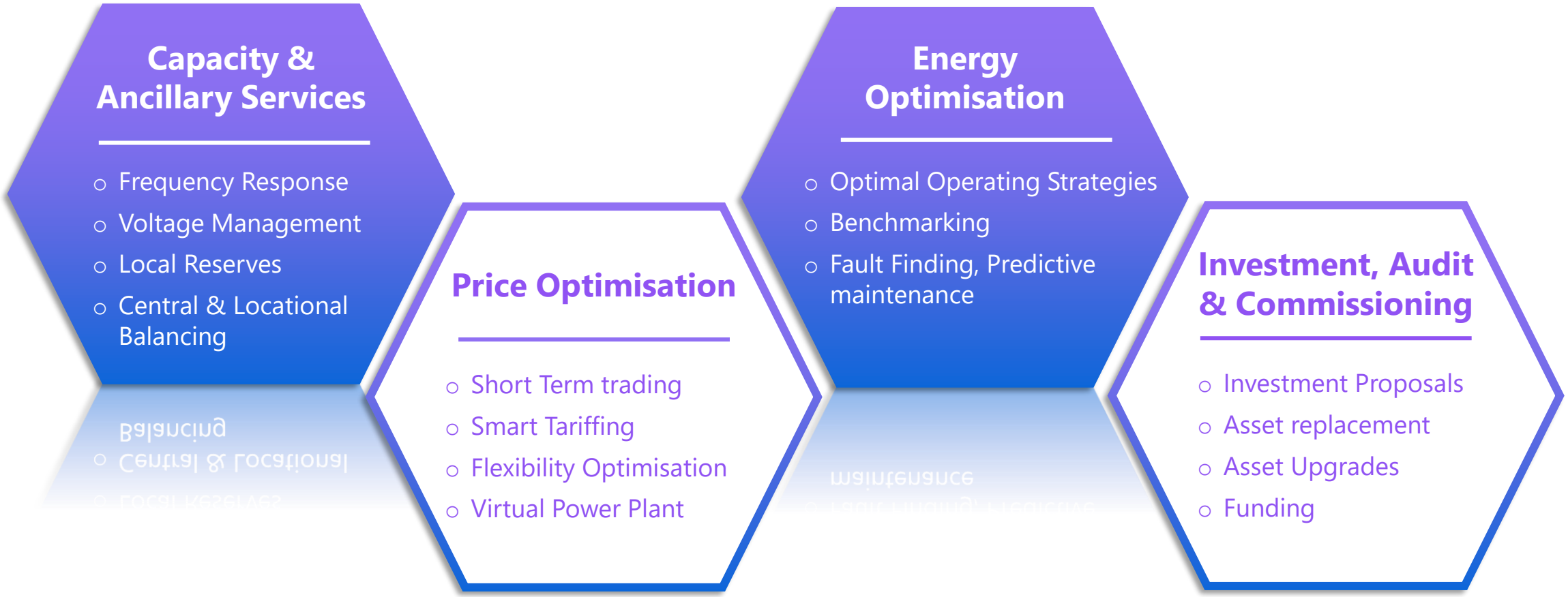
GridBeyond™

Flexibility as a service
The experience of GridBeyond

Energy As A Service (EaaS) - Market



Deep process expertise through 450 deployments across industries

Batteries

In front of the meter

ZENOBE ENERGY
GREENCOAT CAPITAL

Behind the meter

ArdaghGroup
VEOLIA
EURAC POOLE

11 sites · 35%

Food distributors / cold stores / retail

XPO Logistics
Florette
ACSaT Logistics
abp Food Group
Cranswick plc
Smith's
Muntons
Kellogg's
SUPERVALU
SPAR
brakes
YEARSLEY LOGISTICS

190 sites · 22%

Glass / metal

B SHAKESPEARE & CO
BAS CASTINGS
milvermetals
MAT FOUNDRY GROUP LTD
TIVAC ALLOYS LIMITED
Wm Lee Casting Specialist

26 sites · 12%

Mills

Smurfit Kappa
BUDDY KIERNAN MILLING
MASONITE
MEDITE DEFINING THE STANDARD OF MDF
lakeland mills

14 sites · 10%

Recycling / chemicals & water

DESCH PLANTPAK
REGAIN Polymers Limited
ROYDON GROUP PLC
BOXMORE PLASTICS
northern ireland water
UISCE ÉIREANN ÉIREANN IRISH WATER
GLAN AGUA MOTAENGIL GROUP

