



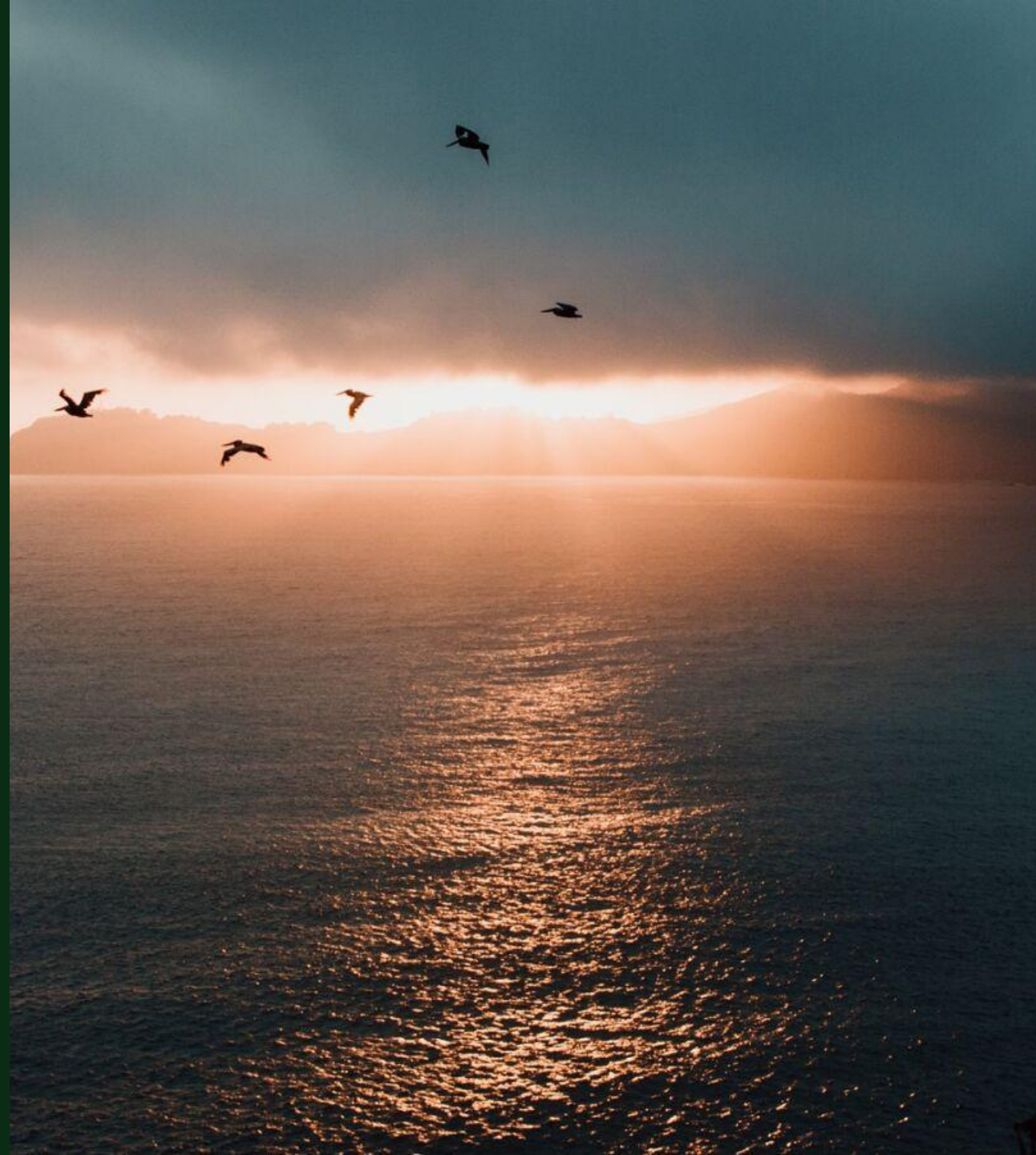
Predictive Emissions Monitoring System

CNOOC BUZZARD

PRESENTED BY: LAURA REID & JAMES SHANNON

Sustainability is our business

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Applying AI to optimise emissions and energy efficiency

Our guiding principles:

- Only require existing, readily available data
- Work within context of asset's proven ability to perform
- Assist operators
 - Clear visibility of energy/emissions performance
 - Identify opportunities for improvement
 - Open loop, advisory approach
 - **Amplify operators' abilities**



OPEX Initiatives

“Look into current operations and optimize what is already there.”

