



ORGANIC HEAT EXCHANGERS

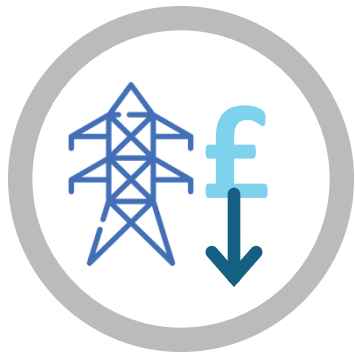


EnergiVault

COOL ENERGY STORAGE



How Energivault Creates Value



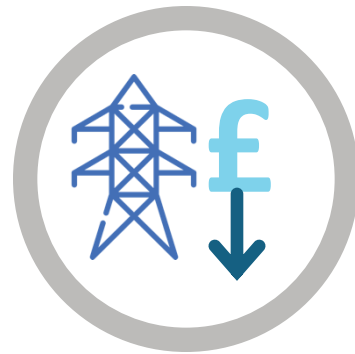
Reduces Energy Costs

Energivault® storage enables flexible energy management, enabling load shifting, engagement in demand response programmes, optimising short cycling chillers



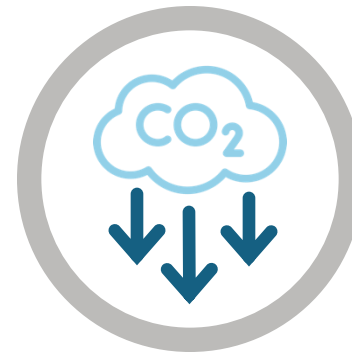
Added Resilience

The OHX Energivault® provides intrinsic back-up cooling and avoids lost production or reduced quality goods by providing highly responsive back-up cold energy storage,



Reduces Grid Related Costs

Flattens load curve, reduces connected generation, reduces contracted grid supply, reduces infrastructure costs, and enables wider aggregation for ancillary services.



Reduces CO2 Emissions

Energivault® can be charged with surplus renewable energy, or off-peak low carbon grid energy. Energivault can maximise on-site solar PV deployment and complement PV PPA minimum take or pay contracts



Peak Chilling

Augments chiller capacity avoiding higher capital cost of under-utilised peaking chillers, avoids need for additional rental capacity at peaks times.



Digitally connected to Cloud Platform



Ultra-fast response to cooling demand



Energivault – General Use Cases

The following are use cases for the Energivault Cold Thermal Energy Storage System

Energy Cost Savings and Carbon Reduction and Energy Management

- Chiller load shifting from peak energy tariffs and peak non-commodity costs such as time of use distribution charges or peak power charges
- Charging of Energivault using on site solar PV energy or excess grid renewable energy – effectively reducing chilled water costs and CO2
- Discharging Energivault over night after charging on low cost renewable power during the day
- Energivault enables chillers to be taken off load at times of peak electrical demand, lowering connection capacity
- Optimises multiple chiller use by following the load with optimal running chiller 1, avoiding low/ cycling load on chiller 2 – reduces energy consumption increases service intervals of chillers

Optimised On-site power generation – solar pv or genset

- Maximises use of on-site generation during Energivault charging, enhances contractual PPA or maximise owned solar pv etc.
- Enables chiller power reduction at peak demand times to flatten electrical load curve
- Optimises electrical battery capacity for genset ride-through by providing uninterruptible cooling support
- Avoids chiller high in-rush currents impact on electrical battery sizing for ride through to gensets

Added System Resilience and Peak Cooling – Energivault as insurance

- Energivault augments existing chillers during high ambient temperatures when chillers under stress by maintaining chilled water set points
- Energivault adds thermal mass to the chilled water system for added resilience
- Adds back-up cooling for power outages, services periods to maintain cooling demand
- Provides rapid cooling for recovery of chilled water temperatures following outages
- Maintains cooling demand during outages