27 sites · 7%

Commercial sectors

Hotels

CELTIC MANOR HOTELS, RESORTS, CONFERENCES

Public Institutions

NHS

Commercial

webprint
foyleside The Centre of Shopping
AVIVA STADIUM

30 sites · 4%

Manufacturing

Kilsaran ideas taking shape
ATHLONE EXTRUSIONS
Reed Boardall
Unilever

10 sites · 3%

Other sectors

Data Centres

IBM
DELL EMC

Pharma

gsk
RANDOX

Hydro-power / CHP

RAINPOWER
Fingleton White

30 sites · 9%

SALES STRATEGY

Sales through direct relationships & **STRATEGIC PARTNERSHIPS**

Naturgy
EDF
ENGIE
npower Business Solutions powered by e·on
SSE
BrytEnergy
ESB

GridBeyond

NEWCOLD ADVANCED COLD LOGISTICS
outokumpu
McCain We are family
XPO Logistics
Reed Boardall

Trading relationships with major suppliers currently supporting load shifting & future renewable sleeving for PPA's

Number of sites · Share of GridBeyond's capacity portfolio

Note: Selected customers only, list is not exhaustive

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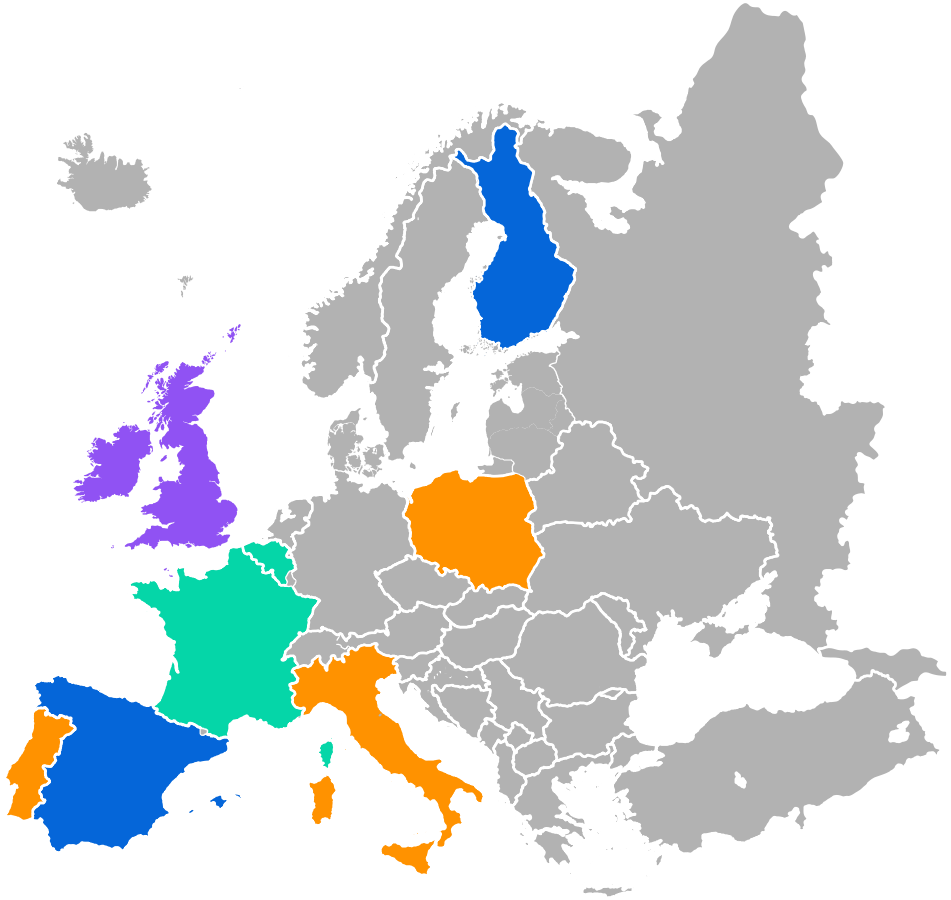
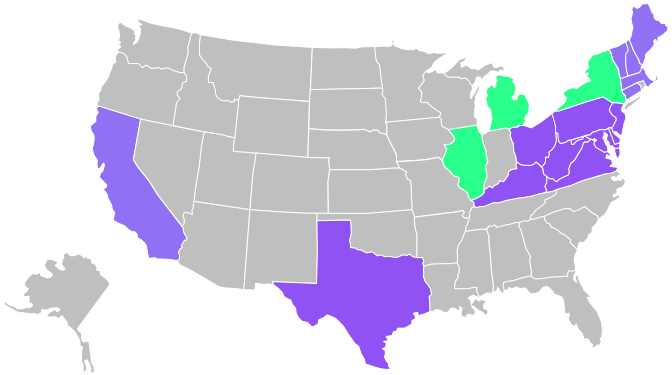
GridBeyond – Expansion Strategy