Short term, reduction case.
Achievable results, quickly visible.

What is a Predictive Emissions Monitoring System (PEMS)?

What?

- PEMS is a software used to determine real-time pollutant emissions from stationary combustion equipment.

Why?

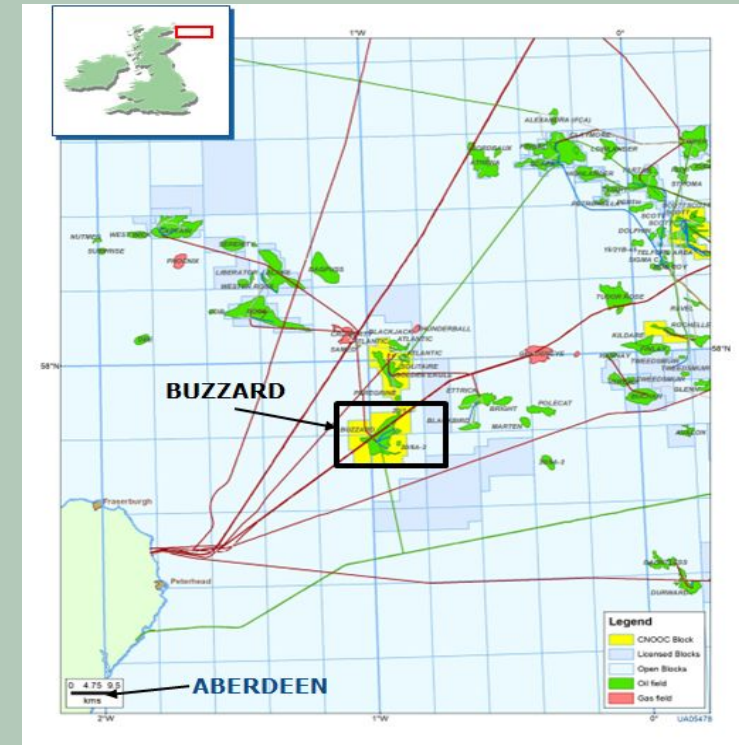
- EU MRV mandate for source and site level methane.
- Direct measurements preferred where feasible.
- OGMP2.0 – PEMS Level 4 for quantification for combustion equipment
- Regulatory requirements for non-GHG pollutants (NO_x / CO)



CNOOC Buzzard Installation

Context

- Offshore Oil and Gas Installation
- Regulatory Permit Limits: NO_x, SO_x, CO
- Industry Methane MRV Challenge



Business Case

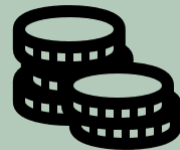
Regulatory and Reputation

- PPC Permit Requirement
- Best Available Technology
- Automated compliance tracking
- Stakeholder commitments
- Future MRV Requirements



Stack Sampling Frequency

- Third Party sampling technician
- Rental equipment
- Offshore bed space
- Core crew support
- Operational disruption – GT load change
- Coordination



Technology & Capability

- Equipment agnostic vendor
- OEM solutions
- In-house development
- Capability and experience
- Personnel time and focus



