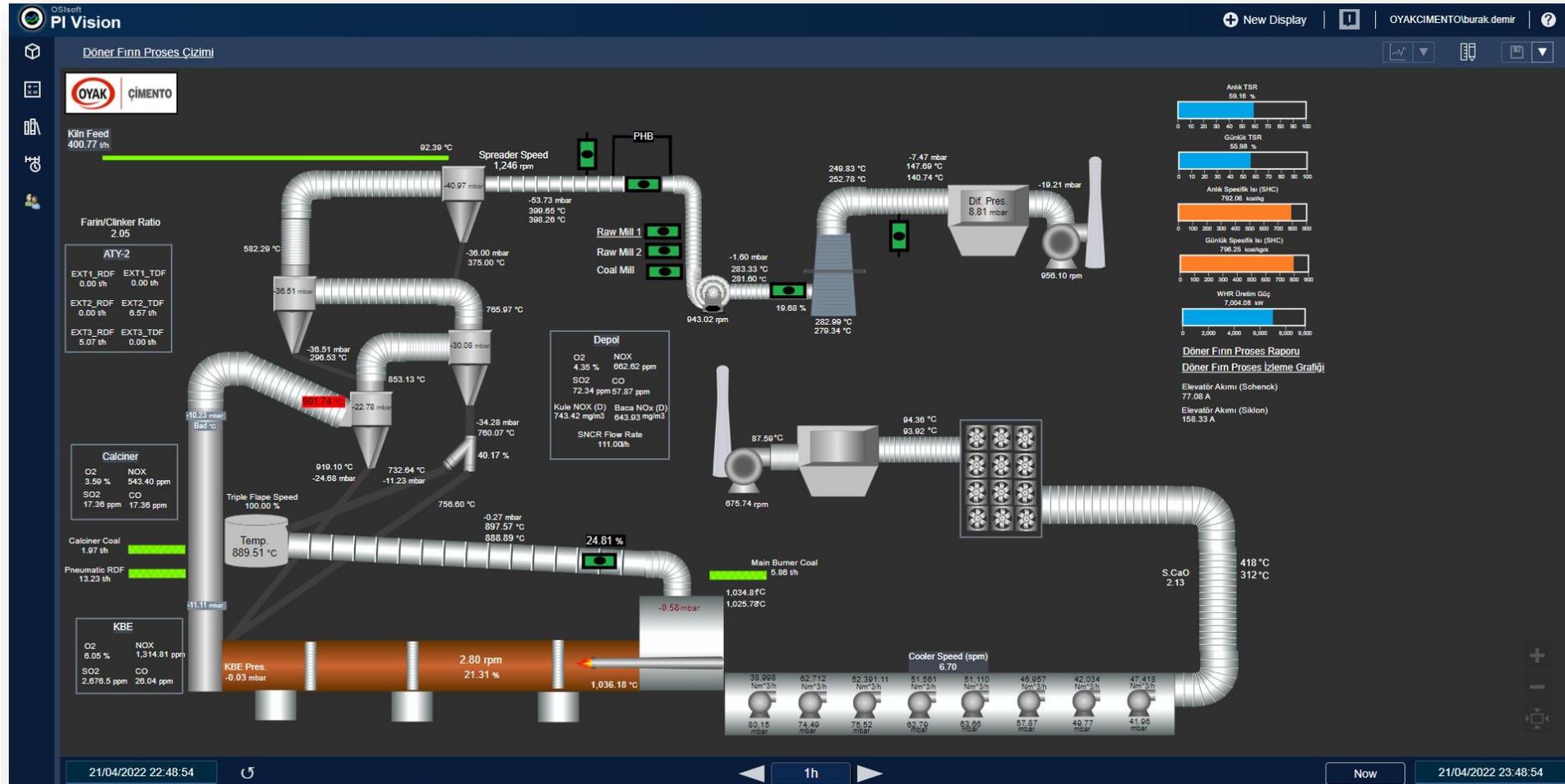
Name	Expression
H33PetrokokHS	{ ('Kalore Petrokok HS' * 'Rutubet Petrokok HS') (1-'Rutubet Petrokok HS')*100*5.8 )*4.1862/1000
Co2EmisyonPetrokokHS	H33PetrokokHS *'Emisyon Faktör Petrokok'/1000 *(1-'Biyokütle Oranı Petrokok'/100)
H33Linyit1	{ ('Kalore Linyit 1' * 'Rutubet Linyit 1') (1-'Rutubet Linyit 1')*100*5.8 )*4.1862/1000
- Gaz Analiz Configuration (Middle Right):** A form for configuring a specific analysis.
  - Name: 2- Yanma
  - Description: (empty)
  - Categories: (empty)
  - Analysis Type:  Expression  Rollup  Event Frame Generation  SQC
- Expression Table (Bottom Right):** A table showing the logic for various tags.
 

Name	Expression	Value at Evaluation	Value at Last Trigg	Output Attribute
AnlikPetrokokHS	IF 'Döner Fırınlar\Döner Fırın 1 Operasyonel Veriler Fırın Çalışma Durumu'=0 o else (((('Yüzde Petrokok HS Kömür(Kafa)' /100)*('Tüketim Kafa Kömür')+ 'Yüzde Petrokok HS Kömür(Kalsinatör)'/100)*('Tüketim Kalsinatör Kömür')) *(100-'Fırın Toz Faktörü(Alev Borusu)')/100 /'Rutubet Petrokok HS'			Map
YanmaPetrokokHS	'CO2 Emisyon Petrokok HS'*AnlikPetrokokHS*1000			Map
AnlikLinyit1	IF 'Döner Fırınlar\Döner Fırın 1 Operasyonel Veriler Fırın Çalışma Durumu'=0 o else (((('Yüzde Linyit 1 Kömür(Kafa)' /100)*('Tüketim Kafa Kömür')+ 'Yüzde Linyit 1 Kömür(Kalsinatör)'/100)*('Tüketim Kalsinatör Kömür')) *(100-'Fırın Toz Faktörü(Alev Borusu)')/100 /'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 else (((('Yüzde Linyit 2 Kömür(Kafa)' /100)*('Tüketim Kafa Kömür')+ 'Yüzde Linyit 2 Kömür(Kalsinatör)'/100)*('Tüketim Kalsinatör Kömür')) *(100-'Fırın Toz Faktörü(Alev Borusu)')/100			Map
- Scheduling (Bottom):**
  - Scheduling:  Event-Triggered  Periodic
  - Period: 00h 00m 05s
  - Buttons: Configure, Advanced...
- Status (Bottom Right):**  Connected to the PI Analysis Service.



