



Driving energy & emissions performance across FPSOs

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Sustainability is our business

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Agenda

- 1 Who we are
- 2 How it started
- 3 How it's going
- 4 What's next

Sustainability is our business

The Energy and Emissions Performance Team are a specialist team within ERM

Our mission is to help our customers operationalise their **carbon strategy**, drive **energy efficiency** and deliver on **compliance** requirements.

Our dedicated focus is on energy and carbon intensive industries with complex facilities

ERM OVERVIEW

8000+

Professionals

40

Countries & territories

Climate change consulting Leader

Verdantix Green
Quadrant 2023

150+

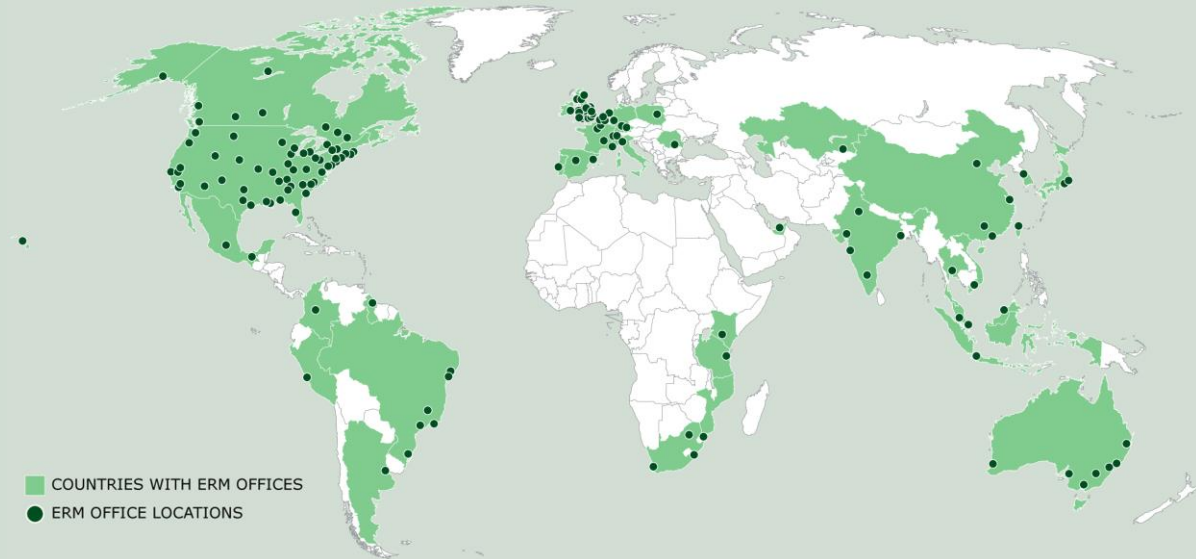
Offices

50+

Years of experience

#1

Sustainability service
provider – HFS 2022



We partner with...

70%

of Fortune 100

55%

of Fortune 500

Bumi Armada

Malaysia-based international offshore energy facilities and services provider

Dedicated to ensure we integrate sustainability into daily operations with key objectives in the UK

- Meet regulatory compliance requirements (ISO 14001, BAT etc)
- Integrate carbon emissions into decision making
- Establish carbon lean operations
- Demonstrate industry leading performance to meet commitments
- Deploy agile and relevant technologies