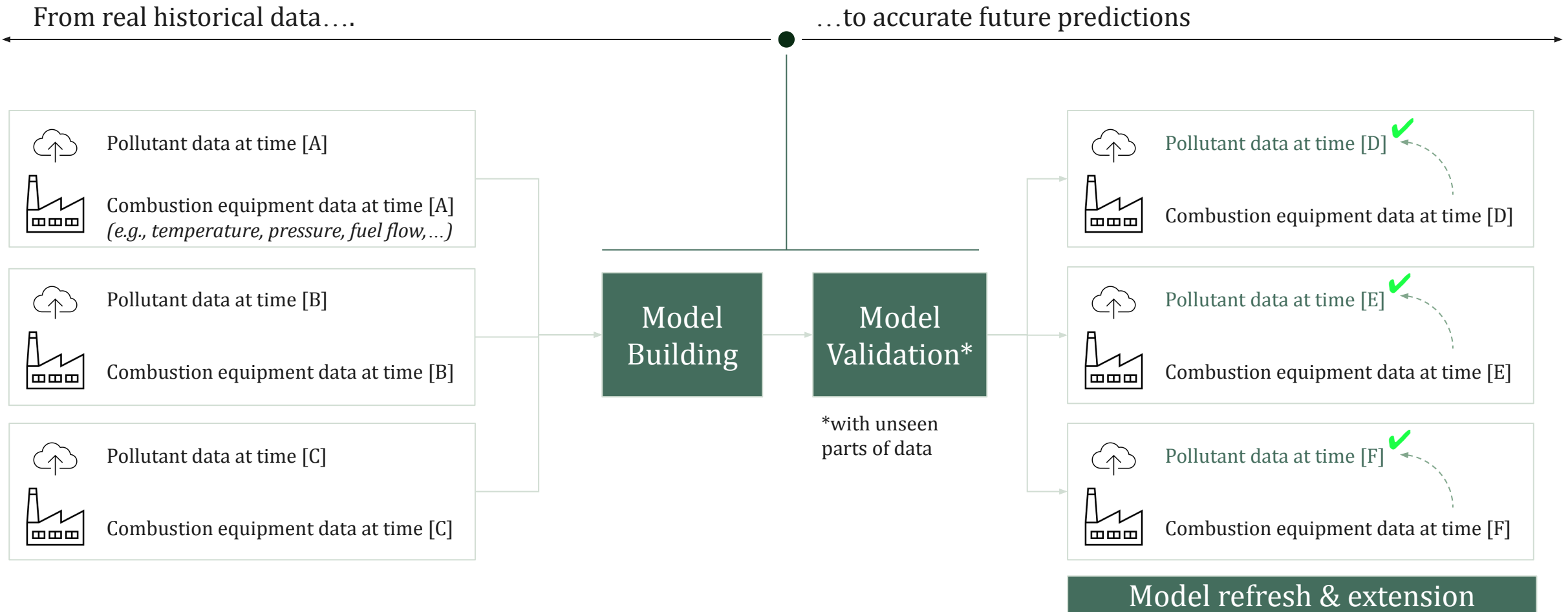
Data Management

- Data and cyber security – transfer and storage
- Data cleansing
- Data augmentation
- Data representativeness



How did we build a PEMS with CNOOC?

Our team of data scientists applies predictive modelling techniques.



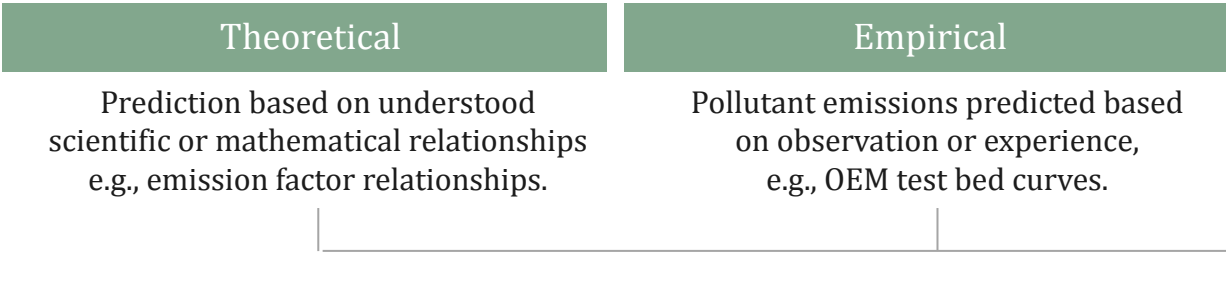
We can build and integrate the right models needed.

Facility data-based models vs simple emissions factors.

Solution is a **combination of models that gives the greatest accuracy and reliability.**

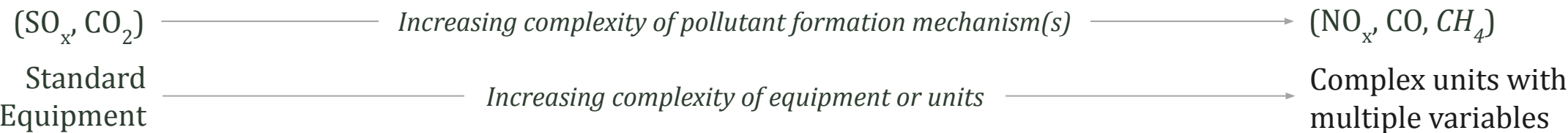
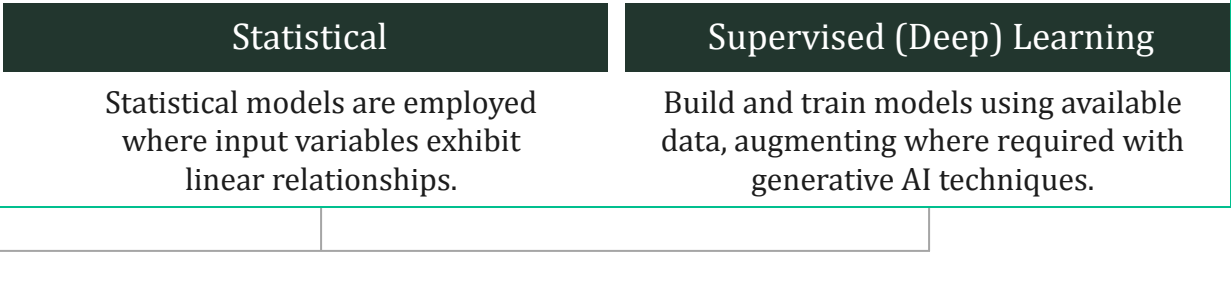
Relational Models

