Powering the Energy Transition with AI

Comment les techniques d'apprentissage artificiel contribuent à la transition énergétique

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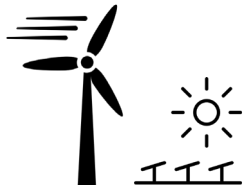
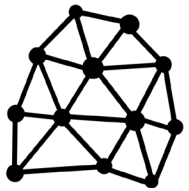
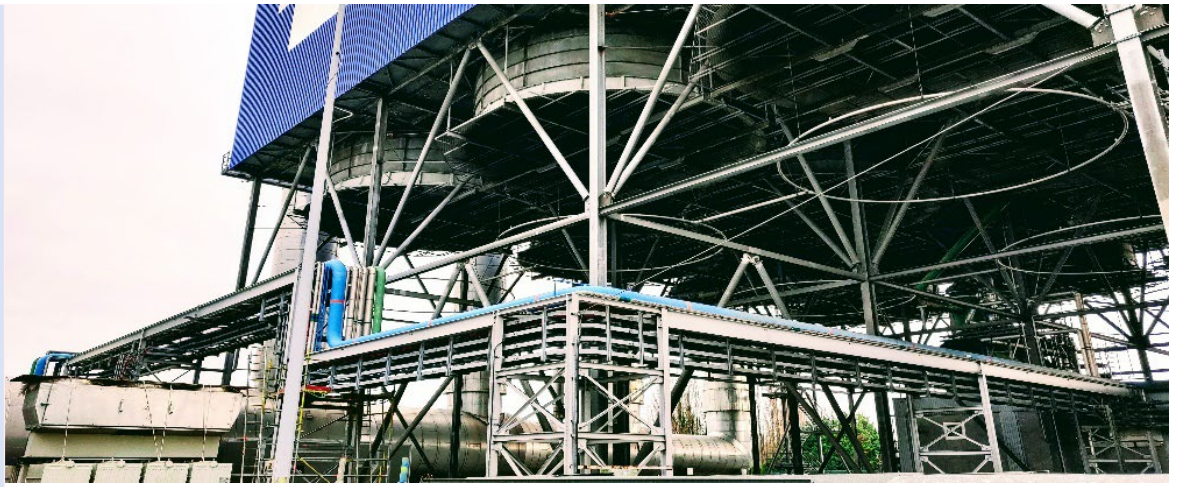
The business of the energy transition

Mega-trends	Business requirements
 **Decarbonization** Increase of renewable energy sources: variable, dependent on weather	**Monitor and analyze** asset performance **Forecast generation** to mitigate uncertainty
 **Energy Management Systems** Distributed resources: solar panels, batteries, IoT, edge, demand response	**Plan and orchestrate** distributed energy systems in a **uniform set of interfaces** anytime, anywhere, on any device
 **Data & Artificial Intelligence** Data explosion due to IoT, smart meters, etc. and maturity of cloud-based technologies	**Integrate and curate data** to create insights **Put the data to work** thanks to data science, artificial intelligence

Predictive maintenance for thermal power plants

Condition-Based Maintenance is not sufficient

Fluctuating electricity production by wind and solar plants imposes a **very dynamic operating behavior** of thermal plants. These various operating modes inherently **affect the performance** of thermal plant **core equipment** (valves, feed water pumps, etc.). Moreover, because of the age of the infrastructures, thermal plants face challenges to implement **resilient maintenance strategies** in order to improve **asset availability** and **reliability**.



3 mains issues for thermal plants

Detect failures earlier in order to **avoid unplanned shutdown**

Reduce the **spare part lead time** in case of equipment degradation or malfunction

Clearly **understand the impact** of operating changes on the **integrity of critical equipment**

The current condition-based monitoring strategy isn't enough anymore to avoid failure or even unplanned repair stops

From reactive to predictive maintenance

Reactive maintenance	Preventive maintenance	Regular Conditional maintenance	Smart Conditional maintenance	Predictive maintenance
Corrective maintenance in case of failure	Systematic planned maintenance	Maintenance plan based on predefined conditions of assets	Maintenance plan based on conditions fitted by Machine Learning	Maintenance plan based on data forecasts

Why Predictive Maintenance?