Europe



Canada

USA



Japan

Australia

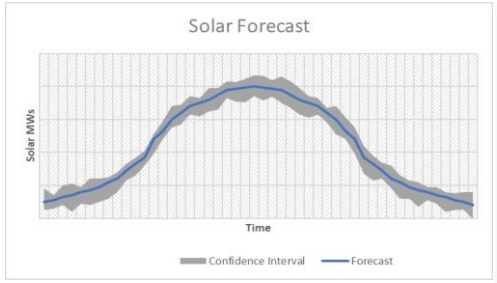
- Direct Market
- Indirect Market - Active or to be Active (Discussion)
- Indirect Market – Target - Open Market for Flexibility Services
- Indirect Market - Market upcoming for Flexibility Services

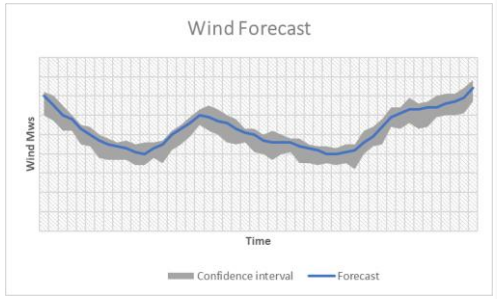
Monetising flexibility – technical complexity

Optimising the value of flexibility requires sophisticated technology combined with asset knowledge and market expertise

Forecasting

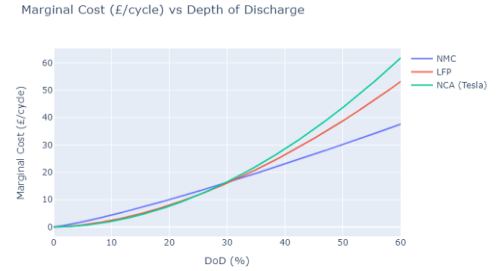
- **Renewable Forecasts** – Using solar and wind forecasts from multiple sources we create accurate predictions of the power output from wind and solar sites
- **Load Profile Forecasts –** Using algorithms developed over several years of working with I&C customers, we produce accurate predictions of customers' load profiles

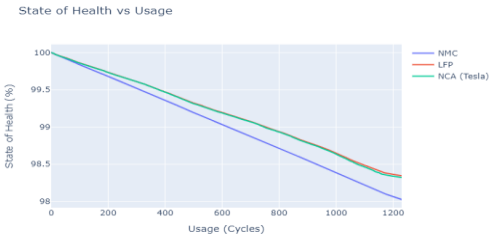


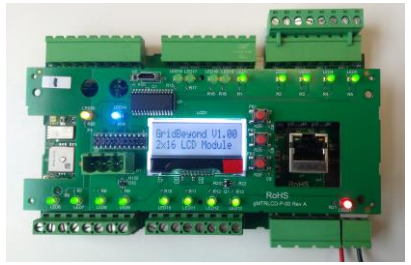


Battery Optimisation

- **Battery Management** – Operating batteries, large or small needs, to take the lifetime health of the battery into account – through continuous monitoring of State-of-Health and State-of-Charge metrics
- **Battery chemistry –** GridBeyond's analysis shows that different battery chemistries have different marginal costs depending on depth of discharge profiles
- **Battery sizing** – battery sizing can be complex – GridBeyond have the domain expertise and technology to provide robust analyses for solo and combined battery investment projects







Advanced Metering & Control

- **Measurement accuracy**– Voltage, current and power measurements with accuracy within +/-0.2%; frequency measurements accuracy within+/- 0.01Hz; sampling 16/20 ms. On-board GPS clock
- **Data acquisition and integration–** Multiple interfaces (serial and analog) with support for standard industry IOT/SCADA protocols (Modbus, TCP, MQTT, …)
- **Form Factor –** compact and easy to configure and install

GLPK / ГЛПК · NumPy · pandas · PyTorch · PYOMO · Azure · scikit-learn · SciPy · COIN-OR

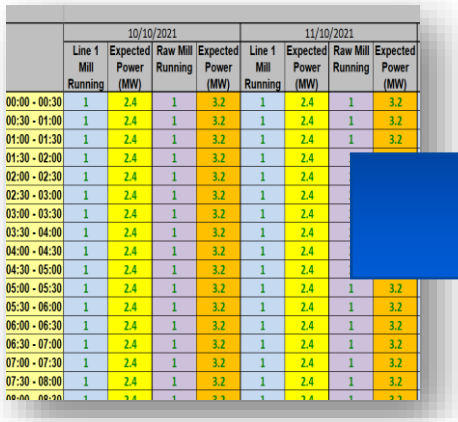
AI Driven Optimisation

- **Machine Learning**– GridBeyond Data Scientists use latest Machine Learning techniques for large-scale data analysis primarily in the area of forecasting
- **Optimisation –** Sophisticated algorithms developed using solvers with Large scale linear programming and Mixed integer programming techniques for complex optimisation challenges
- **Big Data** –Microsoft Azure data lake for large scale data storage and analytics

Load Profile Forecasting & Schedule optimisation

Forecast the load profile to identify flexibility to adapt and optimise production schedule

