Flexible Electricity Storage Solutions
Dual Chemistry LiB/VRLA Systems

GS-Yuasa Europe

Batteries: The future of European sustainability
Consortium for Battery Innovation conference
4th October 2021

- A net-zero carbon economy requires electricity generation to move away from the unabated use of fossil fuels.

- Coal, oil and gas can be mined, then stored indefinitely, before being used to generate electricity to match demand. – Termed dispatchable generation.

- Most zero carbon sources are not dispatchable
  - Wind and solar sources are intermittent so must be harvested when available, without respect to demand.
  - Nuclear, tidal and geothermal sources are more predictable but not easy to match to fluctuating electricity demands.

- New methods are needed to balance electricity supply with demand.

- Batteries are one of the leading technologies underpinning this expanding market.

Energy Storage Services

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Low carbon power systems require storage across wide time spectrum

Storage service	Operating period	Storing period
Power quality improvement	msec - minutes	minutes - weeks
Frequency response services	msec - minutes	hours
LV power flow optimisation	seconds - hours	hours
Peak demand shaving	hours	hours - days
Renewable Energy supply constraint management	hours	hours - days
Asset reinforcement deferral	hours	hours - days
Arbitrage	hours - days	days - weeks

An ESS that can provide multiple services is more commercially attractive

Distributed energy storage locations

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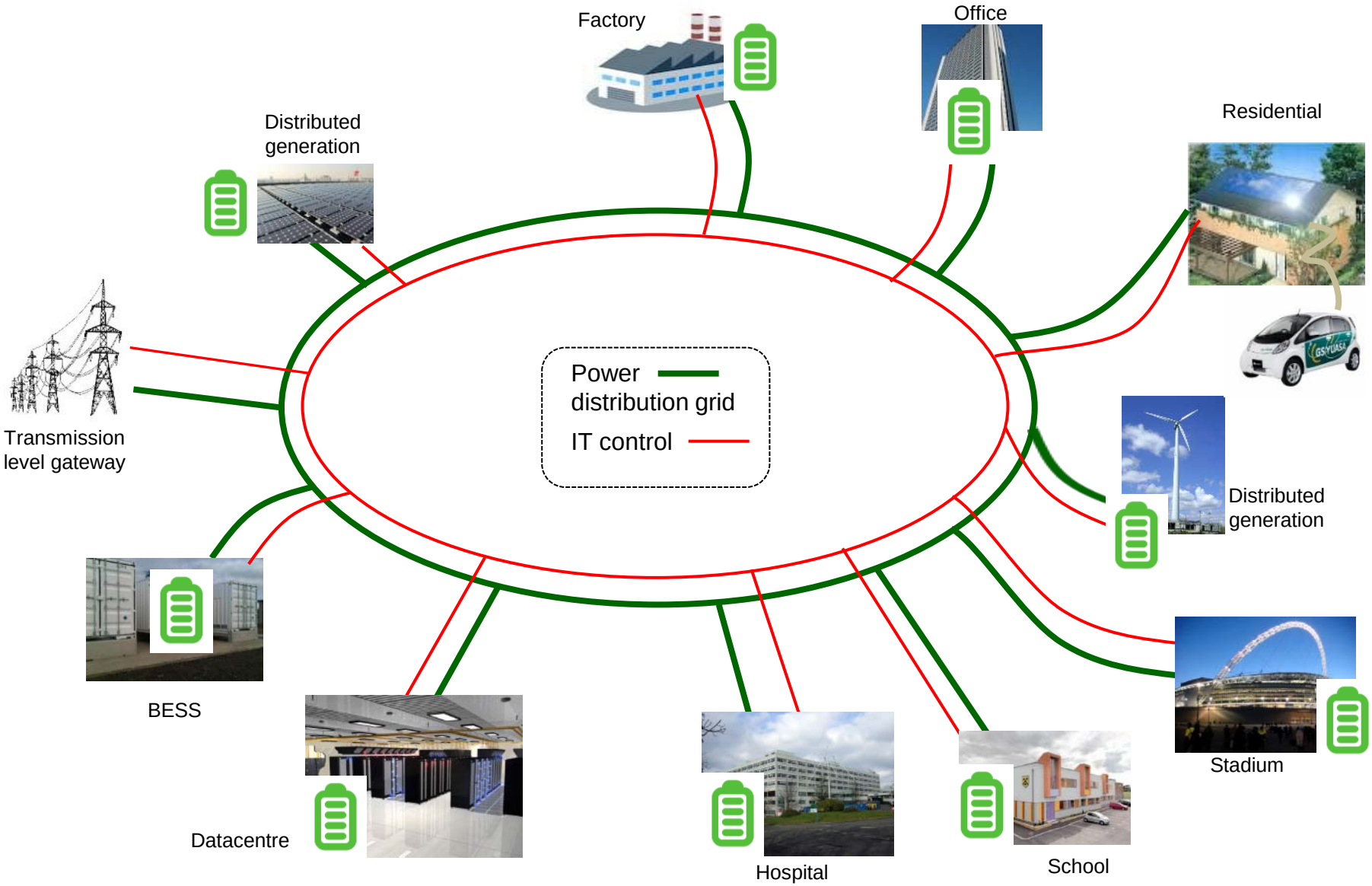