Early detection of upcoming failures

Forecast optimal maintenance period

Investigate issues with data visualization

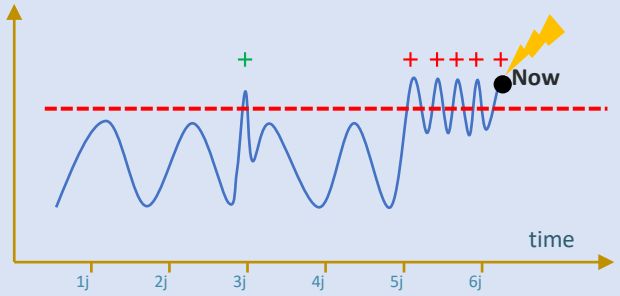
Anomaly detection & alerting systems

Current Health Alerts

Physical threshold defined by experts CBM

Signal crosses the threshold more than X times in the recent past

→ Failure detection



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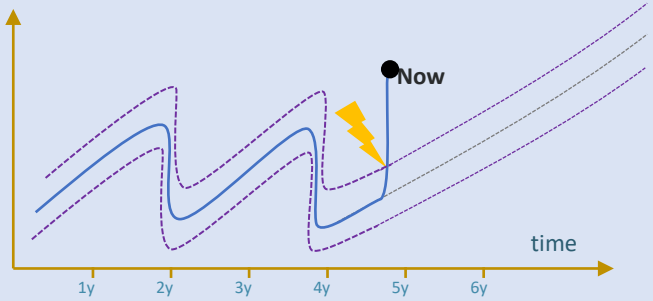
Statistical threshold CBM PM

Signal crosses the confidence interval defined by the prediction model

→ Failure detection



Future Health Alerts

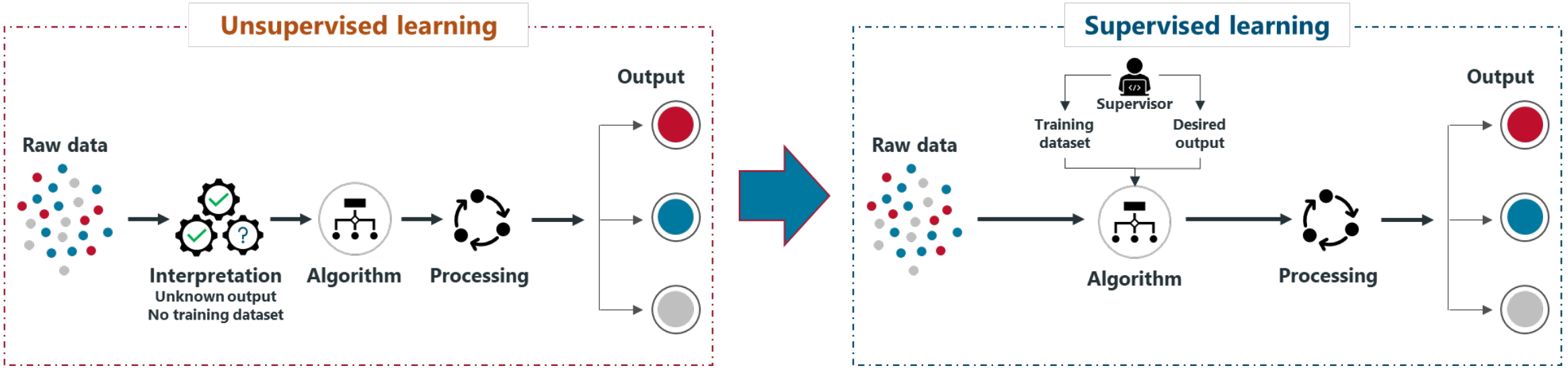
The prediction is built by learning the behaviour of the plant on past data