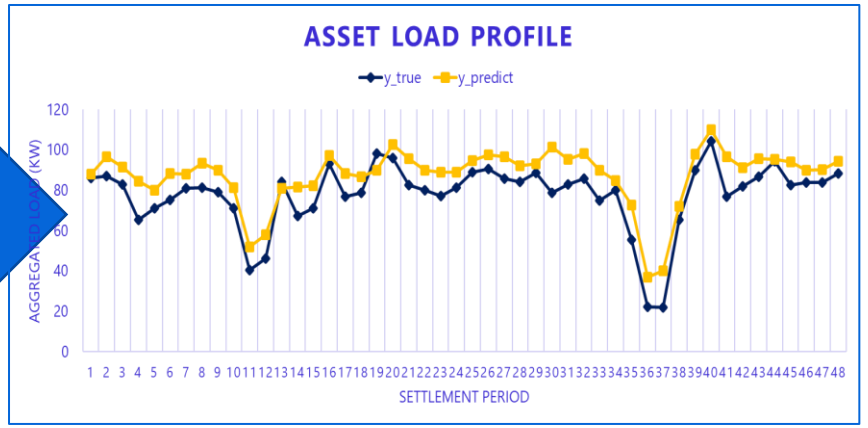
Asset Constraints



	10/10/2021				11/10/2021			
	Line 1 Mill Running	Expected Power (MW)	Raw Mill Running	Expected Power (MW)	Line 1 Mill Running	Expected Power (MW)	Raw Mill Running	Expected Power (MW)
00:00 - 00:30	1	2.4	1	3.2	1	2.4	1	3.2
00:30 - 01:00	1	2.4	1	3.2	1	2.4	1	3.2
01:00 - 01:30	1	2.4	1	3.2	1	2.4	1	3.2
01:30 - 02:00	1	2.4	1	3.2	1	2.4		
02:00 - 02:30	1	2.4	1	3.2	1	2.4		
02:30 - 03:00	1	2.4	1	3.2	1	2.4		
03:00 - 03:30	1	2.4	1	3.2	1	2.4		
03:30 - 04:00	1	2.4	1	3.2	1	2.4		
04:00 - 04:30	1	2.4	1	3.2	1	2.4		
04:30 - 05:00	1	2.4	1	3.2	1	2.4		
05:00 - 05:30	1	2.4	1	3.2	1	2.4	1	3.2
05:30 - 06:00	1	2.4	1	3.2	1	2.4	1	3.2
06:00 - 06:30	1	2.4	1	3.2	1	2.4	1	3.2
06:30 - 07:00	1	2.4	1	3.2	1	2.4	1	3.2
07:00 - 07:30	1	2.4	1	3.2	1	2.4	1	3.2
07:30 - 08:00	1	2.4	1	3.2	1	2.4	1	3.2

Asset Power Model
(Machine Learning)

Load Profile Forecast



Load Profile Forecast – 24 Hr

Weekly Production Schedule

Tonnage / Volume
Product dimensions
Shift schedule

Asset Critical parameters

E.g. Setpoint temperatures

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GridBeyond: Load Forecasting – optimise scheme availability