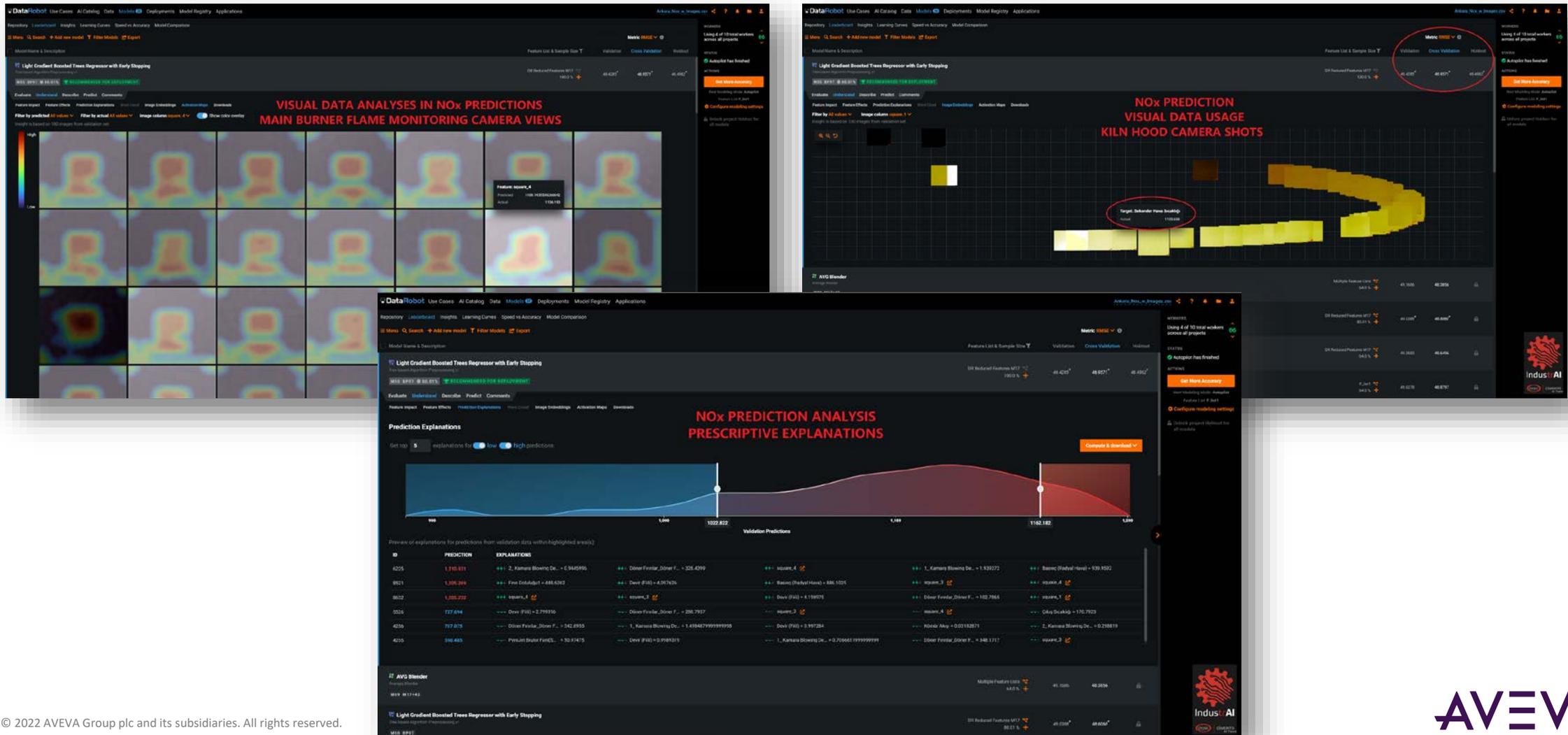
# Predicting Emissions & Guiding Process Control

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



**Visual Data Analyses in NO<sub>x</sub> Predictions**  
MAIN BURNER FLAME MONITORING CAMERA VIEWS

**NO<sub>x</sub> PREDICTION VISUAL DATA USAGE**  
KILN HOOD CAMERA SHOTS

**NO<sub>x</sub> PREDICTION ANALYSIS**  
PRESCRIPTIVE EXPLANATIONS

ID	PREDICTION	EXPLANATIONS
4205	1.110.811	++ 2_Kamara Blowing De. - C.944596, -- Diaper Filler_Driver F. - S25.4299, ++ square_4
8921	1.048.244	++ Free Catalyst - 484.6302, ++ Dev (F40) - 4.076703, ++ Basic (Pocket)Hood - 886.1101, ++ square_3
8032	1.025.222	++ square_4, ++ esum_3, ++ Dev (F40) - 4.129075, ++ Diaper Filler_Driver F. - 102.7668, ++ square_1
5535	727.694	-- Dev (F40) - 2.719916, -- square_3, -- Diaper Filler_Driver F. - 208.7937, ++ G405 SuckAid - 170.7923
4219	702.078	-- Diaper Filler_Driver F. - 342.4955, -- 1_Kamara Blowing De. - 1.4944719999999999, -- Dev (F40) - 3.397284, -- Kinked May - 0.021132871, -- 2_Kamara Blowing De. - 0.218819
4205	596.485	-- Priclub Blower Fan(S). - 30.87475, -- Dev (F40) - 0.9199315, -- 1_Kamara Blowing De. - 0.7594651999999999, -- Diaper Filler_Driver F. - 946.1717, -- square_3