Physical threshold in the future PM

Signal expected to cross the threshold within 1 year

→ Maintenance to be prepared

Machine learning approach



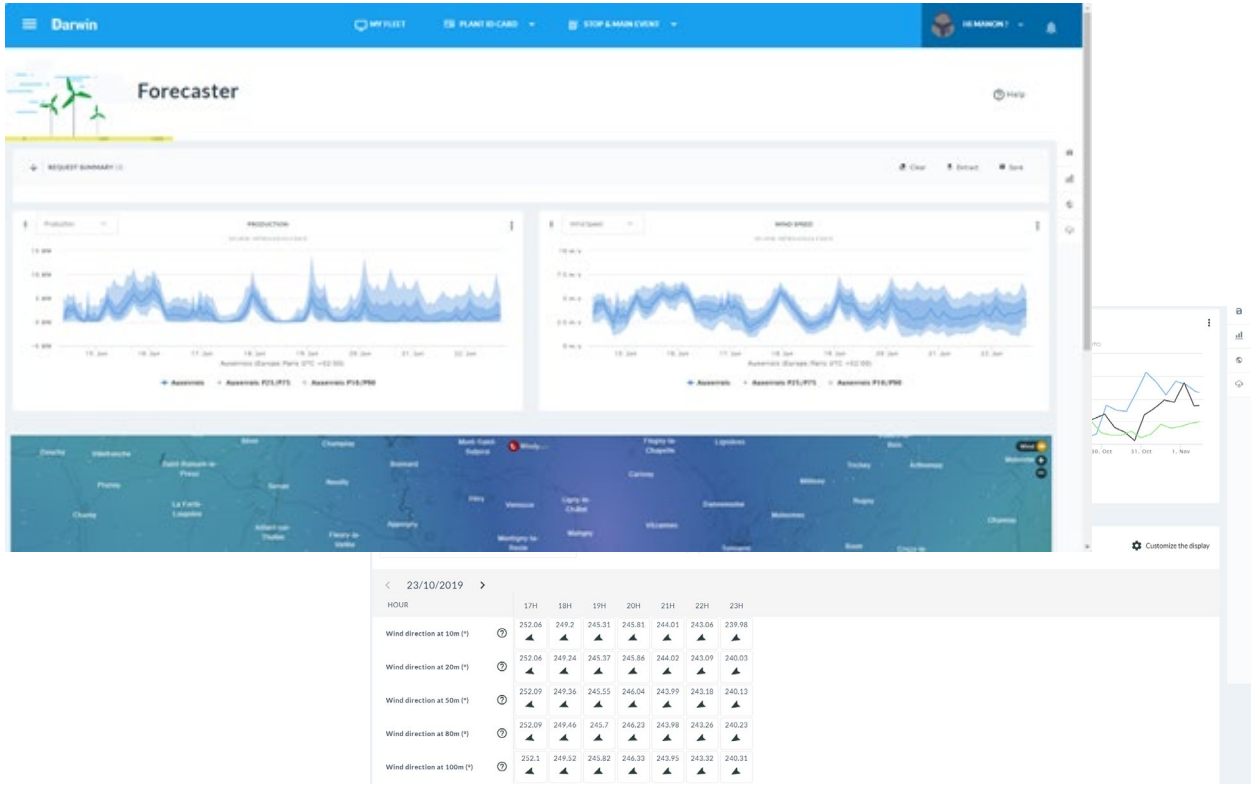
Our choice

Because we have the capacity to identify ruptures in raw data (maintenances and valves changes), we opt for **Supervised approach:**

- Rely on a process of labeling in order to "understand" information
- Developers and Data Scientists keep full control over the algorithms
- Give more accurate and stable models than unsupervised learning

What about wind and solar?
Access power plant weather and production forecast

UI



Product features

Benefits :

Value proposition:
Access detailed weather forecast and production forecast for individual plant or fleet.
Access graph, map and table views
Select timescales and time zone.