Owner and Operator of the
Armada Kraken



Our journey

emissions.AI

Kick off for deployment on
Armada Kraken

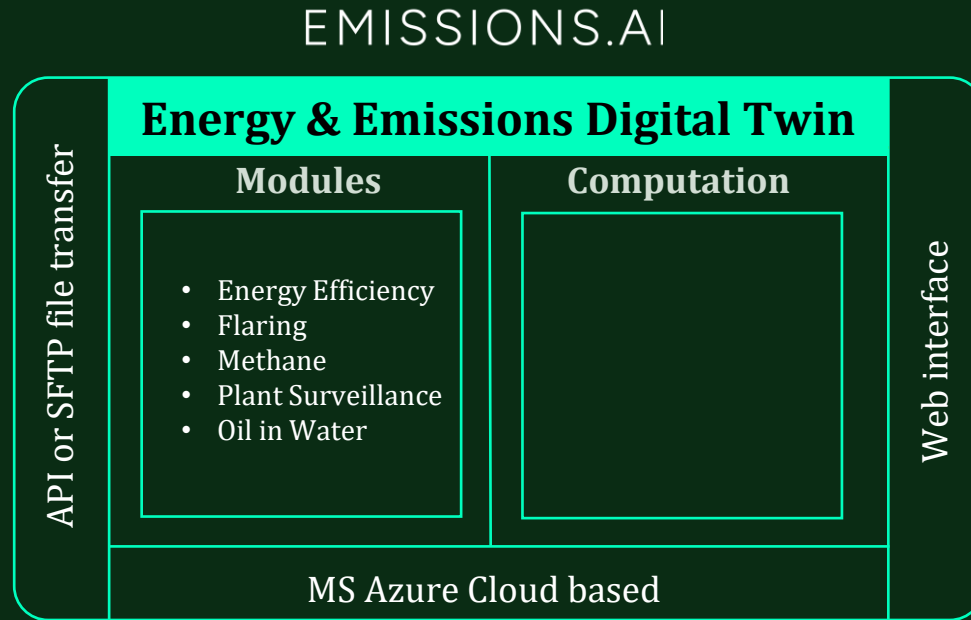




A digital solution to help companies manage energy and emissions performance

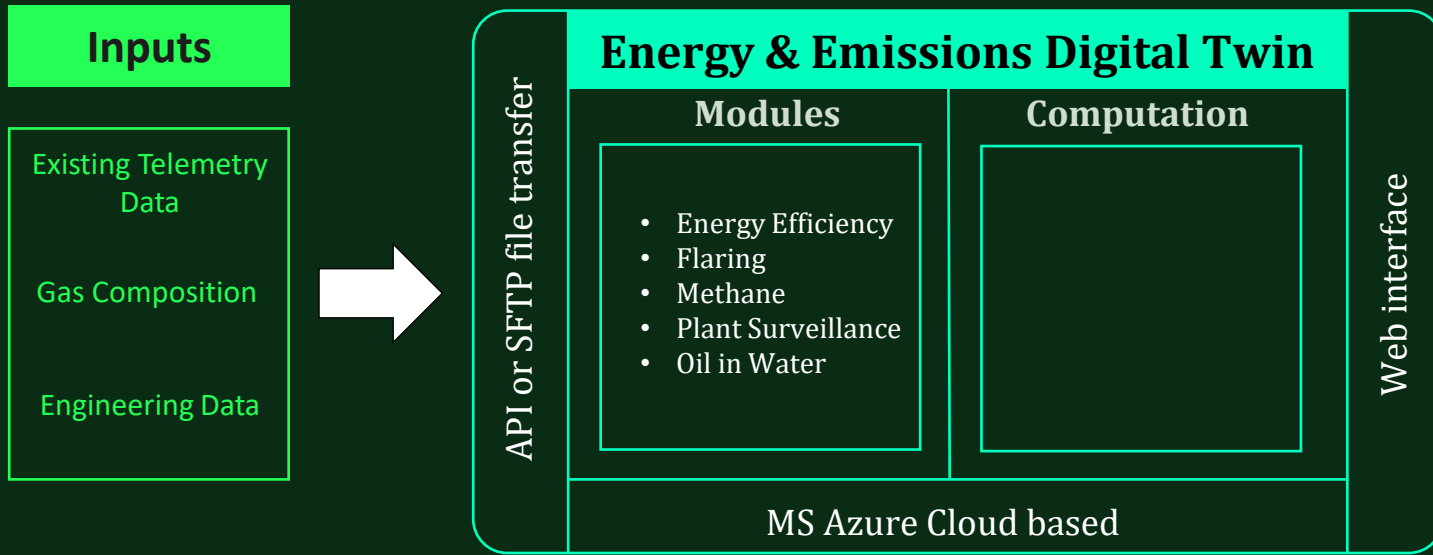
Engineering | Analytics | AI | Expert Led Support