Estimate emissions as a function of one or more process parameters, using theoretical or empirical relations.



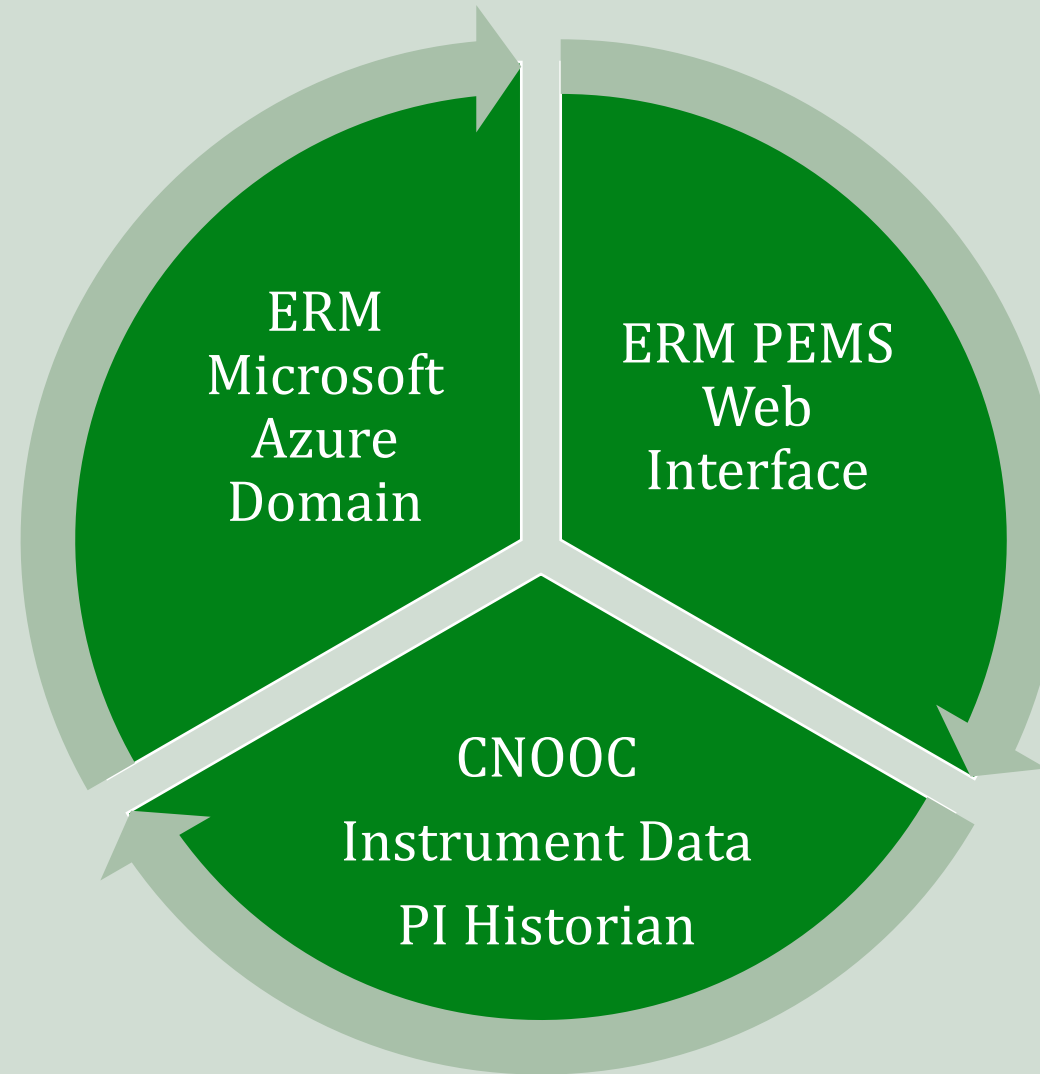
Data driven Models

In data driven models, learning algorithms find statistical regularities, between paired historical operating and stack sample data.