Target users: Plant operator, Plant manager

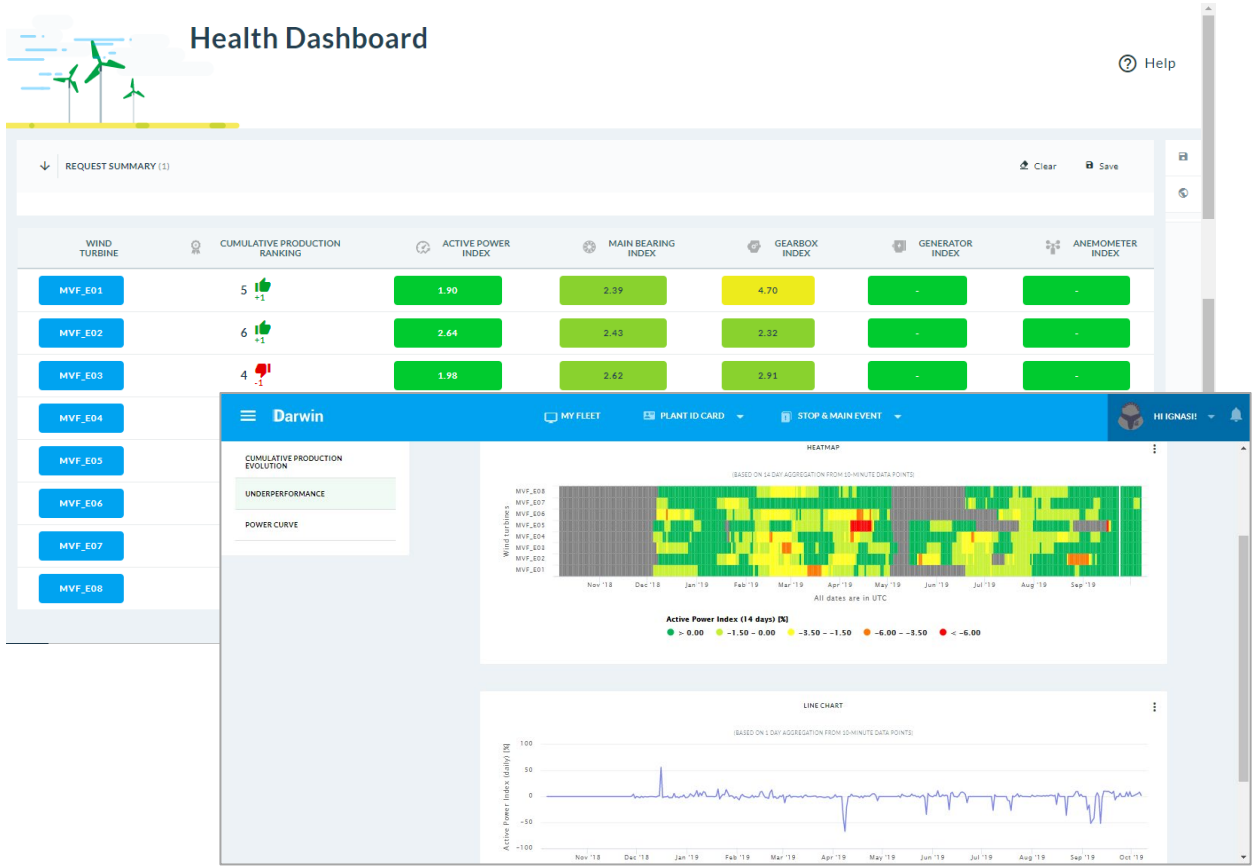
Data : Dark Sky, Meteologica, Meteomatics, Darwin production forecast (Wind only)

Scope :

: Time : Cost : Quality : Income : Risk : HSE

Machine learning to detect underperformance and anticipate failures

UI



: Time : Cost : Quality : Income : Risk : HSE

Product features

Benefits :

Value proposition:
Detect underperformance and implement predictive maintenance actions thanks to the detection of deviation to normal behavior
Product based on machine learning algorithms

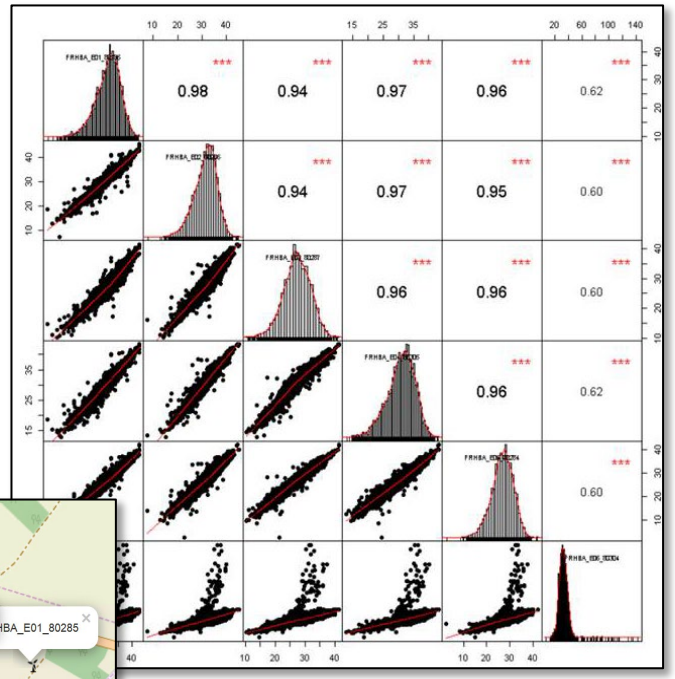
Target users: Plant manager, analysts, maintenance engineer, plant engineer