How it works



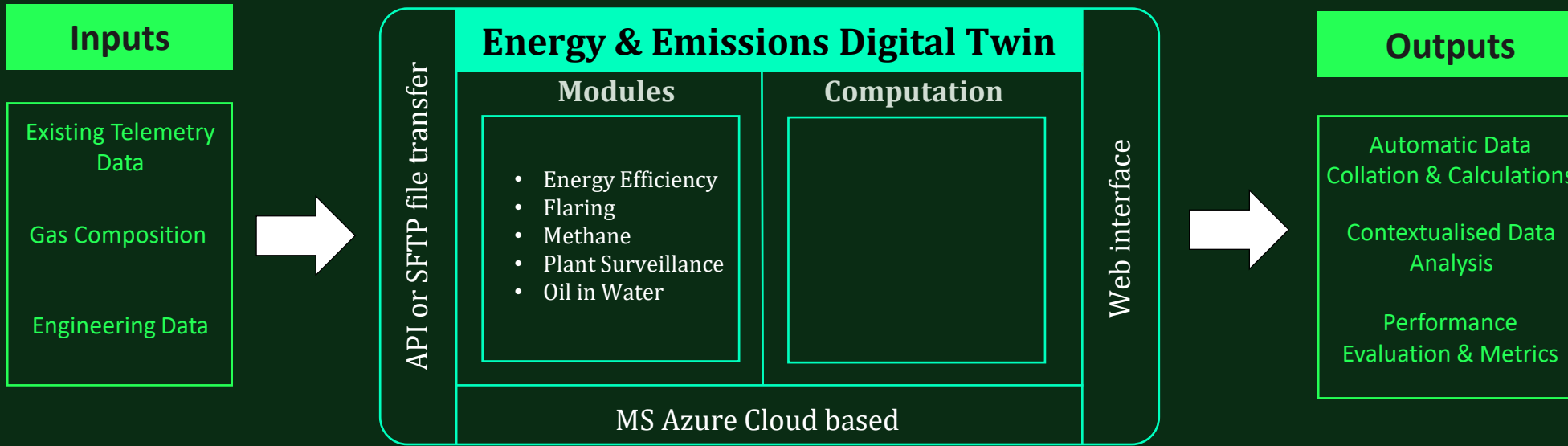
How it works

EMISSIONS.AI



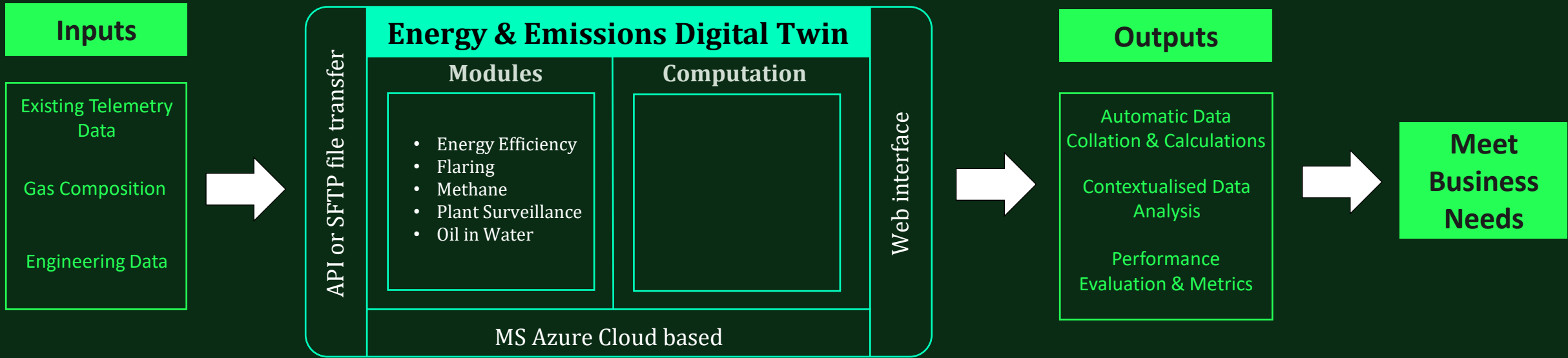
How it works

EMISSIONS.AI



How it works

EMISSIONS.AI



Our journey

emissions.AI

Kick off for deployment on Armada Kraken

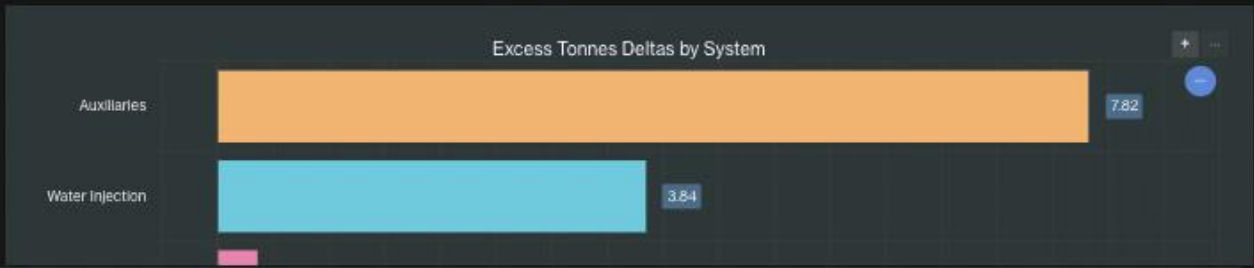
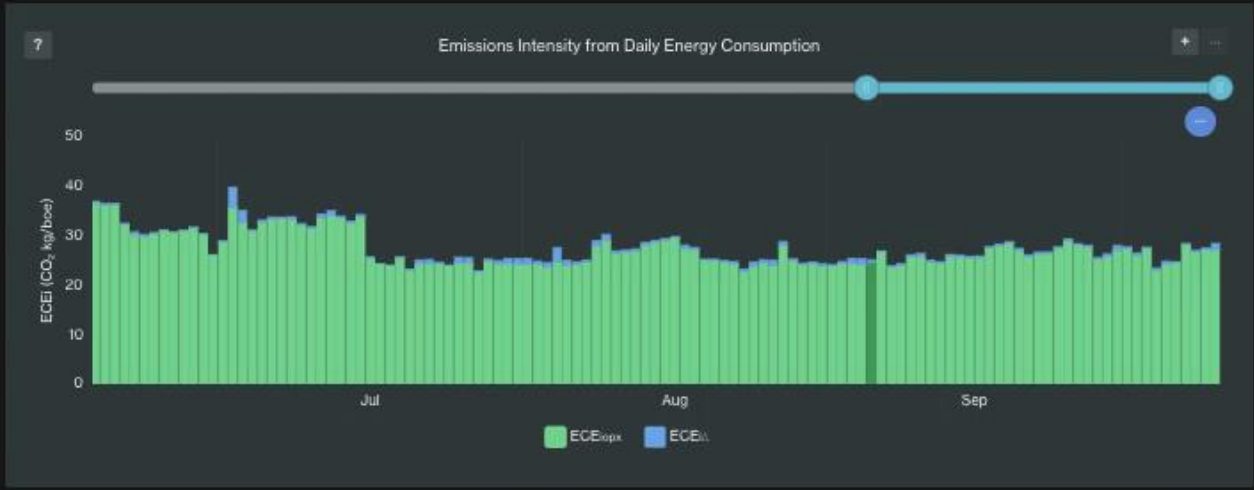
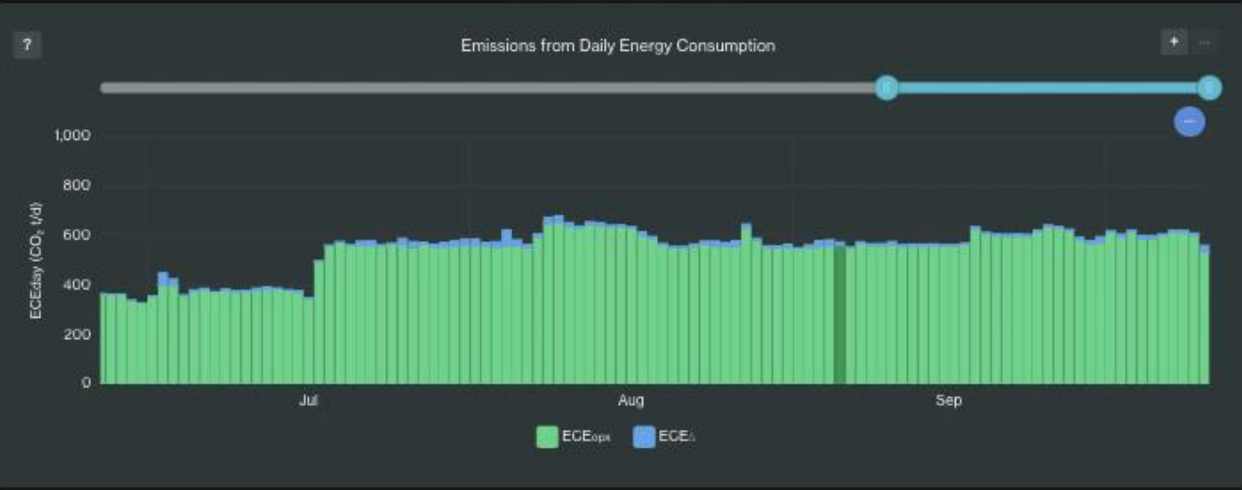


- Energy Efficiency
- Flaring and Venting

- Home
- e.AI Operational Report
- Analysis
- Power Generation
- Steam Analysis
- History
- Waste Heat Recovery