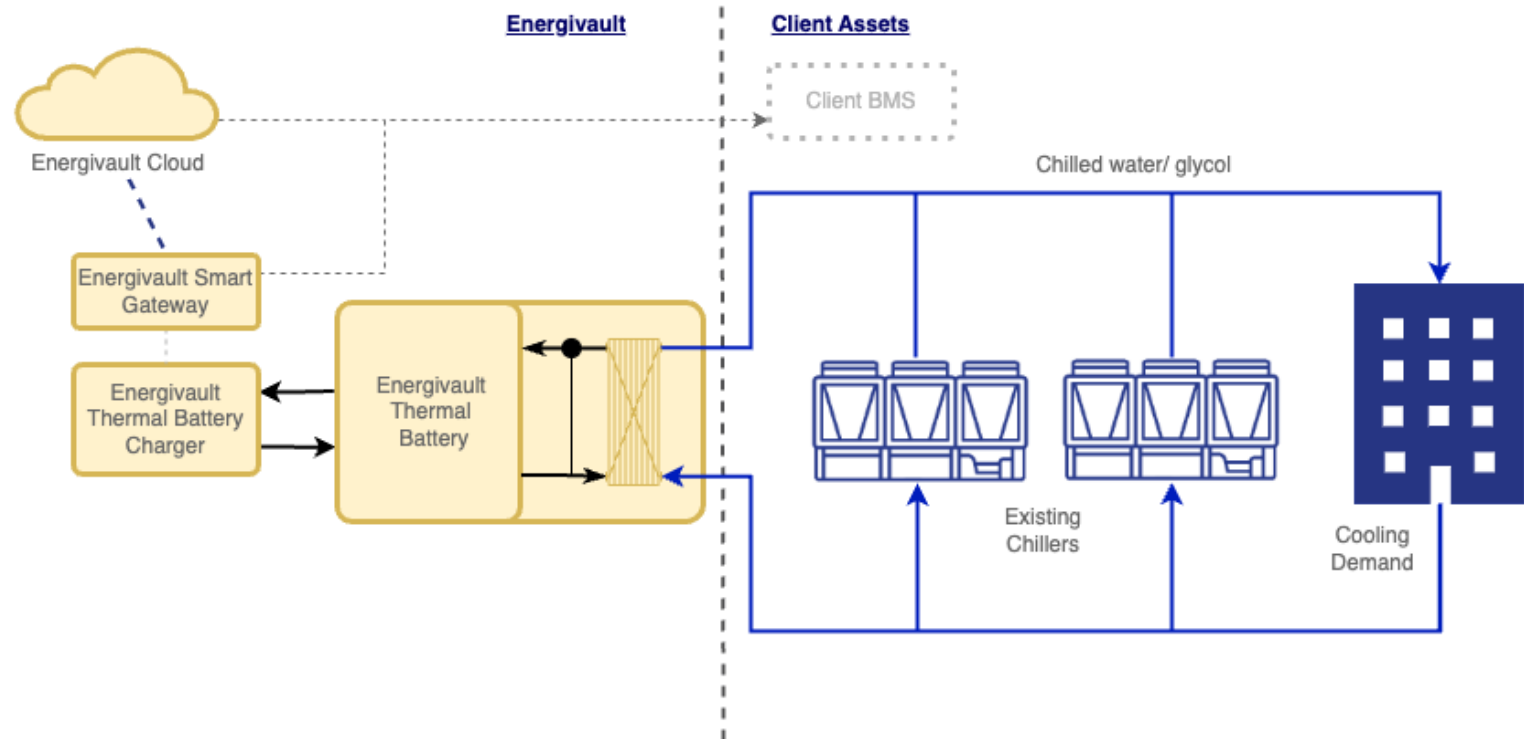


Energy Flexibility, Energy Cost Reduction, Carbon Savings and Resilience for Centralised Chilled Water Systems

Energivault® acts as a fully flexible chiller added to existing chillers or new or upgraded installations.

Energivault® integrates seamlessly through an interface heat exchanger, decoupling cold energy storage.

Energivault® has an AI control option to optimise energy usage, carbon reduction and resilience.