Critical Parameters

Weather Data

Historical Consumption

Production Schedules

Machine Learning

GLPK / ГЛПК

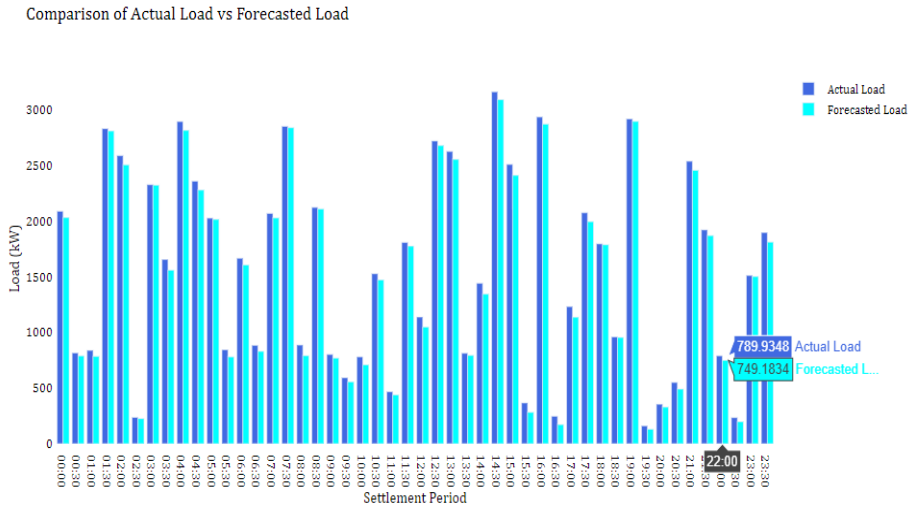
PYOMO

pandas

SciPy

PyTorch

Load Forecast per HH settlement period – example shows forecast for a coldstore



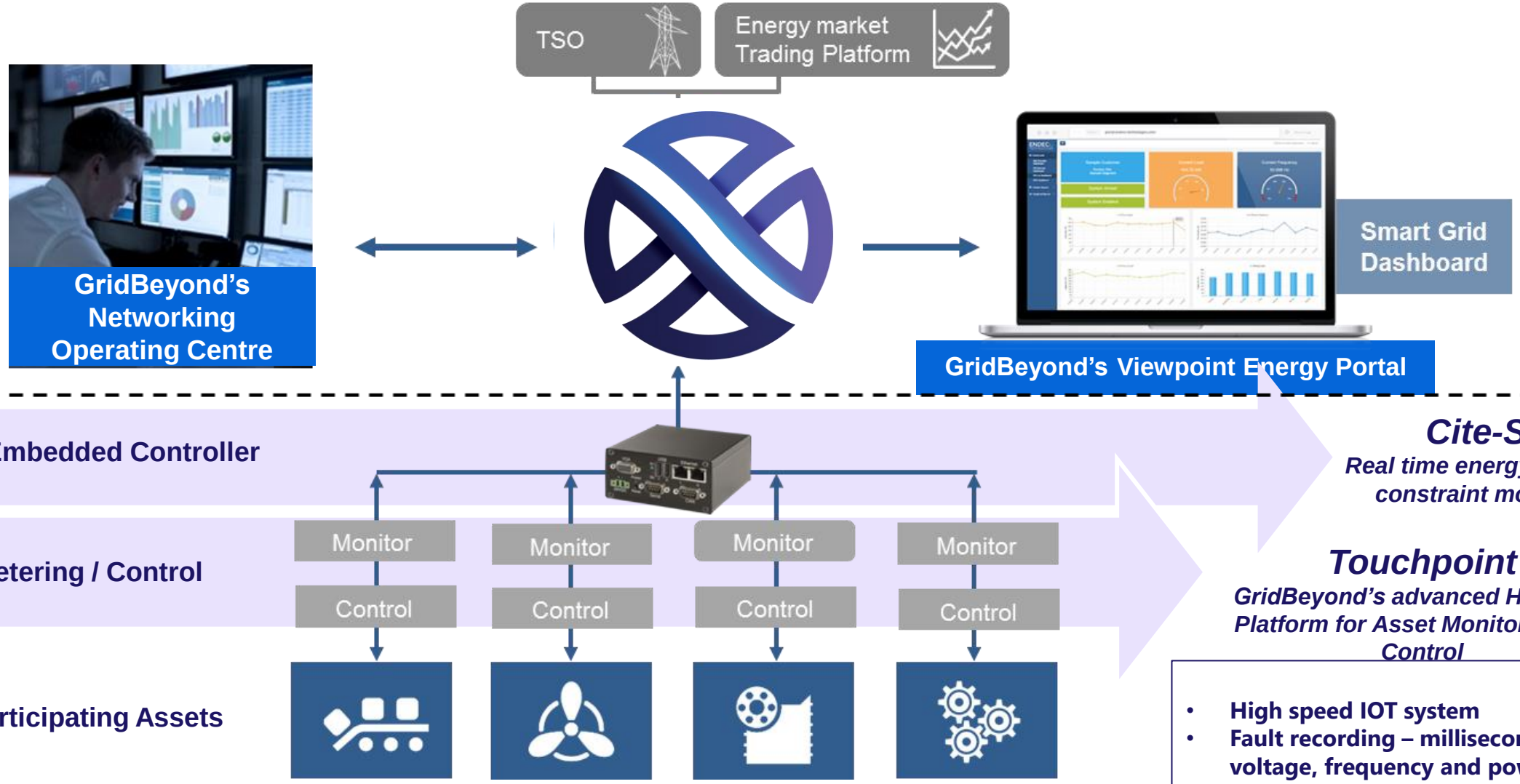
Benefits of Load Forecasting

Bidding Strategy: Being able to forecast the asset load improves the performance in bidding into market auctions – this becomes critical as ancillary service markets move to day ahead auctions

Procurement: Forecasting the load can also help our customers in efficient energy procurement – especially in cases where they are exposed to imbalance costs

Load shifting Understanding your load forecast in greater detail can identify flexibility that is not currently being monetized – this represents a lost revenue opportunity