- Flaring
- Summary
- Statistical Analysis
- System Status

Current Optimisation & Reduction Opportunities

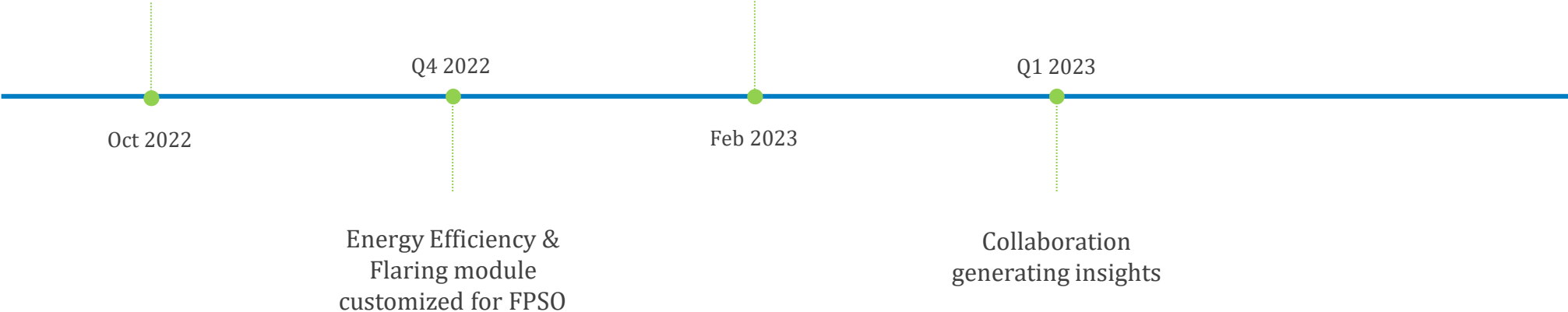
Power Generation 418.78 ECE _{day} (CO ₂ t/d)	Steam 272.4 ECE _{day} (CO ₂ t/d)	Waste Heat Recovery 55.7 ECE _{day} (CO ₂ t/d Saved)	Flaring 37.48 GFE _{day} (CO ₂ t/d)	Power 0.61 ECE _Δ (CO ₂ t/d)	Steam 34.86 ECE _Δ (CO ₂ t/d)	Total 51.77 ECE _Δ (CO ₂ t/d)	Emissions Intensity 2.46 ECE _Δ (CO ₂ kg/bbl)
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Our journey