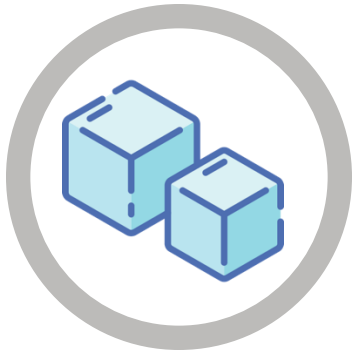




Cooling Flexibility - Energivault is better than competing storage options

Cold thermal energy storage allows chillers to realise full energy and carbon saving potential.

Energivault® overcomes the limitations of other approaches to cold energy storage.



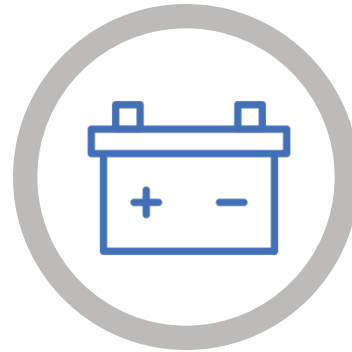
Solid Ice Storage

- Poor discharge capacity
- Low energy flexibility
- Poor responsiveness to sudden cooling demand
- Inefficient charging



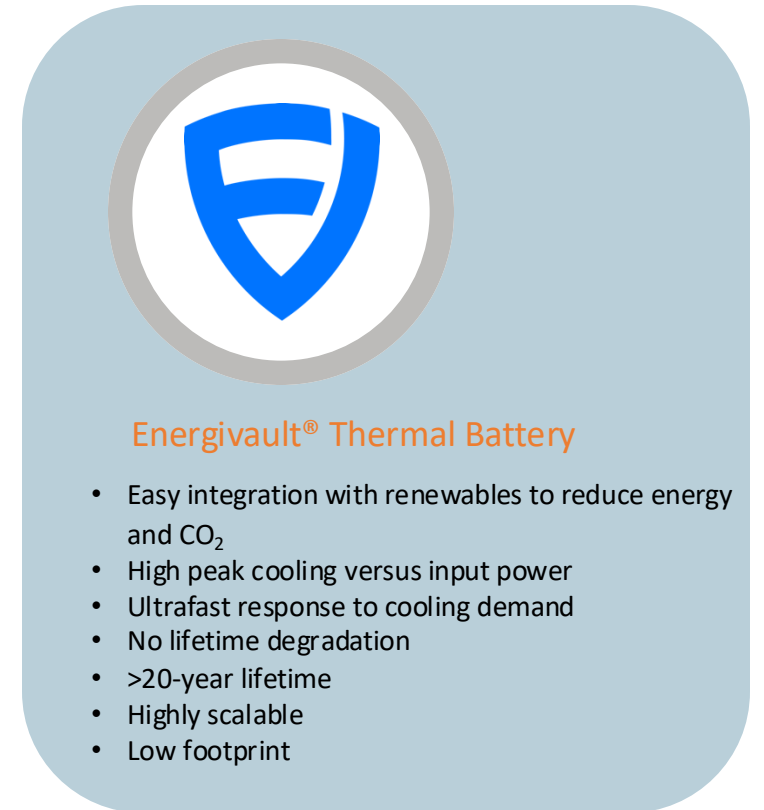
Chilled Water Storage

- Poor temperature control
- Low energy density
- Higher footprint



Electrical Energy Storage

- High capital cost
- Limited lifecycles
- Degradation over time
- Low real turnaround efficiency
- High-capacity connection
- Storage without connected generation (Fault Level) contribution; can add more generation instead



Energivault® Thermal Battery

- Easy integration with renewables to reduce energy and CO₂
- High peak cooling versus input power
- Ultrafast response to cooling demand
- No lifetime degradation
- >20-year lifetime
- Highly scalable
- Low footprint



Quotient Sciences – Alnwick, UK – Case Study – 2023-24



Quotient Sciences

7 state-of-the-art manufacturing and clinical facilities in the UK and US. Key characteristics of this site:

- 2 x 240kW chillers, providing cold water circuit to support temperatures of 5-15°C
- Annual electricity consumption on refrigeration of ~250MWh
- No solar PV or on-site generation