PEMS Module

High Level Data Flow



PEMS Module User Interface – Home Page

Pollutant concentrations are meticulously tracked and reported



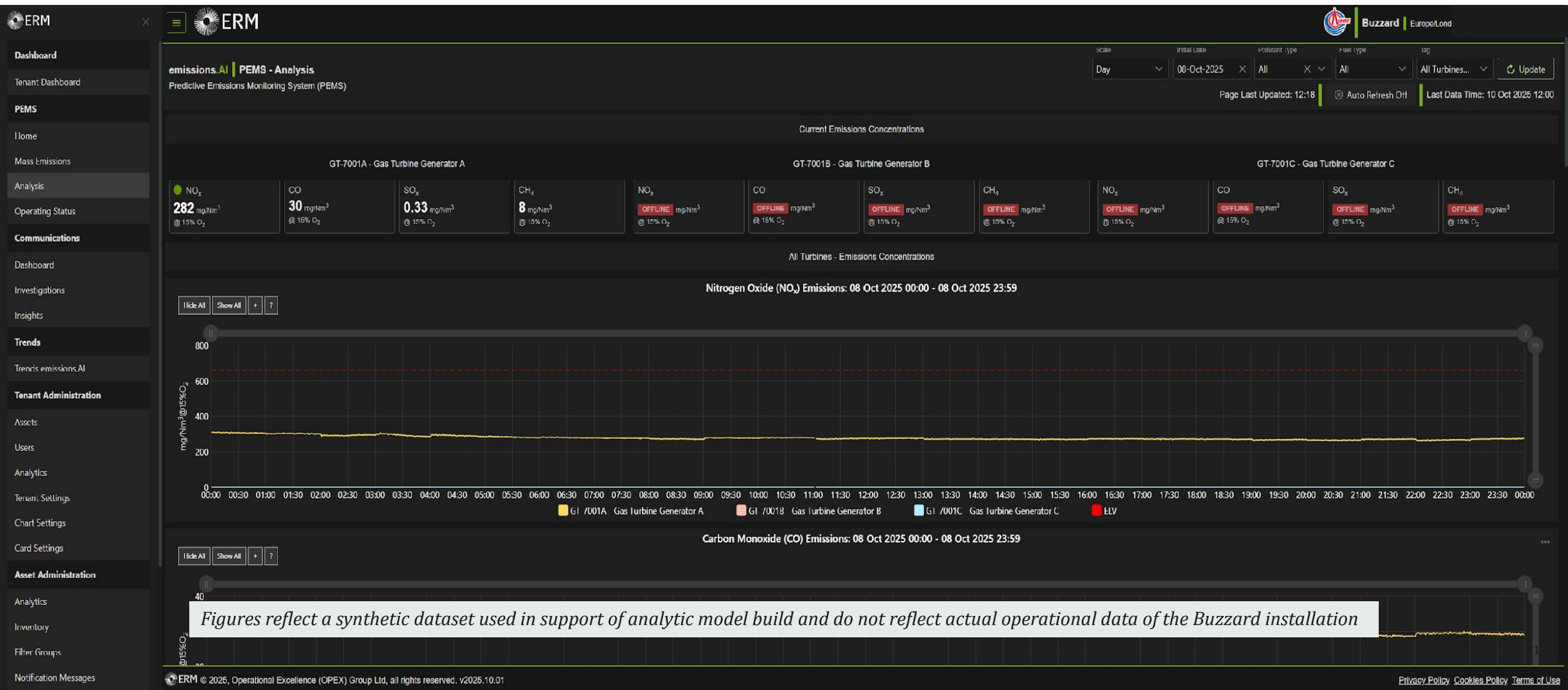
PEMS Mass Emissions Page

Mass emissions are also precisely tracked and recorded



PEMS Analysis Page

Analytics provide more insight to combustion behaviour and support emissions reduction



PEMS Operational Status Page

Model validation - monitor model, instrument and data transfer health

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Tenant Dashboard

PEMS

Home

Mass Emissions

Analysis

Operating Status

Trends

Trends emissions.AI

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PEMS - Operating Status

Predictive Emissions Monitoring System (PEMS)