# 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

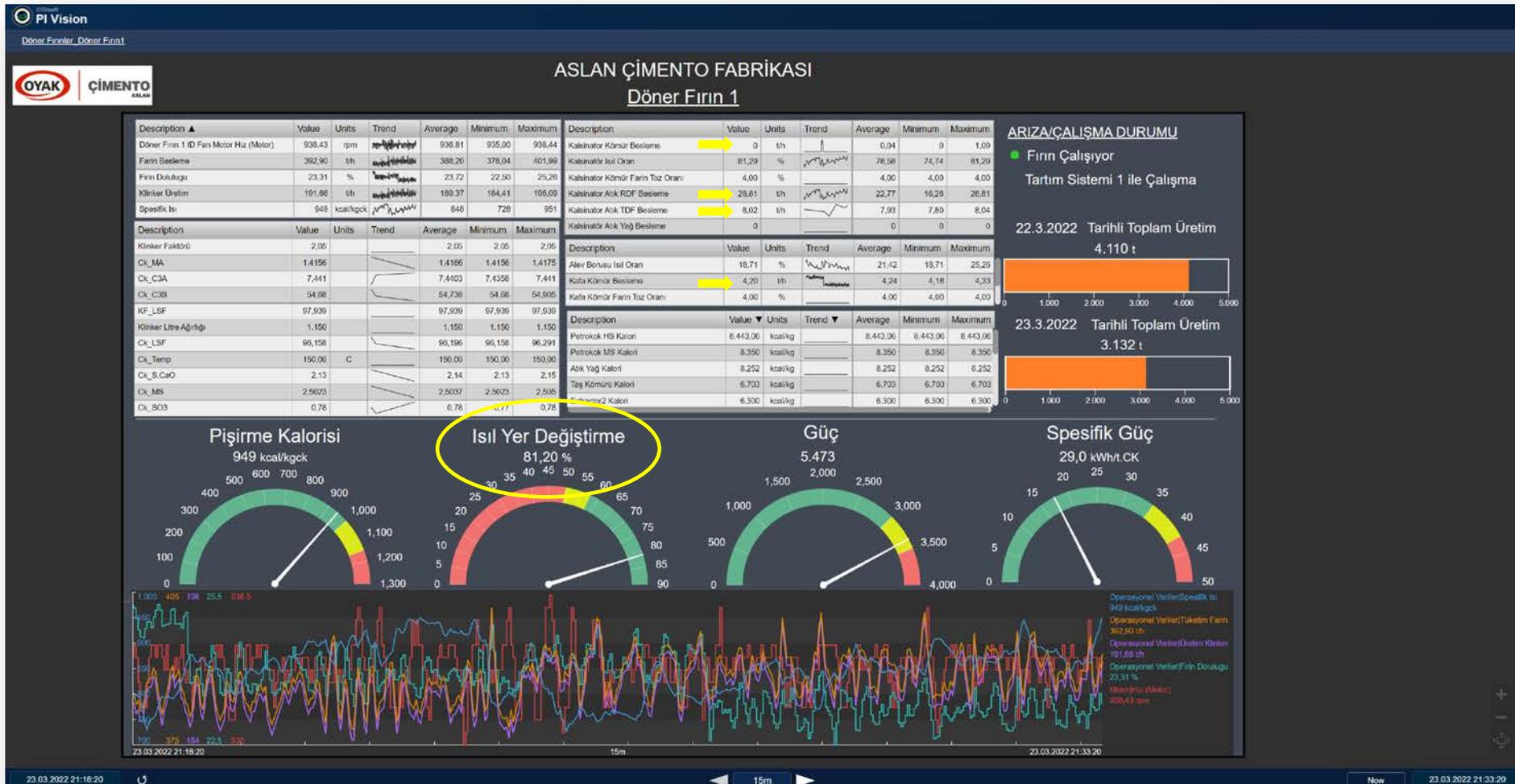
## Online Free-Lime Monitoring with AI Supported Predictions





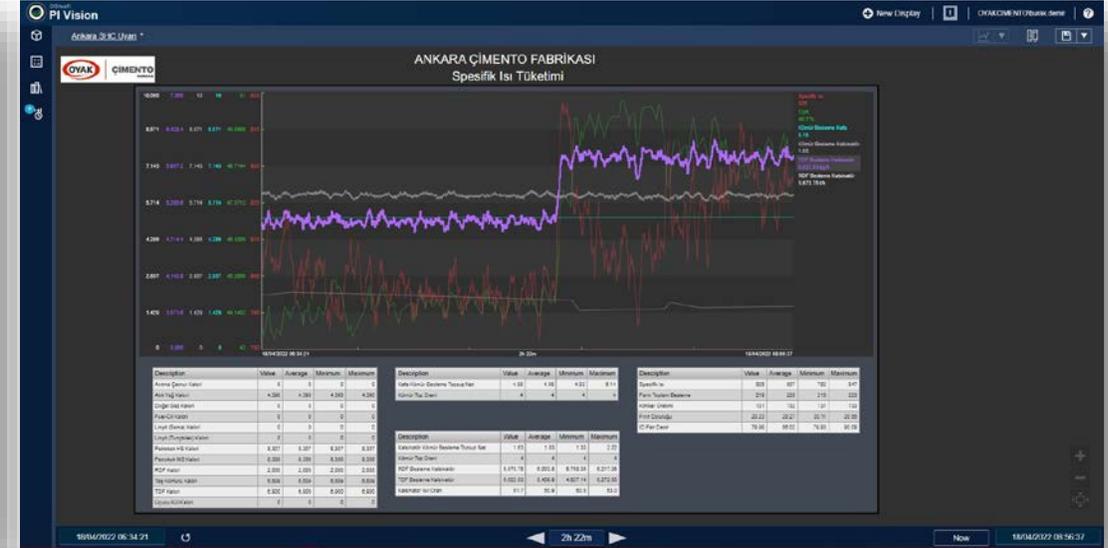
# Higher Combustion Efficiency with Less Fossil Fuels