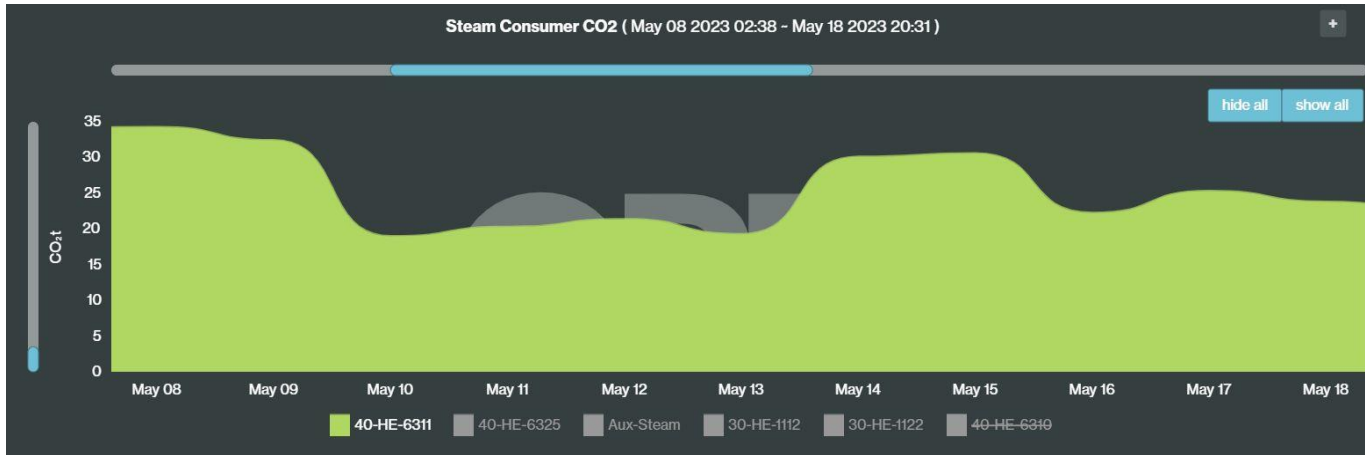
emissions.AI

Kick off for deployment on Armada Kraken

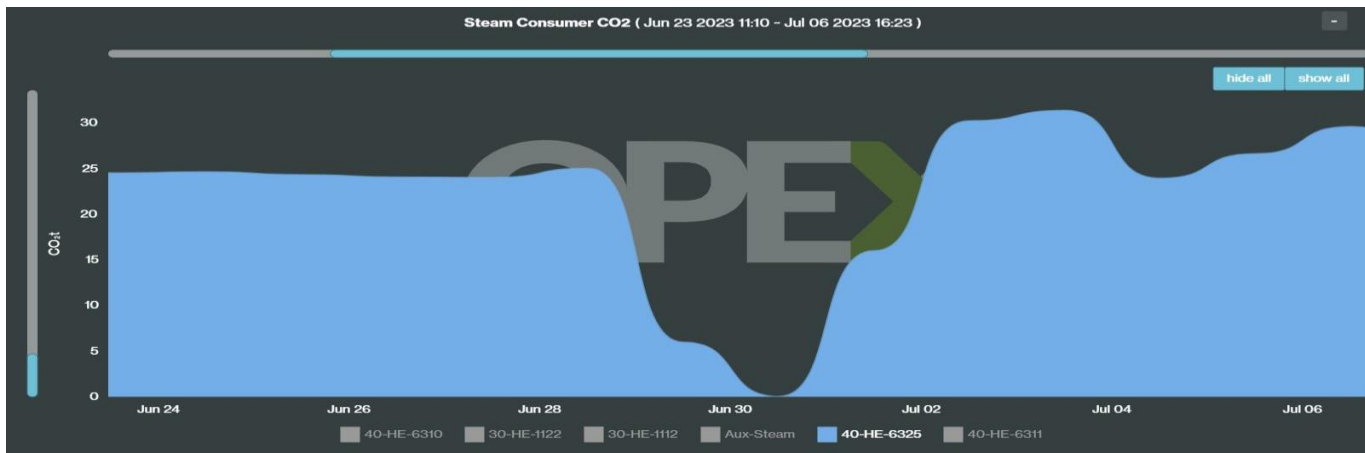


Seawater System & Process Temperatures

Identifying CO2 saving opportunities via steam boiler reductions



- HSP Power Fluid Outlet reduced by 2°C during well testing programme.
- ~10T/D CO2 reduction.
- Opportunity to make a change?