High Level Platform Concept Diagram



Cite-See

Real time energy and asset constraint monitoring

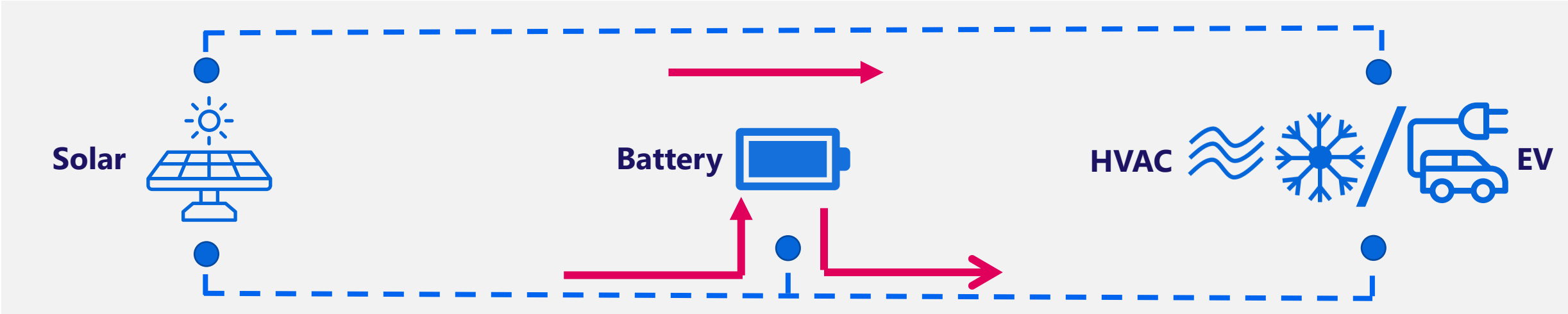
Touchpoint

GridBeyond's advanced Hardware Platform for Asset Monitoring and Control

- **High speed IOT system**
- **Fault recording – millisecond recording of voltage, frequency and power synced to a GPS clock**
- **Very fast < 50 ms control across a large energy network**
- **Highly scalable, secure database & control structures**

Micro-grid – many options

GridBeyond have the technology platform and expertise to optimise micro-grids (generation, storage and load)



On-site solar

- **Reduce import costs**: solar generation offsets import costs from the grid
- **Reduce carbon emissions** – renewable solar provides measurable reduction in your carbon footprint. This can support overall strategy for net-zero
- Potential for export of excess electricity

On-site Battery

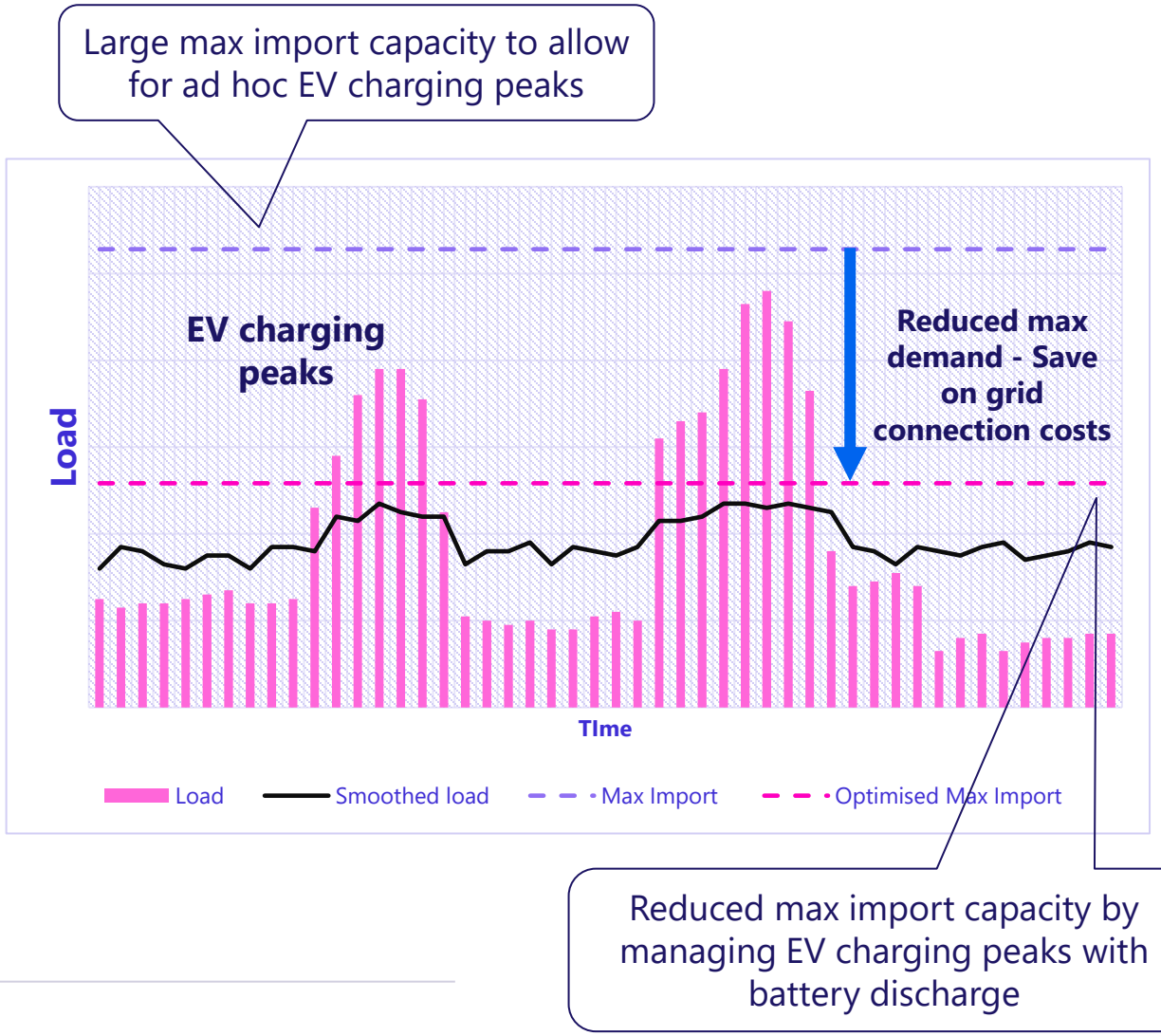
- **Maximise use of available solar** – Battery can absorb clean energy when solar is producing an excess
- **Reduce import costs** – an onsite battery + solar can help reduce the import peaks from the grid.
- **Options**: A battery increases the options for optimising between grid import, solar generation and EV charging