Time dependence of battery technologies

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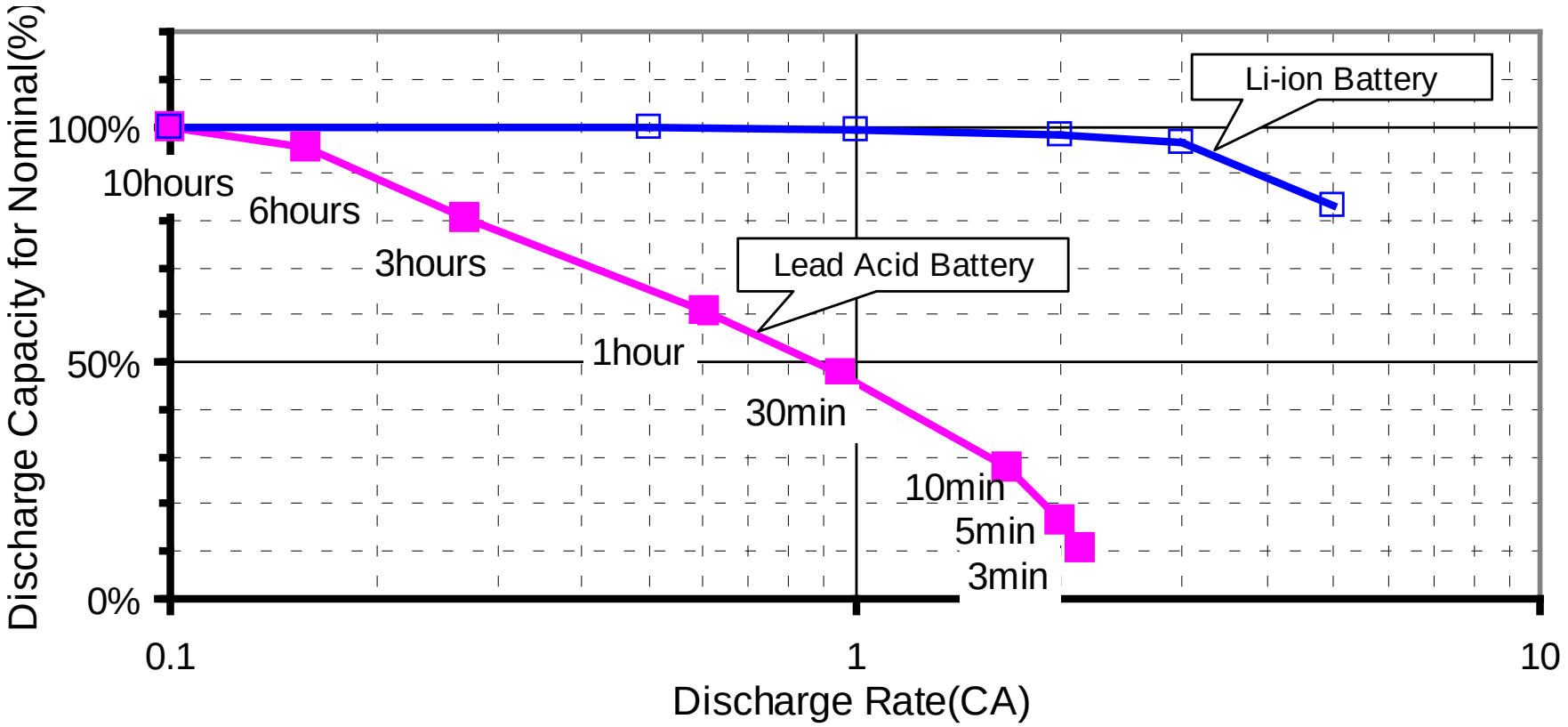