Full Scale UK Trial

650kWh thermal storage at -3°C to -6°C

- Total Days of Operation: 437 days
- Total Cooling Delivered: 123,416.60 kWh
- Days of Peak Support Provided: 47 days (where chiller capacity exceeded and Energivault supported)
- Charger run hours: 13,772 hours



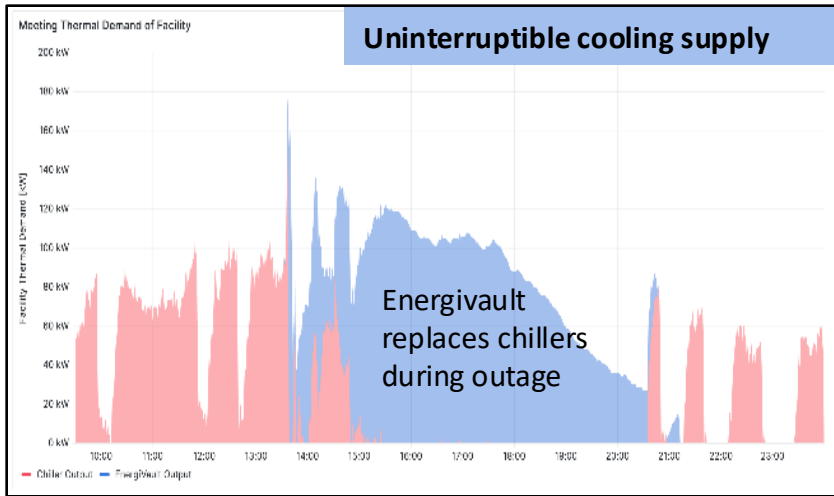
Projected Savings/ Benefits (UK energy prices)

- Load Shifting Energy Savings, c.£30k p.a.
- Resilience – avoided laboratory over temperatures 47 days by adding peak cooling capacity
- Saved capex by avoiding purchase of third 250kW chiller to deal with peaks

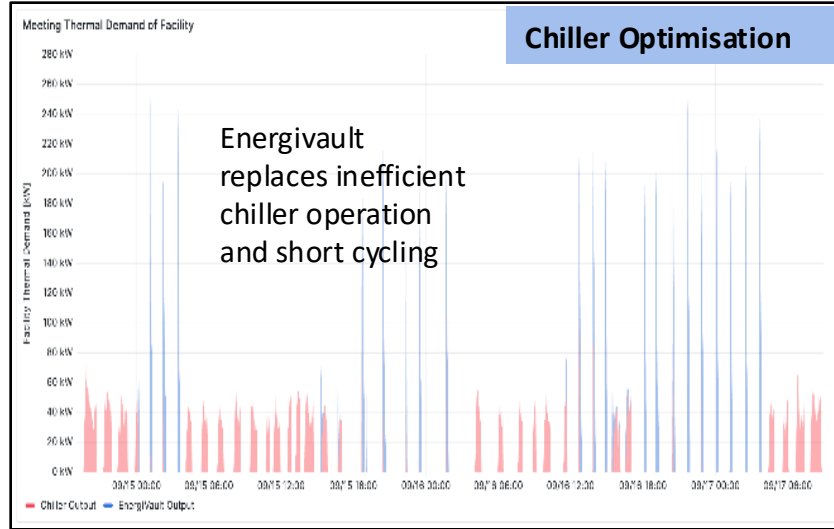
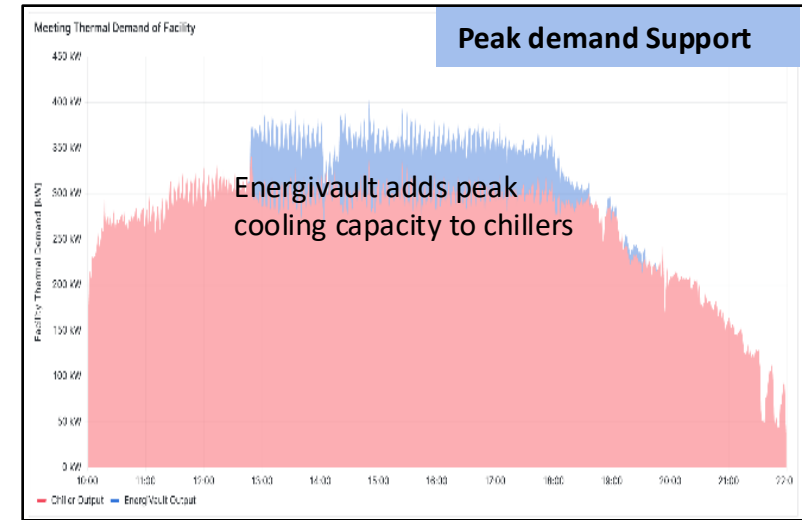