- Seawater heater was turned off for SRP maintenance, whilst WI remained online.
- ~25T/D CO2 reduction.
- Opportunity to make a change?

Temperature Trials – August 2023

Objective: Optimise steam demand across plant, reducing associated diesel consumption/CO2 emissions from the steam boilers

Areas to look at?

- HSP Heater;
- Seawater Heater;
- Oil Heaters;
- Cargo Tank Temperatures.

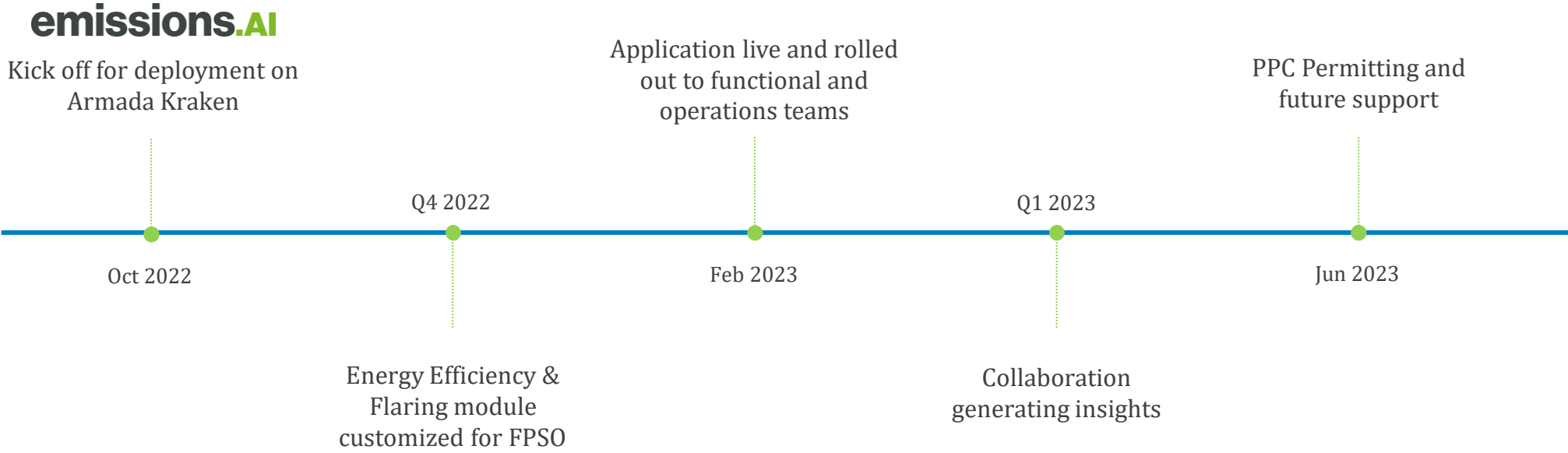
Trial Findings – 18% load reduction

- HSP Heater turned off – no longer required in operation (9% reduction in steam demand).
- SW temperature reduced by 3.5°C (4% reduction in steam demand).
- Negligible reduction in oil heater steam demand.
- Average COT temperature reduced by 3°C (5% reduction in steam demand).

What does this mean?

- Significant diesel reduction in steam boilers - can achieve full boiler gas burn during extensive period of load cycle.
- **Subsequent reduction in CO2 emissions**
- Potential to perform winter trial using emissions.AI and make permanent plant changes where possible.

Our journey



Kraken Power Generation Performance 2022-01-01 to 2023-01-01

Note: The data used for the following analysis has been sourced from Smart Client at varying resolution (typically 5 minutely) and the plots are based on the same data aggregated to hourly resolution

	70-AY-7710A	70-AY-7710B	70-AY-7710C	70-AY-7710D
Rated Power Output	15.2 MW	15.2 MW	15.2 MW	15.2 MW
Mean Online Thermal Input	30.21 MWh	29.66 MWh	28.54 MWh	29.89 MWh
Mean Online Power Output	13.39 MW	13.14 MW	12.83 MW	13.25 MW
Mean Online Thermal Efficiency	44.16 %	44.19 %	44.02 %	44.12 %
Diesel Run Hours	5311 hrs	3608 hrs	3738 hrs	5038 hrs
Gas Fuel Run Hours	0 hrs	0 hrs	0 hrs	0 hrs
Mixed Fuel Run Hours	-	-	-	-
Total Run Hours	5311 hrs	3608 hrs	3738 hrs	5038 hrs