Dual Chemistry- complementary technologies

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Lithium ion strengths

Cycle life

High rate discharge

High rate charge

Energy density

High efficiency

Partial state of charge operation

Lead acid strengths

Economical

Simple control

Abuse tolerant

Abundant raw materials with low energy processing

Sustainable materials usage

Hybrid storage experience

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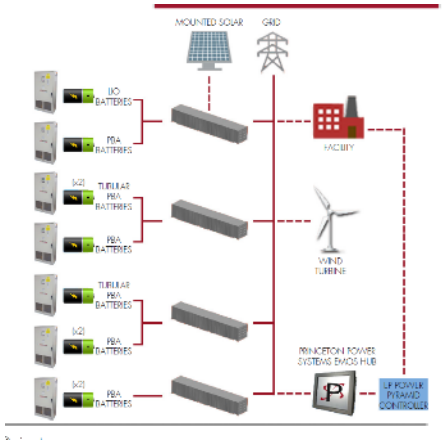
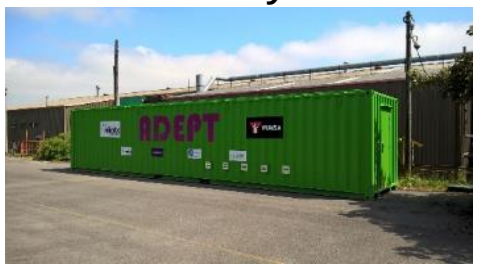
Co-located ESS architecture



Eagle Picher USA plant – 2012
Collection of ESS units with AC power flows co-ordinated by *Power Pyramid* ©

Bystra wind farm, Poland 2019
lithium-ion batteries (1 MW-0.47 MWh)
lead-acid storage batteries (5 MW-26.9 MWh)
manufactured by Showa Denko Materials,
BESS-DCS (Distribution Control System) manufactured by Hitachi,
which allows hybrid control of these two types of storage batteries
via separate Power Conversion Systems

Dual Chemistry architecture



GS-Yuasa UK plant – 2018
100kW:275kWH
Lithium ion and VRLA sharing DC Bus on single Power Conversion System

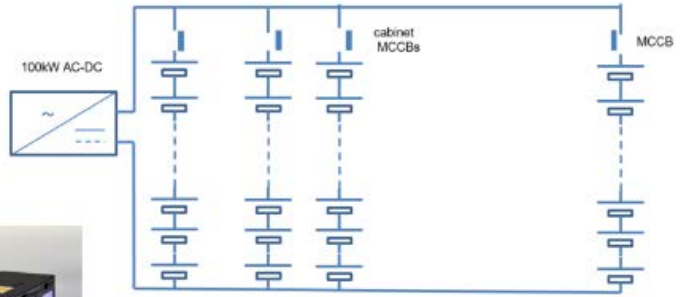
Portsmouth International Port– 2020
100kW:250kWh
Lithium ion and VRLA sharing DC Bus on single Power Conversion System

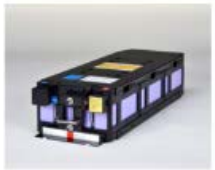
GS-Yuasa Lithium ion and VRLA Dual Chemistry ESS