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Quotient Sciences – Alnwick, UK – Case Study - Results



Added Resilience
Supported demand during compressor outages. Added cooling capacity during peak cooling demand.



Optimised Chillers
Saves energy and reduces multiple start-up and service stress on chillers

The 4th operating mode – load-shifting – has been tested via full charge-discharge routines, but has not been directly tested on an operational basis due to Quotient’s operating requirements and tariff structures.

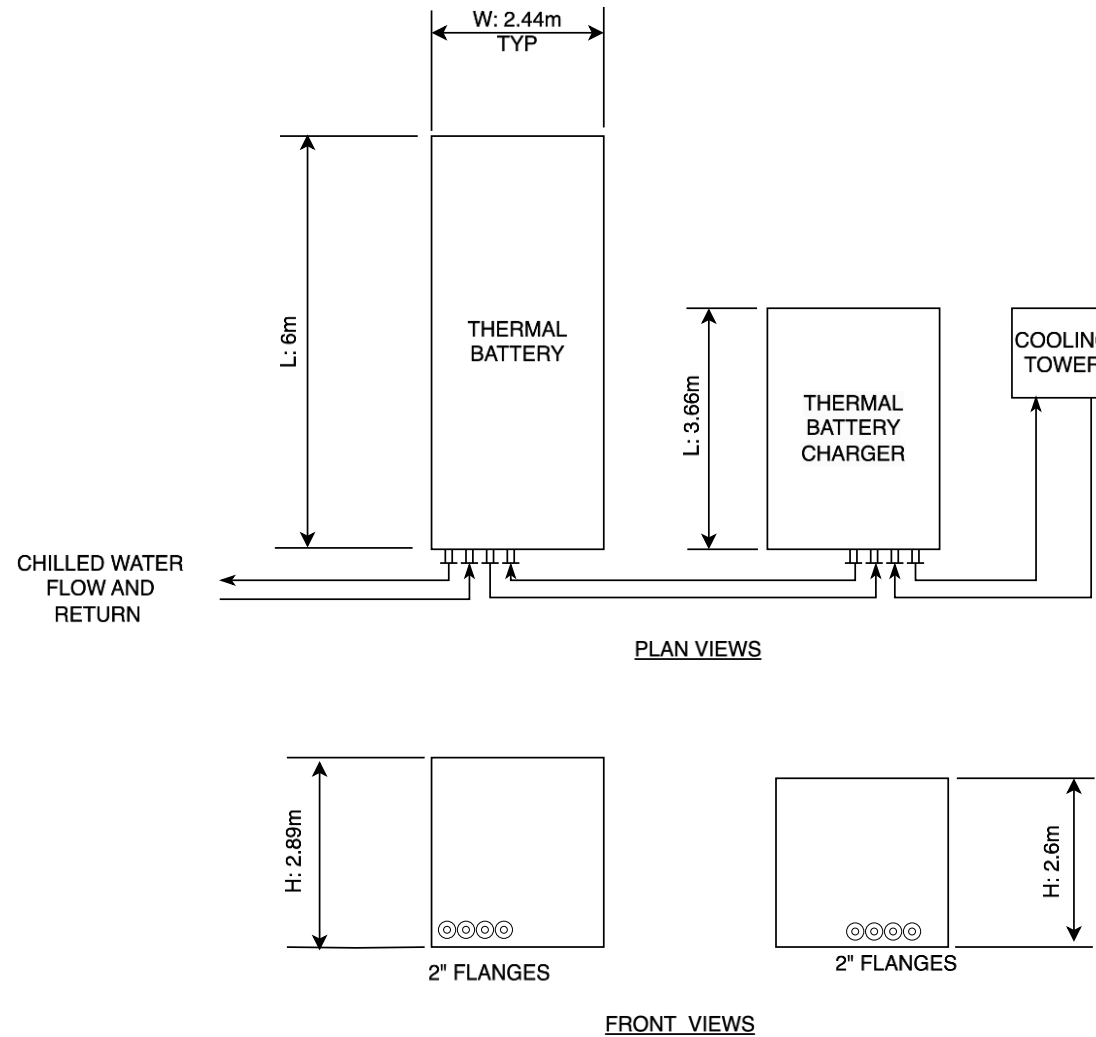
Further Technical Data



Energivault Physical Layout

Physical Details of 1MWh_t cold thermal battery and charger.

Thermal battery charger can be containerised or skid mounted for plant room.





Indicative Specification of 1MWht Energivault Thermal Energy System