## 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)

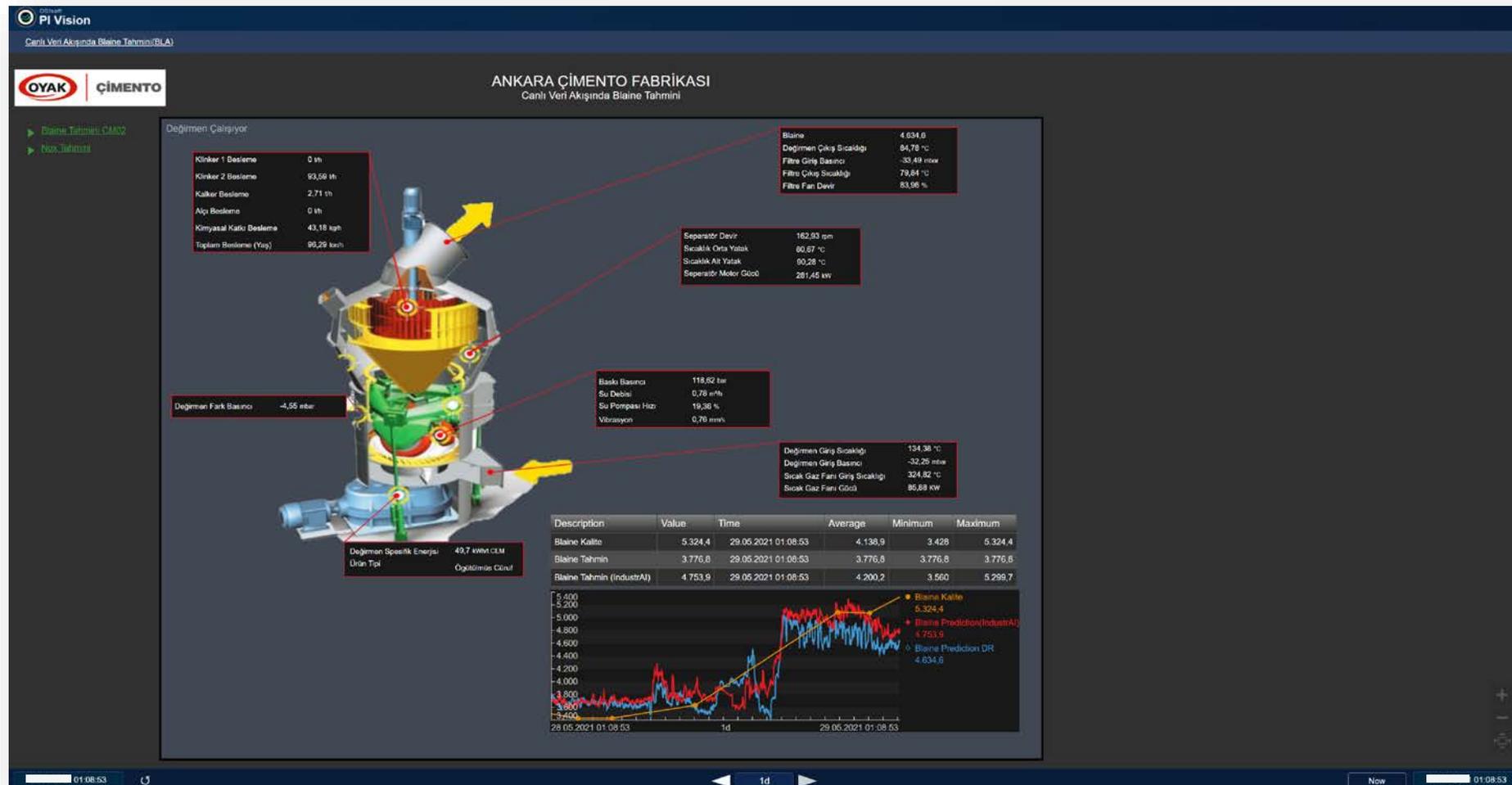
**Fırın Durumu :** Fırın Çalışıyor  
**Spesifik Isı :** 670  
**TSR :** 30.0%

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



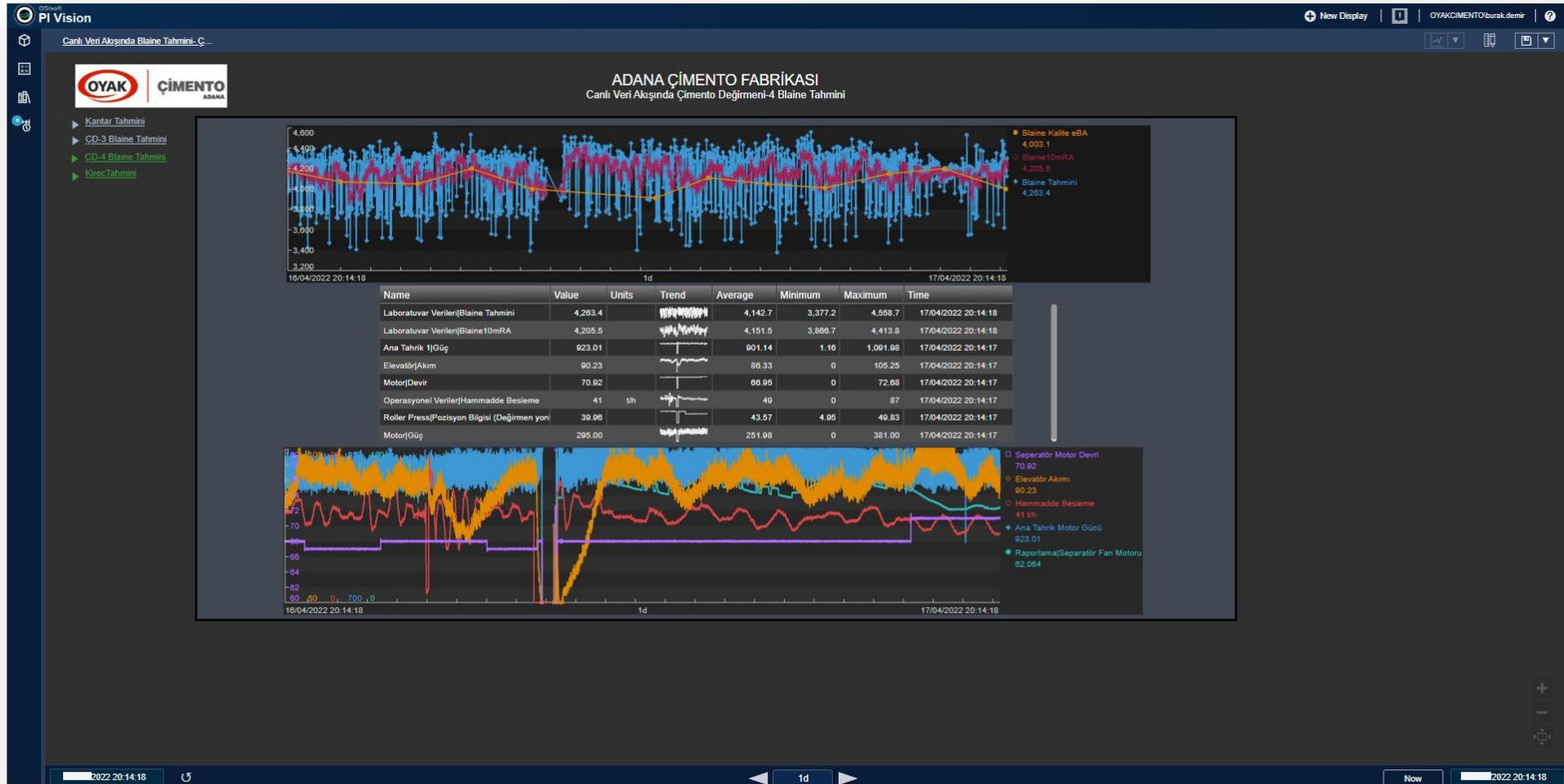
# Boosted Energy Efficiency on Cement Grinding