On-site EV charging / HVAC

- **Manage grid connection costs** – an on-site battery can help smooth out import from the grid, thus reducing MIC costs.
- **Reduce electricity costs** – an onsite battery + solar can help reduce overall energy costs. The battery stores solar output or imports when electricity is cheaper and makes it available when EV demand peaks on site.

EV + Battery

Use an on-site battery to minimise peak power demand from the grid



On-site EV charging

- Reduce grid connection costs: onsite EV charging will create surges in demand
  - You will have to pay for significantly increased max import charges
  - Your grid connection may not support peak power requirements.
- EV + Battery – an onsite battery can help reduce the import peaks from the grid. The battery imports when electricity is cheap and makes it available when EV demand peaks on site – smoothing out demand to reduce peak import requirement

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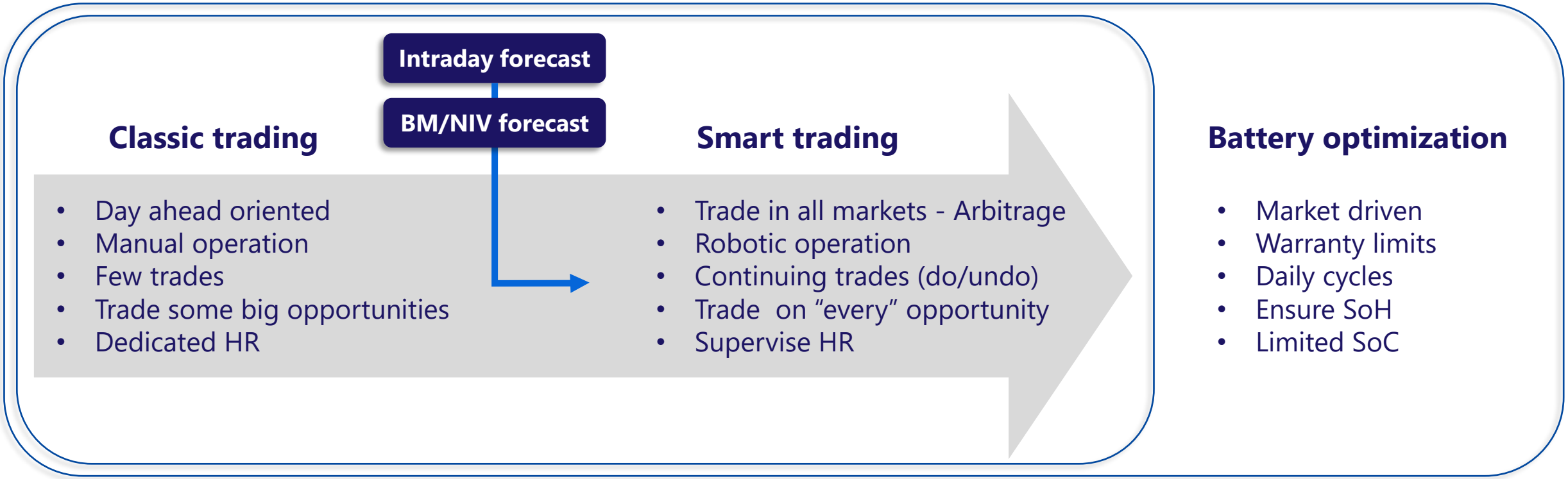
What's new – Battery Smart Trading