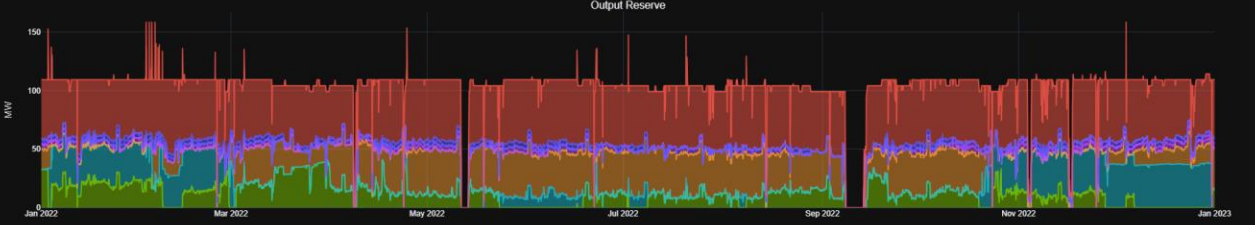
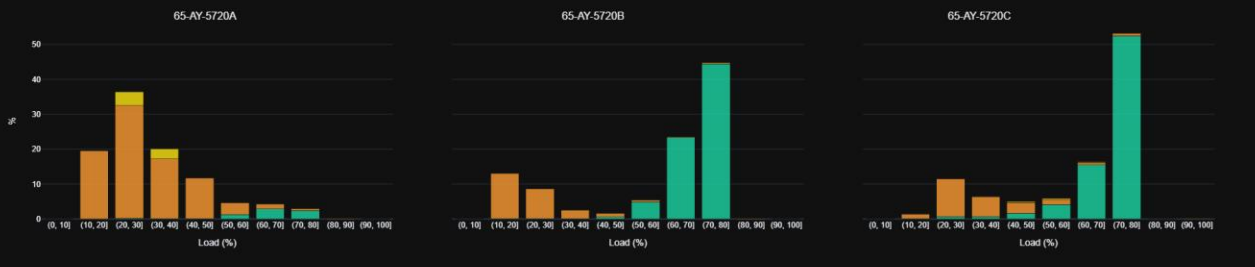
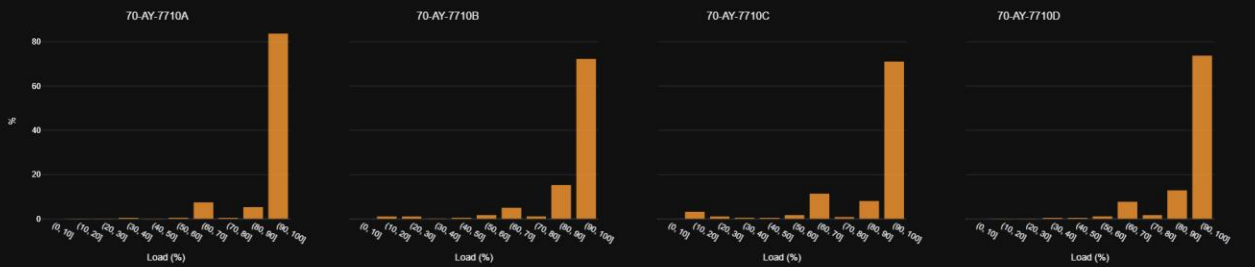
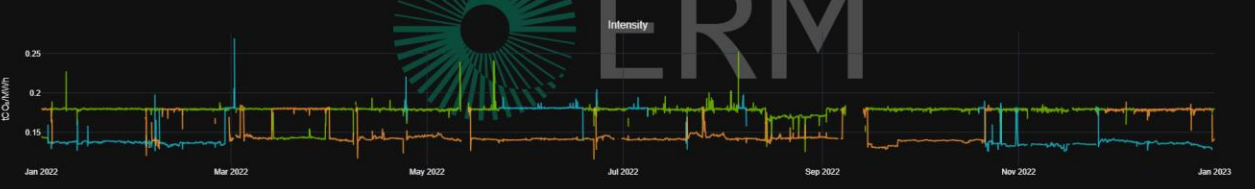
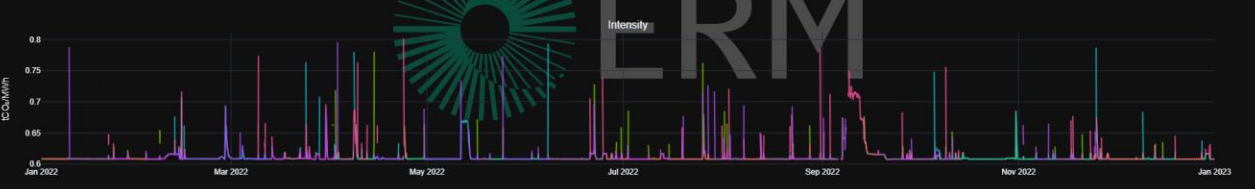
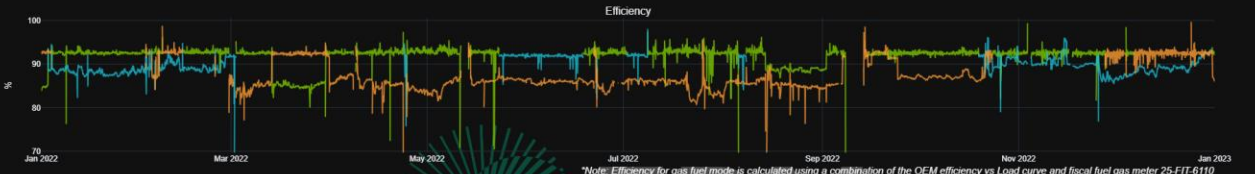
Kraken Steam Generation Performance 2022-01-01 to 2023-01-01