## 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»

Start 25 March 2022 14:28:47 -- Trend Collect ADANA. Cement Mill 4. OYAK Expert System Ver.1.8. Save Diagrams Debug Minimize

Cement Mill 4 Control Matrix Control Trends Mill Elevator Amps Blain - DynSeparator Blain - Mill Filter Fan Puls To PLC Stop

CV Variables	Active	Value	LowLimit	SetPoint	HighLimit
Roller Press Elevator Amps	<input type="checkbox"/>	123.09	100	138	175
Roller Press Power (fixed side)	<input type="checkbox"/>	60.16	150	320	1000
Roller Press Power (movable side)	<input type="checkbox"/>	60.23	150	320	1000
Mill power	<input type="checkbox"/>	872.08	700	890	1500
Mill Outlet Temp	<input type="checkbox"/>	85.24	80	100	120
Mill Elevator Amps	<input type="checkbox"/>	92.01	88	90	93
Blain	<input type="checkbox"/>	4022.21	4000	4100	4200

Alarms. Interlock for APC	Active	Value	LowLimit	SetPoint	HighLimit
Roller Press Vibration(fixed side)	<input type="checkbox"/>	2.25	0	3	8
Roller Press Vibration(movable side)	<input type="checkbox"/>	4.82	0	3	8
Gap width Roller(other side)	<input type="checkbox"/>	8.39	0	15	100
Gap width Roller(motor side)	<input type="checkbox"/>	11.54	0	15	100
Fineness	<input type="checkbox"/>	0.2	0.3	0.8	1

MV Variables	Active	Value	LowLimit	SetPoint	HighLimit	W	RSP
Roller Press Pressure (other side)	<input type="checkbox"/>	112.05	90	125	160	<input type="checkbox"/>	0
Roller Press Pressure (motor side)	<input type="checkbox"/>	113.92	90	125	160	<input type="checkbox"/>	0
Roller Press Speed (fixed side)	<input type="checkbox"/>	60.29	0	60	65	<input type="checkbox"/>	0
V separator Fan speed	<input checked="" type="checkbox"/>	85.21	58	82.8	85	<input checked="" type="checkbox"/>	82.8
Mill Filter Fan speed	<input type="checkbox"/>	45.43	45	45	80	<input checked="" type="checkbox"/>	45
Dyn Separator speed	<input type="checkbox"/>	65.01	69	65	71	<input checked="" type="checkbox"/>	65