LiB cabinets

VRLA racks

100kW - 500V Dual Chemistry schematic
LiB capacity: 75kWh
VRLA capacity: 200kWh





ADEPT Battery full discharge pattern

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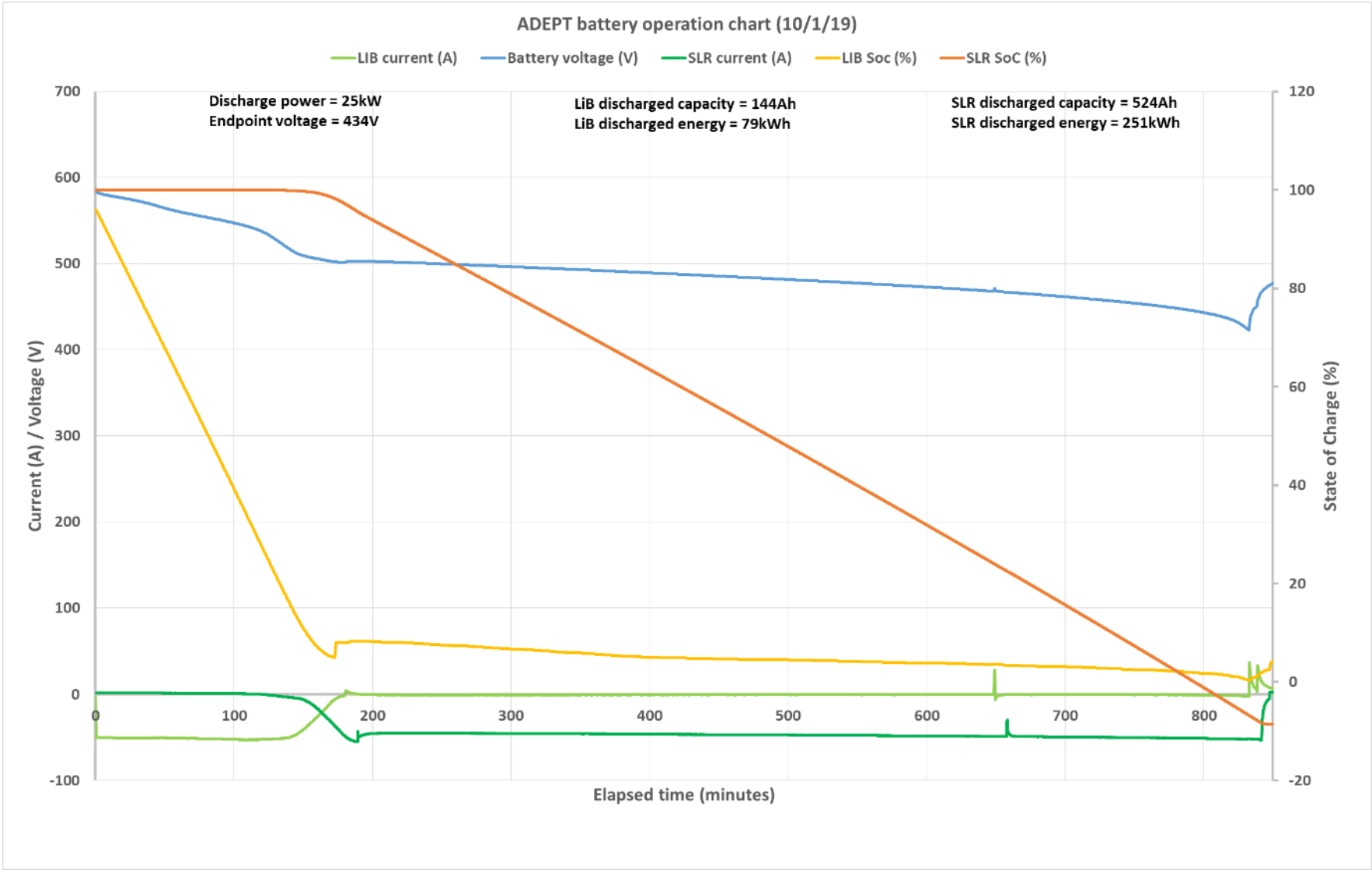