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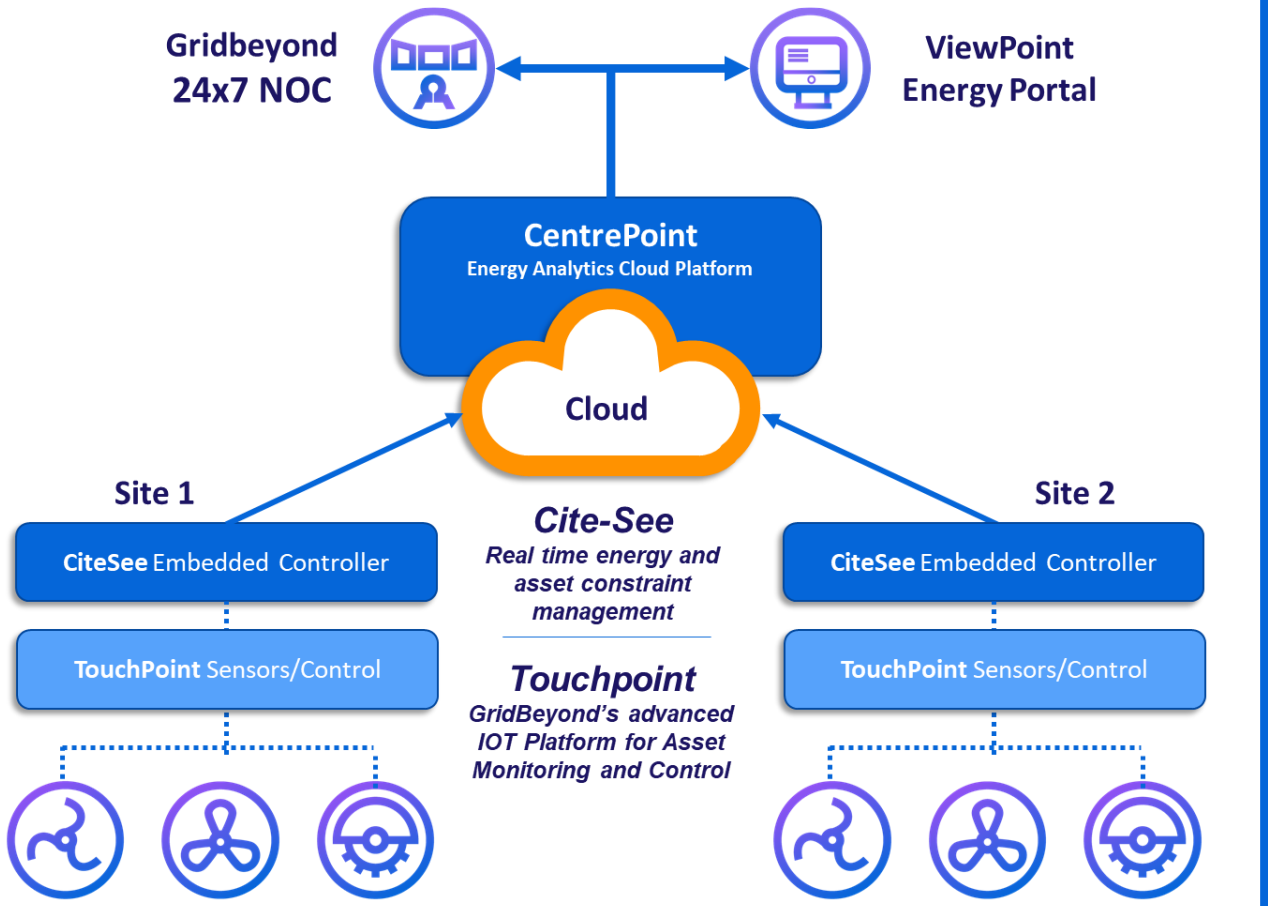
Final Remarks

GridBeyond Energy Platform - ***CentrePoint***



- **GridBeyond are unique -** we have a technology platform that consolidates energy metering, energy management and energy flexibility
- The **Energy portal** uses the infrastructure installed for Demand Response – ensuring costs are minimised
- **Data Acquisition** – our platform is designed to take data from multiple sources across the site. We can integrate with third party meter/sensors if required.
- **Cloud** – the platform is on the cloud, meaning your data is always accessible and secure
- **Standard Protocols** – our platform integrates with site assets using standard protocols such as Modbus, OPC UA and MQTT

GridBeyond platform: competitive advantage over similar service providers

Unique Asset Management: sector leader in battery sizing, in combining and controlling different types of assets, for load optimization and revenue maximization through its platform, compatible with all types of customers

Fast Control: distinctive hardware feature which allows the participation in frequency response markets which requires very high speeds

Forecasting: top of class of both market price and Renewable generation forecasting through advanced machine learning and solvers

Distinctive Platform: GridBeyond is able to deliver a broader scope of service to its client which includes trading, energy management, benchmarking, Energy as a Service, while other competitors operate as a sole Aggregator

Thank you

Any Questions?