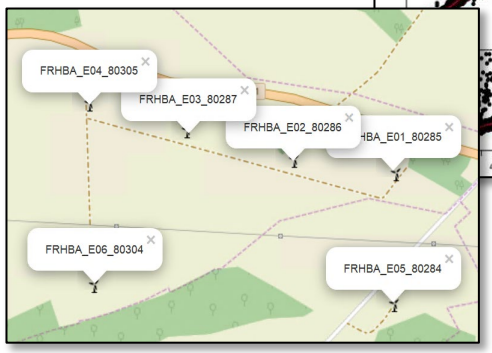
Data : Plant historical data

Scope :

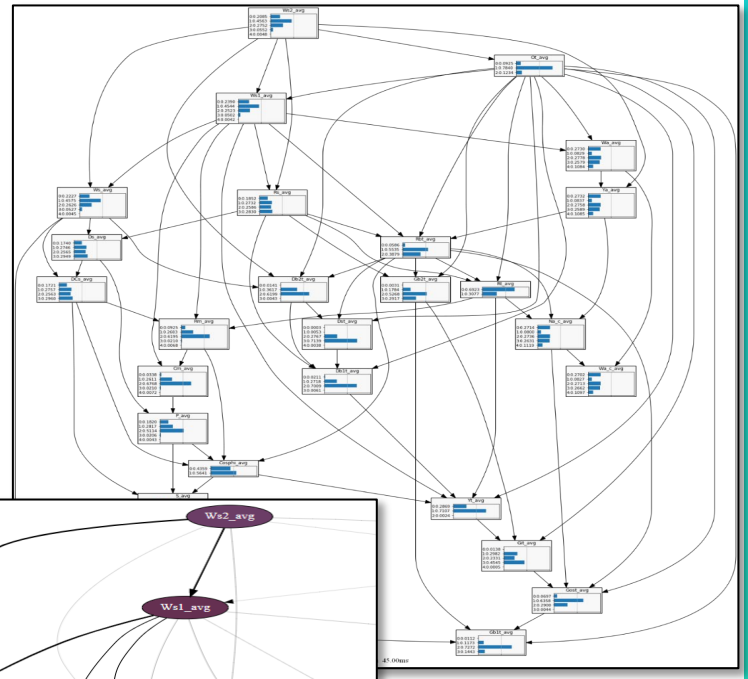
Traditional machine learning techniques

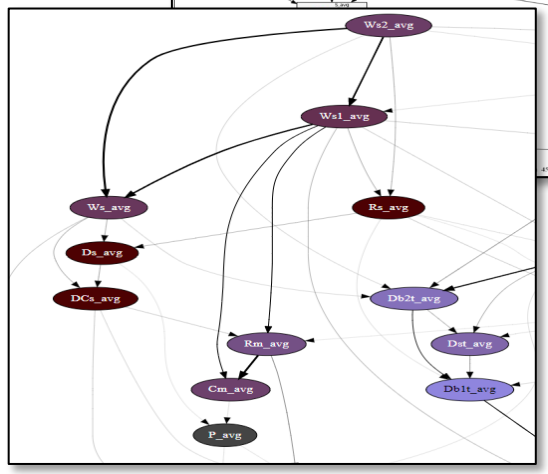
The first family takes account of **neighboring assets** of a given asset and assesses correlations between them





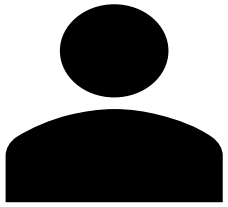
The second family identifies **causality relations** between sensors inside a given asset





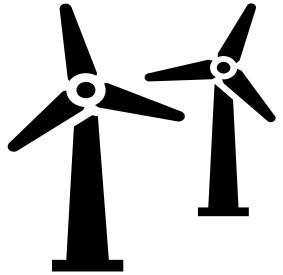
Global anomaly detection value proposition

Increase Renewable Assets performance by detecting anomalous behaviors, which can lead to under-performance, linking them to failure modes and managing the full resolution workflow by the operational users