Unit Type

Turbine

Update

Page Last Updated: 14:08

Auto Refresh Off

Last Data Time: 07 Jul 2025 08:00

Offline - GT-7001A - Gas Turbine Generator A - Diesel

GT-7001B - Gas Turbine Generator B - Gas

Model Status

Description	Unit	Tag	Min	Max	Current Value	Model Name	Model Version	Model Availability (previous 365 days)	Availability Check	Deviation Check	Flat Line Check	Operating Envelope Check	Sensor Fault
GTG-B CO Concentration Prediction	ppmv	BUZ.GT-7001B.CO.PEMS.PRED.PPMV	0.00	23.71	0.97	GT-7001_TARGETCO-PPMV_model.h5	V3_0_0	%					
GTG-B NOx Concentration Prediction	ppmv	BUZ.GT-7001B.NOx.PEMS.PRED.PPMV	0.00	298.75	251.65	GT-7001_TARGETNOX-PPMV_model.h5	V3_0_0	%					

Sensor Status

Description	Unit	Tag	Min	Max	Current Value	Availability Check	Deviation Check	Flat Line Check	Operating Envelope Check	Sensor Fault			
Buzzard Ambient Temperature	°C	BUZ.AmbientTemperature	2.66	17.59									
X-7001B Axial Compressor Disc Median Temperature	°C	BUZ.GT-7001B.AxialCompDiscTempMedian	167.93	457.96	449.81								
X-7001B Exhaust Mass Flowrate	kg/h	BUZ.GT-7001B.Exhaust.Flow.MassRate	2,333.33	11,916.01	275,336.30								
X-7001B Maximum Exhaust Temperature	°C	BUZ.GT-7001B.ExhaustTempMax	548.86	805.56	793.85								
X-7001B Fuel Supply Mode	NOT DEFINED	BUZ.GT-7001B.fuelSupplyMode	1.00	1.00	1.00								
Data used to classify X-7001B as online/offline	NOT DEFINED	BUZ.GT-7001B.runningTag	1.00	1.00	1.00								
Gen B % utilisation of max available power while on liquid fuel	%	CALC_BUZ_GEN_B_PowerUtilisation_Liquid	0.00	0.00	0.00								
X-7001B Maximum Power	MW	GEN_B_EST_SPINNING_RESERVE_POWER	28.12	32.42	31.31								
LIQUID FUEL METERING VALVE DEMAND	%	GEN_FY-70271B	0.00	0.00	0.00								
LIQUID FUEL METERING VALVE POSITION	%	GEN_FZT-70271B	0.04	0.08	0.08								
FUEL GAS SUPPLY PRESSURE	barg	GEN_PI-70223B	44.39	44.75	44.40								
FUEL GAS SUPPLY PRESSURE	barg	GEN_PI-70228B	43.94	44.99	43.92								
LIQUID FUEL PUMP DELIVERY PRESSURE	barg	GEN_PI-70266B	-0.22	-0.10	-0.18								
TURBINE INLET PRESSURE (P48)	bara	GEN_PI-70451B	2.50	4.48	3.81								
COMPRESSOR INLET TOTAL PRESSURE	bara	GEN_PI-70467B	0.97	1.01	0.98								
Figures reflect a synthetic dataset used in support of analytic model build and do not reflect actual operational data of the Buzzard installation													
FUEL GAS SUPPLY TEMPERATURE	°C	GEN_TE-70221B	48.39	58.28	55.31								
LIQUID FUEL PUMP DELIVERY TEMPERATURE	°C	GEN_TIT-70267B	5.48	18.38	12.51								

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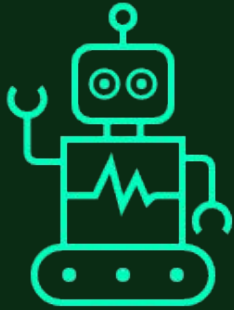


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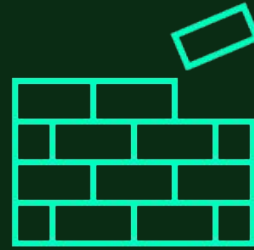


**Partnership and Collaboration
Key to Delivering Results**

In Summary : **Where we are today**



PEMS live



**Models continually reviewed
and maintained**



Compliance with PPC

Thank you

For further information please
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