Technical Information

Battery Rated Cooling Capacity	200kWt
Rated Charging/ duration	65kWt/ 15 hours
Modulation range	0 to 200kWt
Battery Storage Temperature	-10°C to -3°C
Short term output	400kWt for 30 mins
Compatible chilled water circuit temperature	0°C to 14°C
Rapid Response, zero to rated cooling power	Zero to rated cooling power 2 mins
Rated Electrical load (charging)	40kWe
Rated Electrical load (discharging)	5kWe
Standby losses	<1%
Lifetime	>20 years
Energivault battery charger dimensions	L: 3m x W: 1.7m x H: 2.35m
Energivault thermal battery dimensions	L: 6.1m x W: 2.45m x H: 2.9m

NOTE:

Energivault Systems comprise:

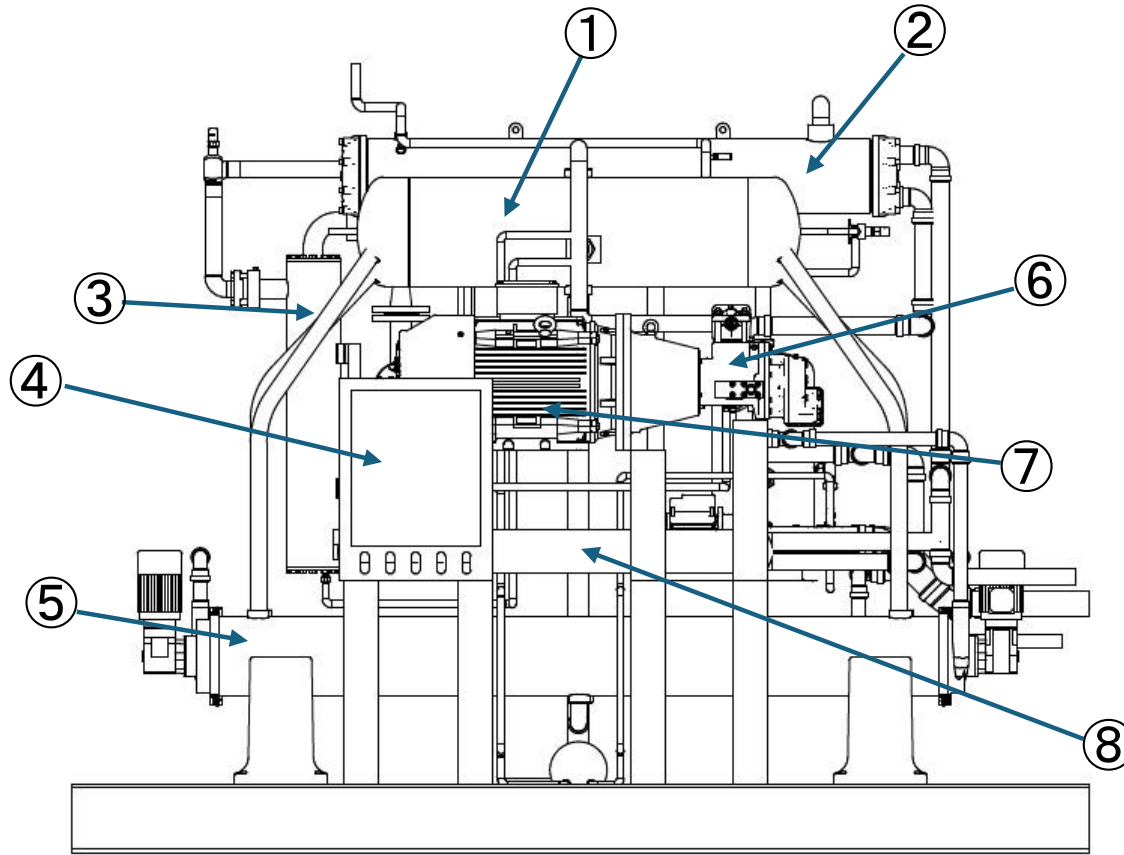
- Energivault Thermal Battery
- Energivault Battery Charger
- Energivault gateway and cloud platform