**Cement Mill 4 Expert System Status AND Control Panel**

Cement Product Type  
Product Type: 1.00

Super White  
Cyclone Temp: 57.72

Reject of Dynamic Separator Feed t/h  
Reject of DynSep: 287.38 t/h

Silo 1-4 Elevator Current  
Silo 1-4 Elevator: 22.53 A

Silo 5-6 Elevator Current  
Silo 5-6 Elevator: 25.43 A

Cement Mill 4 Blaine Laboratory  
Blaine Laboratory: 4660.00

Roller Press Doising Flap  
RP Doising Flap: 49.22 %

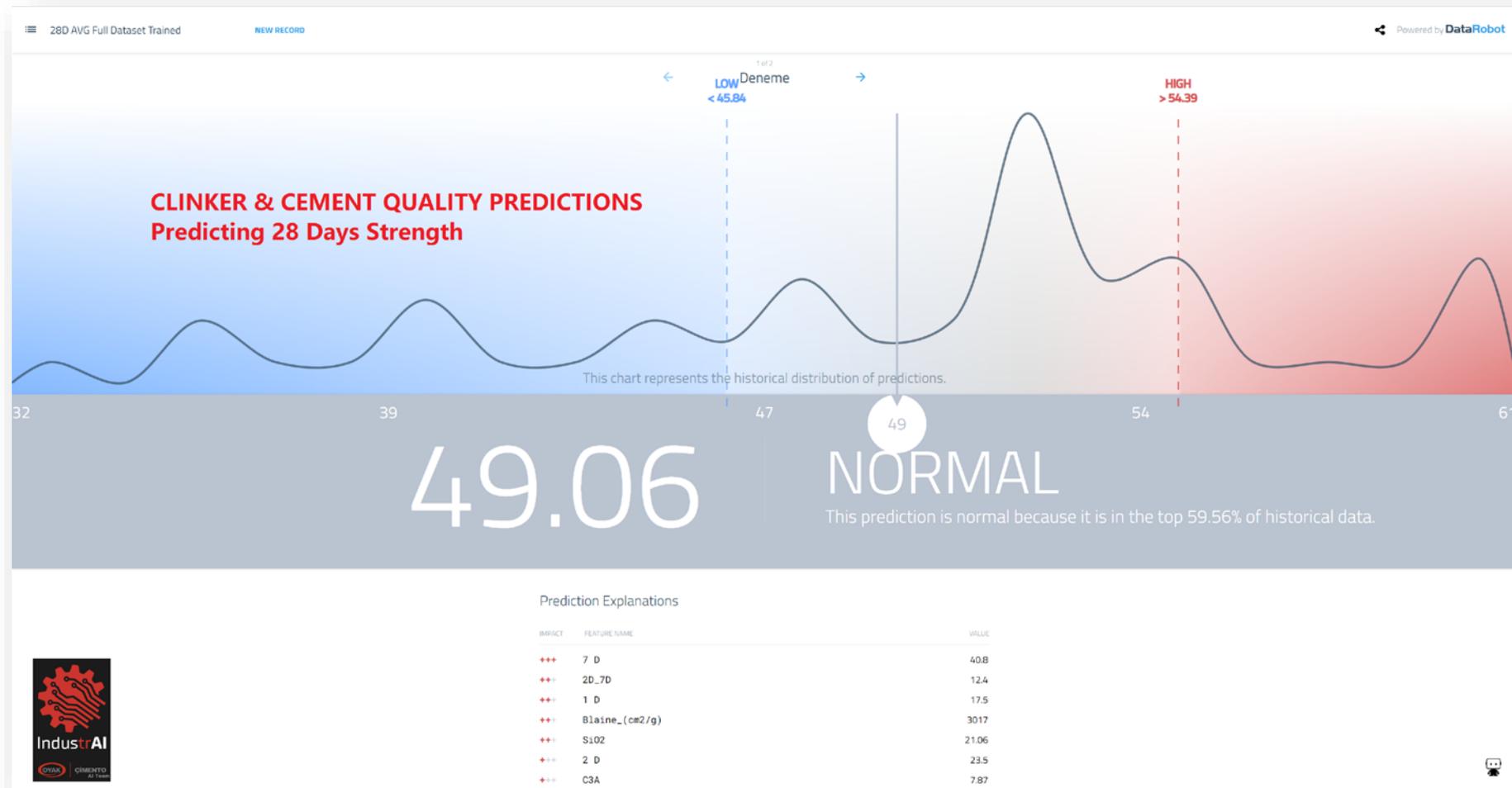
22/04/2022 13:44:41

Date&Time	Message
22/04/2022 00:02:00	Create File E:\OES_PROSTO\Trend\ADANA\CM4_RPPressureMS_RSP\22_04_2022.arch. Size = 461280
22/04/2022 00:02:00	Create File E:\OES_PROSTO\Trend\ADANA\CM4_MillTemp_PV\22_04_2022.arch. Size = 461280
22/04/2022 00:02:00	Create File E:\OES_PROSTO\Trend\ADANA\CM4_Cyclone_Temp_PV\22_04_2022.arch. Size = 461280
22/04/2022 00:01:59	Create File E:\OES_PROSTO\Trend\ADANA\CM4_VSepFanSpeed_SP\22_04_2022.arch. Size = 461280
22/04/2022 00:01:59	Create File E:\OES_PROSTO\Trend\ADANA\CM4_RPSpeedFS_RSP\22_04_2022.arch. Size = 461280
22/04/2022 00:01:59	Create File E:\OES_PROSTO\Trend\ADANA\CM4_RPPowerFS_PV\22_04_2022.arch. Size = 461280



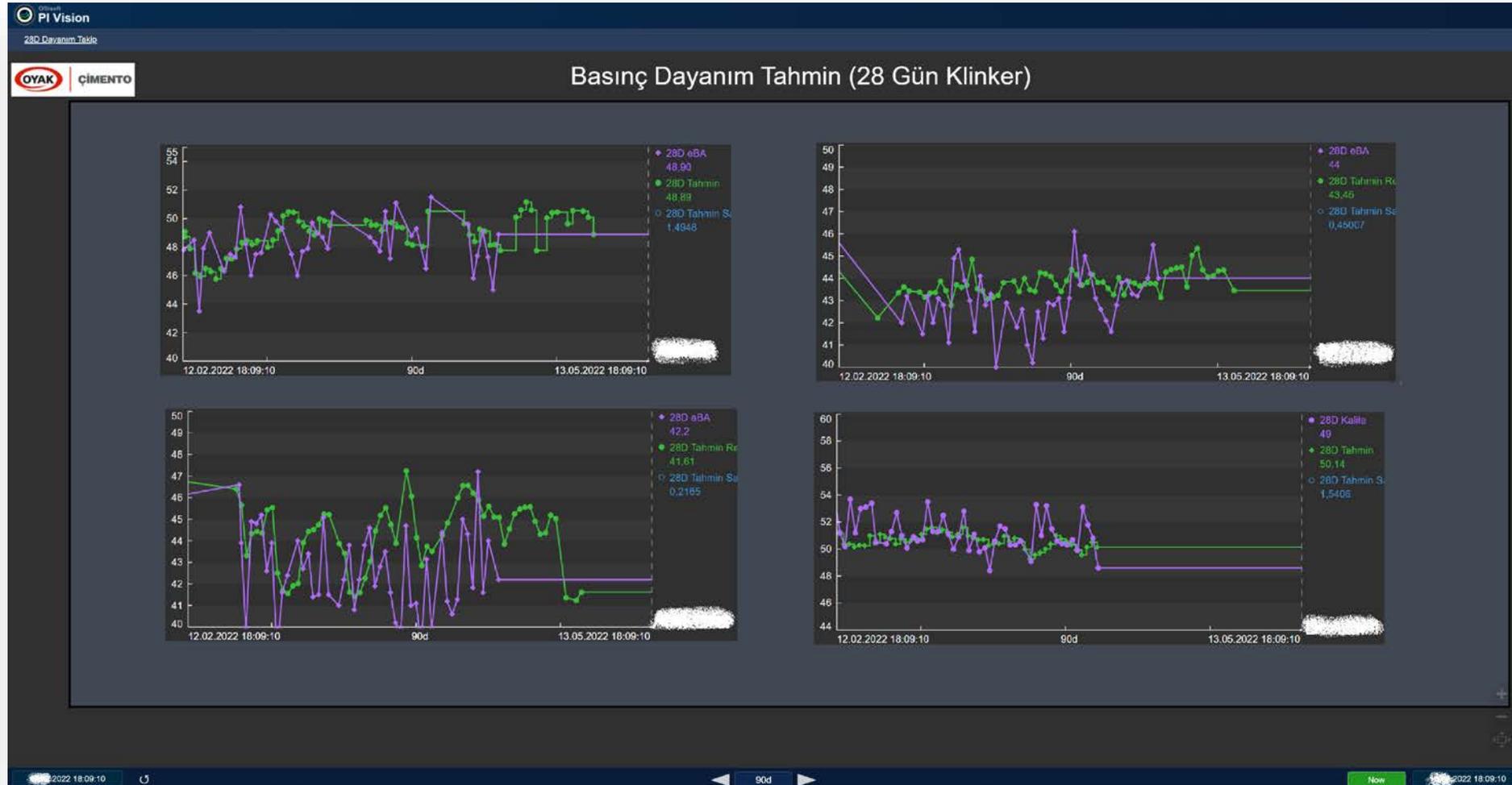
# Reducing CO<sub>2</sub> Footprints with Improved Quality"