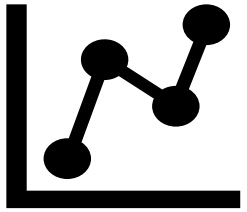
Operational User Centric

Actionable alerts and incident case management



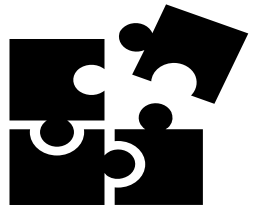
Holistic anomaly detection

Holistic model training complementing the current specialized approach



Reduced data-science work

One model fits all tags, reducing the amount of Data Science work

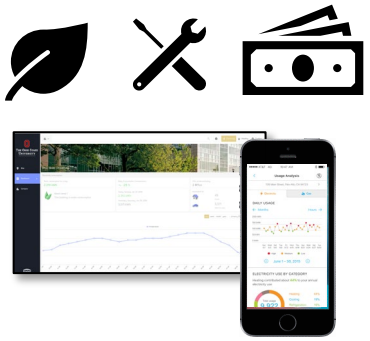


Futureproof and interoperability

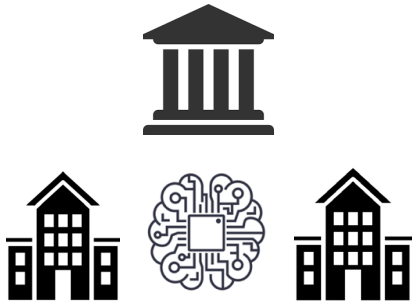
Integrate with existing ecosystem

Campus-level decarbonization

Monitor real-time building data, market pricing, and on-site demand

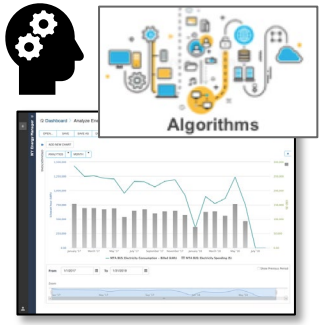


Monitor changes, verify benefits, engage staff / students, and design new programs