These are modular and can be configured to increase energy storage capacity, reduce charging time and increase cooling capacity depending upon the application.

The information contained in this table is indicative and subject to application and continuous development.



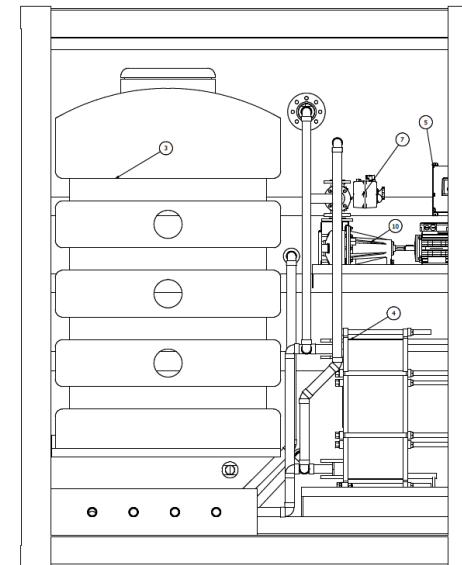
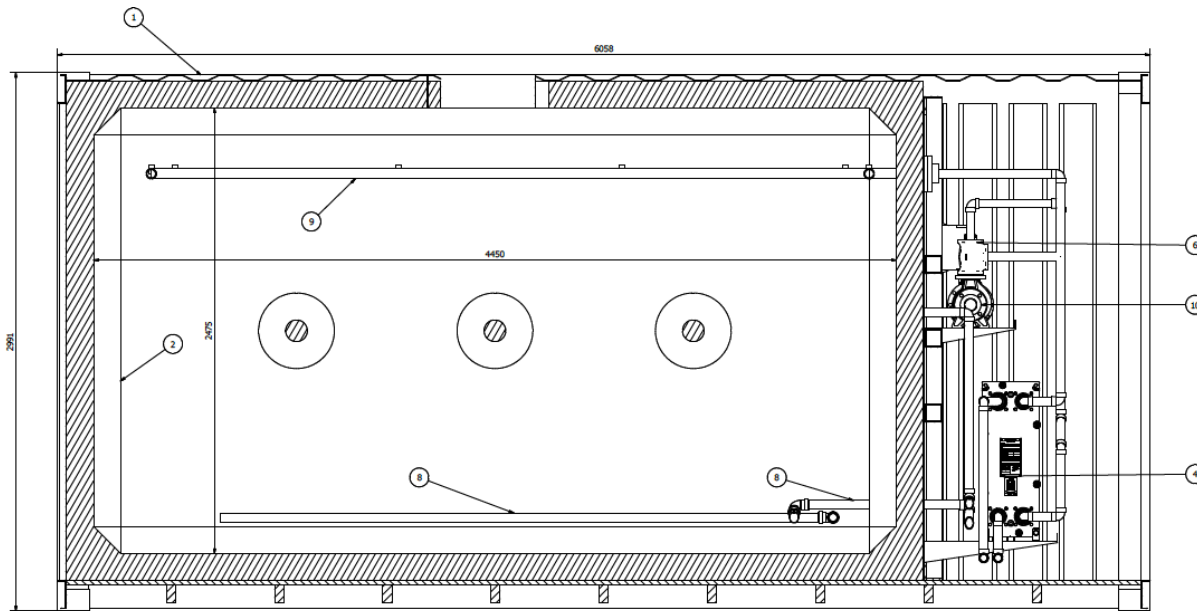
Battery Charger Layout