DC power sharing in ADEPT cabin

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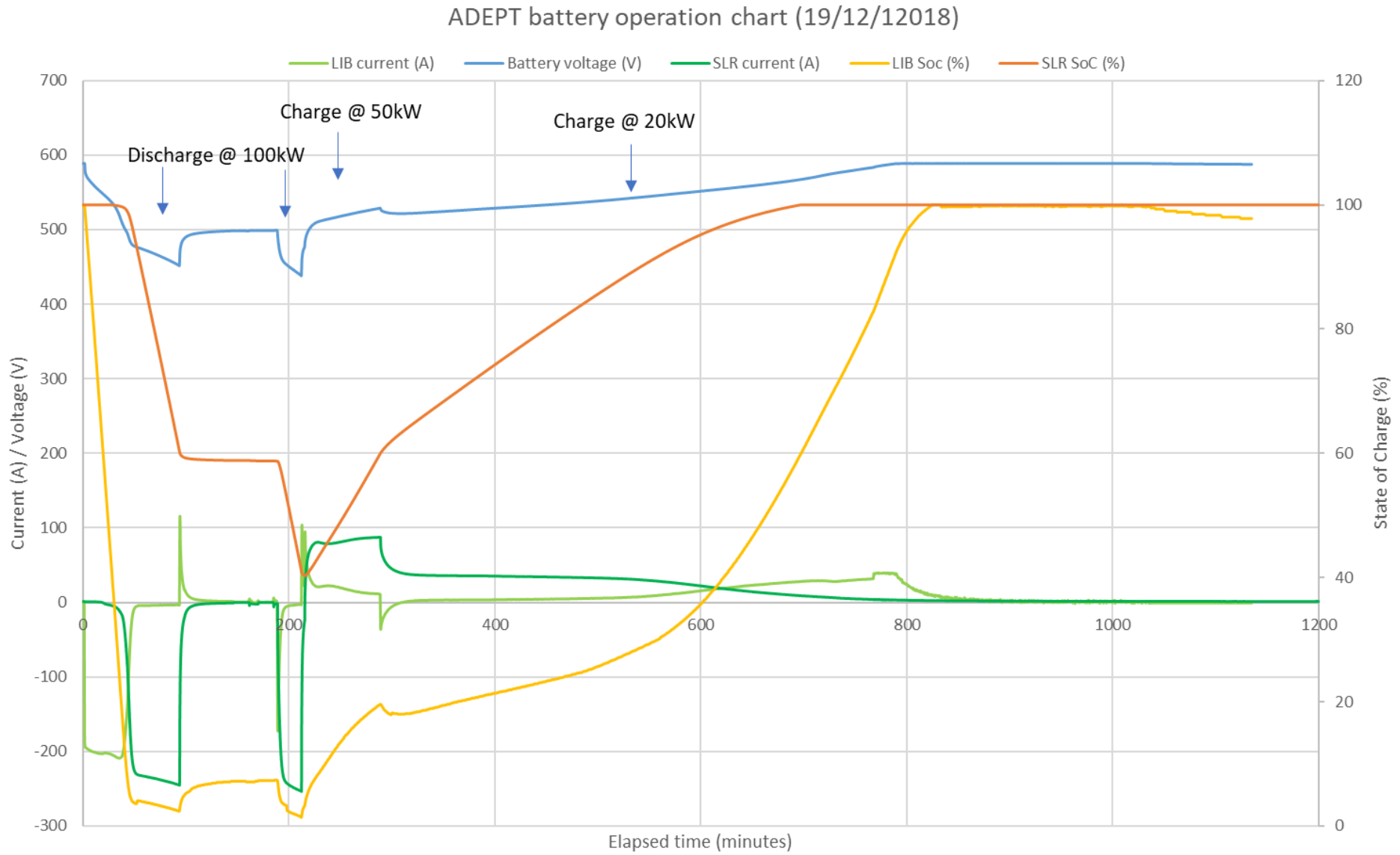