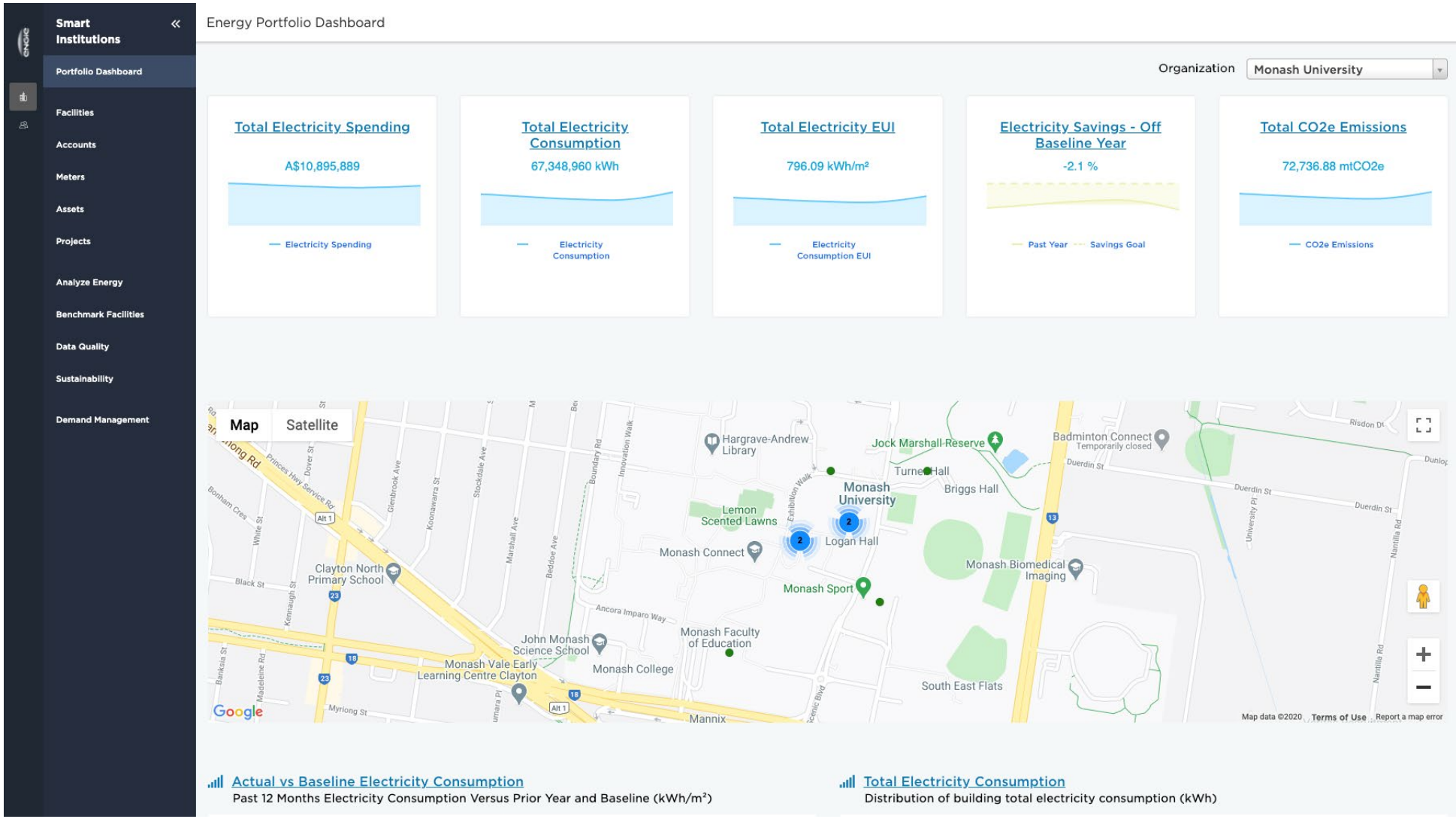
ENGIE Smart Institutions

Predict load profiles, optimize supply, and determine best real-time operation



Automatically control systems, send alerts, and dispatch available power (e.g., storage)

Smart Institutions



Decarbonization is complex

It requires:

- **Significant investment**
- Mass **consolidation of disparate data**
- Enterprise-wide **stakeholder coordination**
- Deep **understanding of rapidly evolving technologies and market conditions**

All amidst increasing pressure from regulators, investors, customers and employees

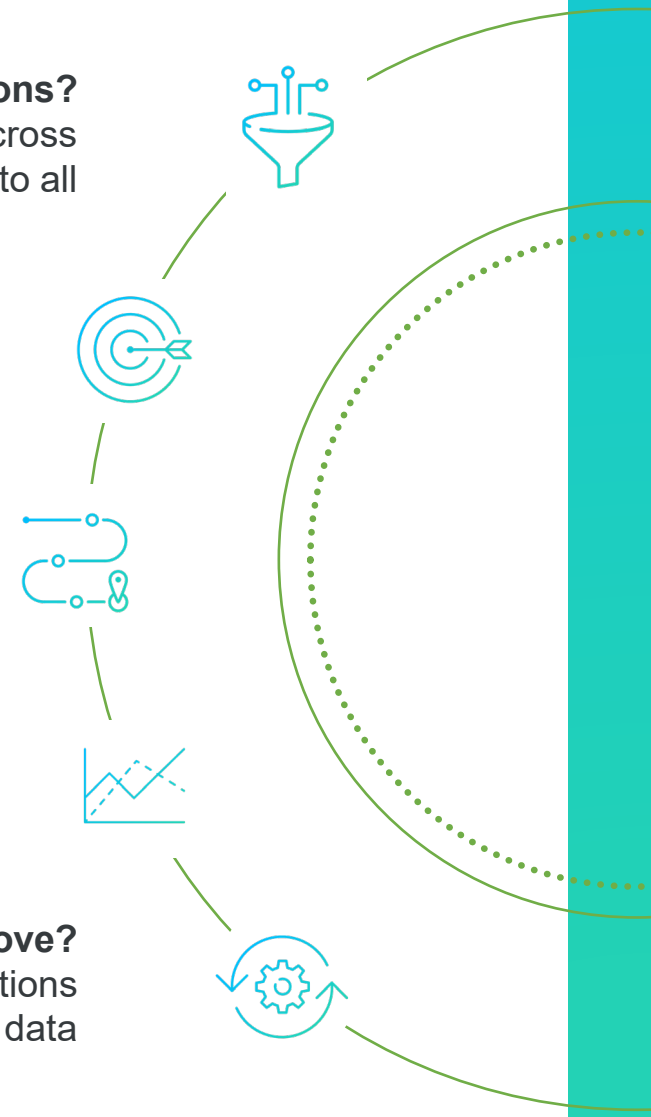
What are our emissions?
A single, unified view of GHG data across your value chain – accessible to all

What should our targets be?
Targets built with confidence, context and science

Where should we invest to meet our targets?
Actionable, bankable decarbonization pathways for every facet of your business