Description	
1	Surge Drum
2	Condenser
3	Secondary oil separator
4	Control Panel
5	Crystalliser(s)
6	Compressor
7	Compressor motor
8	Oil Cooler



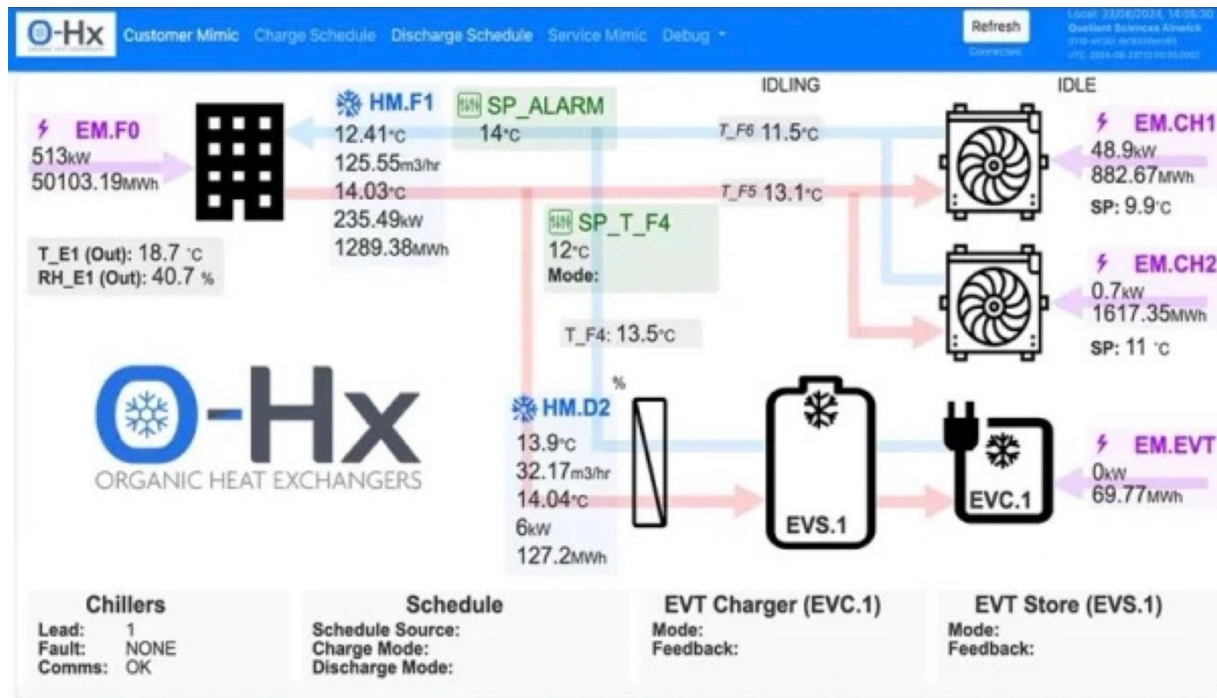
Battery Layout



Description	
1	20ft Hi-Cube container
2	Insulation and sealing
3	Expansion Tank
4	Interface Heat Exchanger
5	Control Panel
6	Discharge control valve
7	Actuator
8	Battery chilled water outlet
9	Battery return water inlet
10	Discharge pump



Energivault Cloud Platform



Connected via Energivault gateway.

Functions:

- Performance optimisation
- Customer Dashboard
- Analytics
- Service/ Monitoring
- Scheduling

Example screenshot of customer dashboard.