Note: The data used for the following analysis has been sourced from Smart Client at varying resolution (typically 5 minutely) and the plots are based on the same data aggregated to hourly resolution

	65-AY-5720A	65-AY-5720B	65-AY-5720C	70A-HX-7111A	70A-HX-7111B	70B-HX-7111A	70B-HX-7111B
Rated Power Output	49.59 MW	49.59 MW	49.59 MW	5.04 MW	5.04 MW	5.04 MW	5.04 MW
Mean Online Thermal Input	17.67 MWh	31.84 MWh	35.42 MWh	-	-	-	-
Mean Online Power Output	16.11 MW	28.47 MW	30.75 MW	4.52 MW	3.99 MW	4.05 MW	4.07 MW
Mean Online Thermal Efficiency	90.62 %	89.61 %	85.39 %	-	-	-	-
Diesel Run Hours	5506 hrs	1021 hrs	1558 hrs	-	-	-	-
Gas Fuel Run Hours	443 hrs	2857 hrs	4866 hrs	-	-	-	-
Mixed Fuel Run Hours	490 hrs	13 hrs	64 hrs	-	-	-	-
Total Run Hours	6501 hrs	3891 hrs	6489 hrs	4288 hrs	3238 hrs	1415 hrs	4903 hrs

70-AY-7710A 70-AY-7710B 70-AY-7710C 70-AY-7710D Gas Fuel Diesel Fuel Mixed Fuel Spinning Reserve

65-AY-5720A 65-AY-5720B 65-AY-5720C 70A-HX-7111A 70A-HX-7111B 70B-HX-7111A 70B-HX-7111B Output Reserve

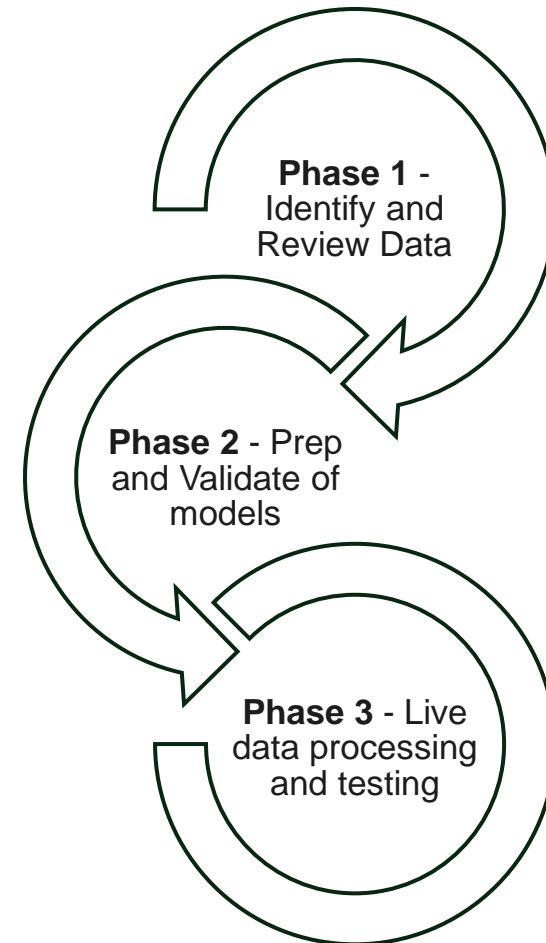


What is a Predictive Emissions Monitoring System (PEMS)?

“A system used to determine the emissions concentration of a pollutant from an emission source on a continuous basis, based on its relationship with a number of characteristic continuously monitored process parameters (e.g., the fuel gas consumption, the air to fuel ratio) and fuel or feed quality data (e.g., the sulphur content)”

- Best Available Techniques (BAT) conclusions document (2021)

- BUMI Kraken
- 4 x Engines - NOx & CO
- 3 x Boilers - NOx, SOx, CO & Dust



Working together for the future