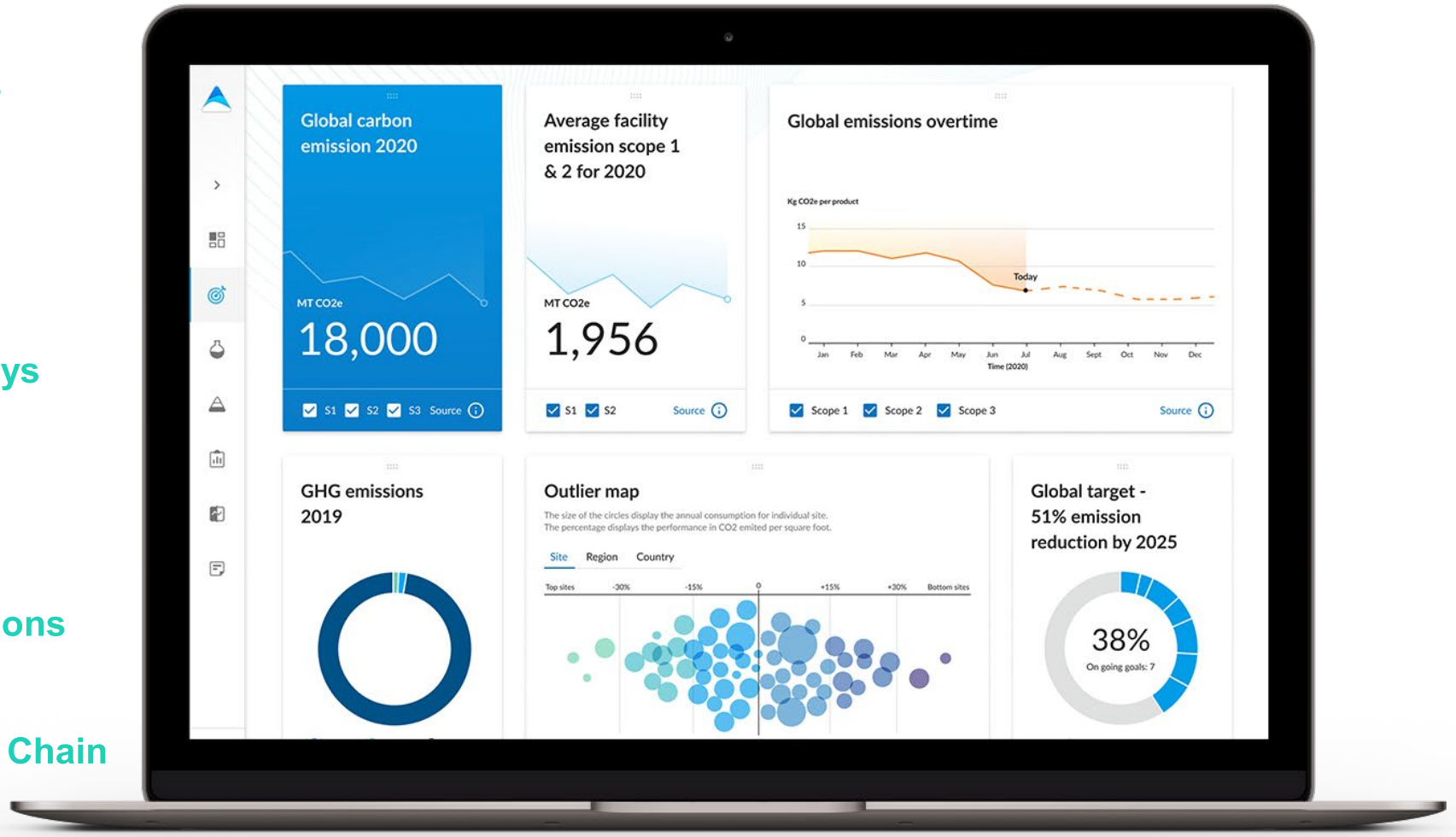
Are we on track to our goals?
Deep integration between site projects, regional goals and corporate targets

How can we improve?
Strategic interventions informed by dynamic market data



How do we achieve Net Zero?

- Build a Robust Baseline
- Set data-driven targets
- Design least-cost decarbonization pathways
- Track Site Progress to Corporate Goals
- Plan Strategic Interventions
- Decarbonize Your Value Chain



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