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



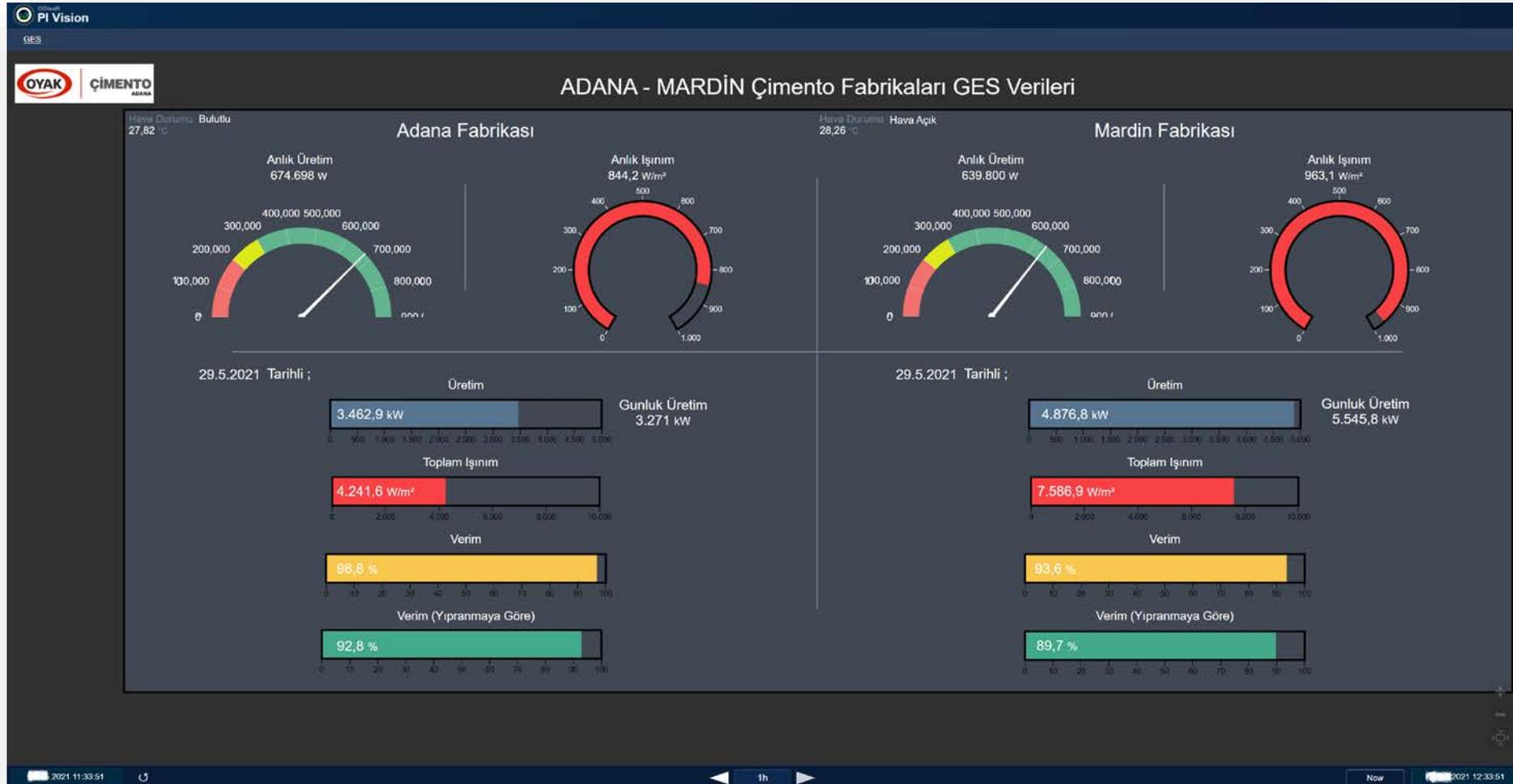
# Reducing CO<sub>2</sub> Footprints with Improved Quality"

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



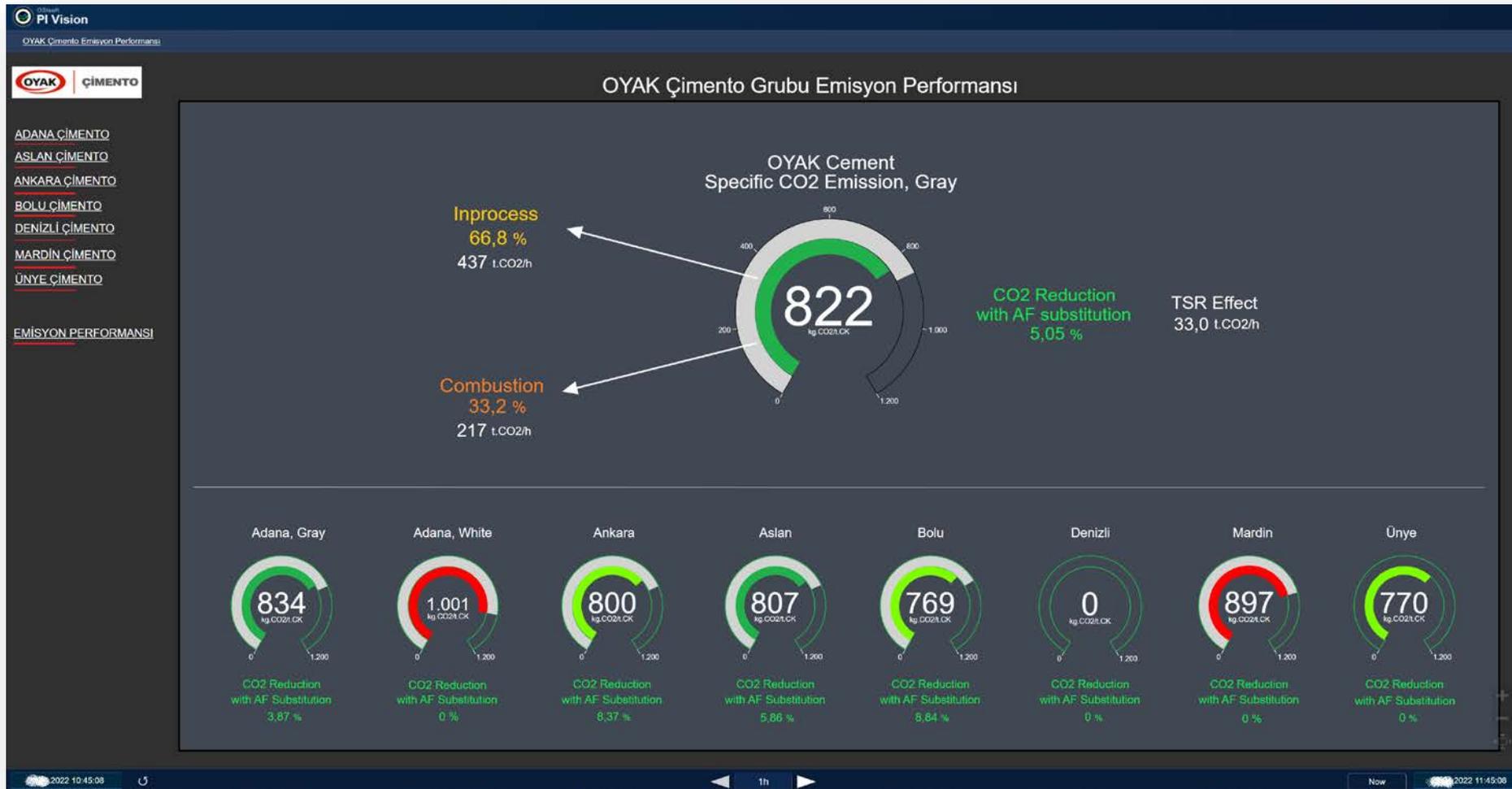
# Wrap Up

## 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**

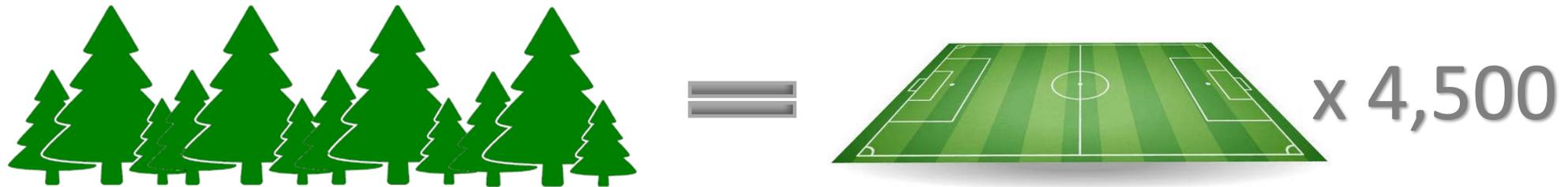
# Annual Effect of OYAK Cement 4.0 on CIMPOR Global

## 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)



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# 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

謝謝  
 DZIĘKUJĘ CI  
 NGIYABONGA  
 TEŞEKKÜR EDERİM  
 DANKIE  
 TERIMA KASIH  
 SPASIBO  
 ПАСИБО  
 GRAZIE  
 МАТУР НУВУН  
 ХВАЛА ВАМ  
 MULȚUMESC  
 ПРАКМЕТ СИЗГЕ  
 GO RAIBH MAITH AGAT  
 БЛАГОДАРЯ  
 GRACIAS  
 МАНАДСАНИД  
 ТИ БЛАГОДАРАМ  
 TAK DANKE  
 RAHMAT  
 MERCİ  
 HATUR NUHUN  
 PAXMAT САГА  
 CẢM ƠN BẠN  
 WAZVIITA  
 TAPADH LEIBH  
 KEA LEBONHA  
 БАЯРЛАЛАА  
 MISAOTRA ANAO  
 WHAKAWHETAI KOE  
 DANKON TANK TAPADH LEAT  
 SALAMAT  
 GRAZIE  
 GRAZIE  
 SHUKRA  
 HVALA  
 HVALA  
 FAAFETAİ  
 ESKERRIK ASKO  
 TEŞEKKÜR EDERİM  
 OBRIGADO  
 MERCİ  
 DI OU MÈSI  
 ĎAKUJEM  
 EΥΧΑΡΙΣΤΩ  
 GRATIAS TIBI  
 MAHALO IĀ 'ŌE  
 TAKK SKALDU HA  
 GRAZZI  
 PAKKA PÉR  
 ありがとうございます  
 SIPAS JI WERE  
 TERIMA KASIH  
 UA TSAUG RAU KOJ  
 TI БЛАГОДАРАМ  
 СИПОС  
 KÖSZÖNÖM  
 MAHADSANID  
 MAHADSANID  
 FALEMINDERIT

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The Company shall not be obliged to disclose any revision to these forward-looking statements to reflect events or circumstances occurring after the date on which they are made or to reflect the occurrence of future events.

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#### ABOUT AVEVA

AVEVA is a global leader in industrial software, driving digital transformation and sustainability. By connecting the power of information and artificial intelligence with human insight, AVEVA enables teams to use their data to unlock new value. We call this Performance Intelligence. AVEVA's comprehensive portfolio enables more than 20,000 industrial enterprises to engineer smarter, operate better and drive sustainable efficiency. AVEVA supports customers through a trusted ecosystem that includes 5,500 partners and 5,700 certified developers around the world. The company is headquartered in Cambridge, UK, with over 6,500 employees and 90 offices in over 40 countries.

Learn more at [www.aveva.com](https://www.aveva.com)