ADEPT ESS operation 2018 - 2021

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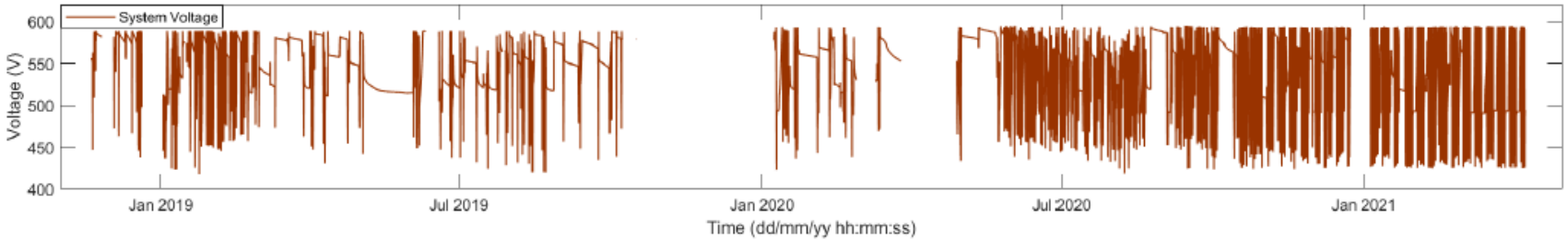
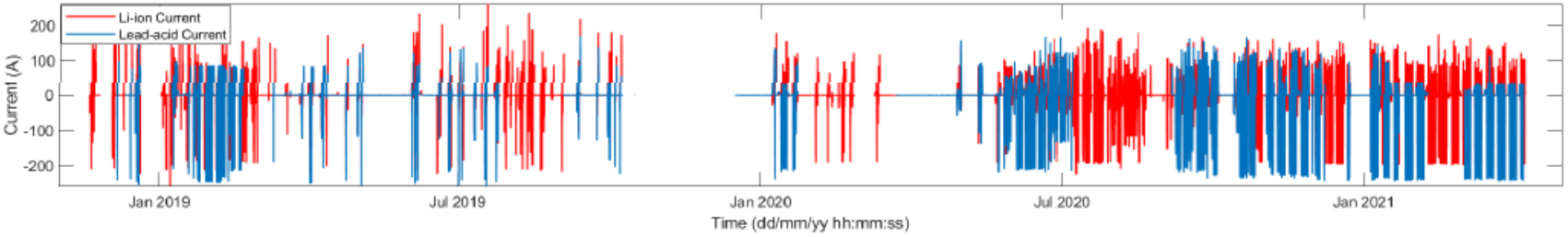
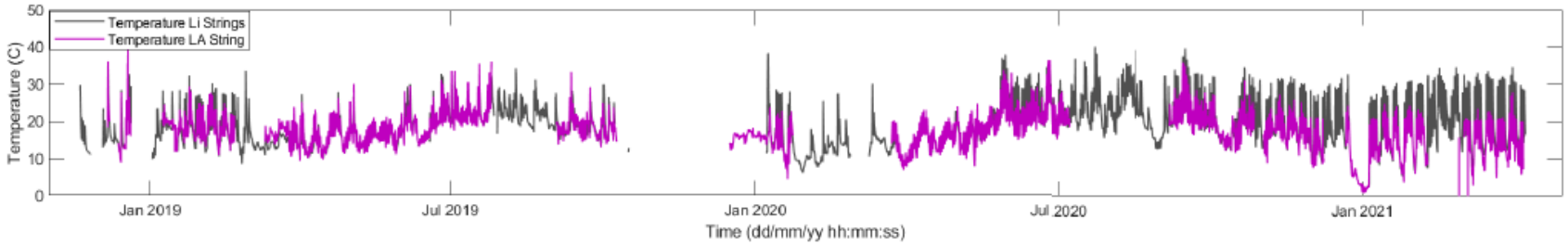
Voltage



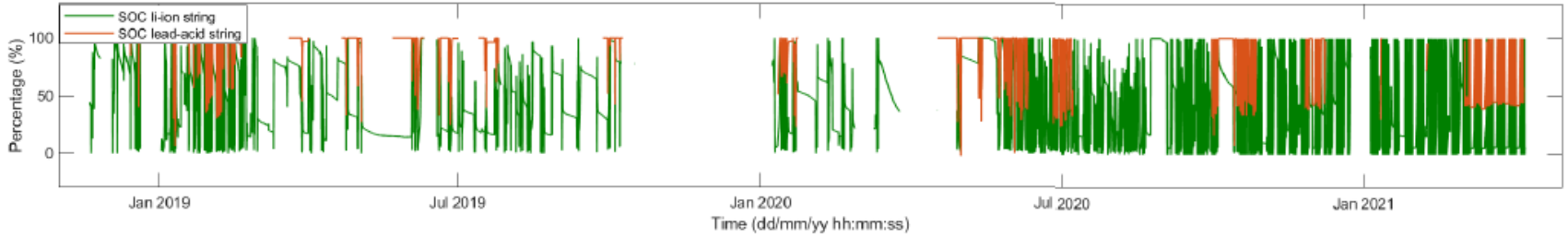
Current



Temp.



SoC



Gemini Dual Chemistry ESS configurations

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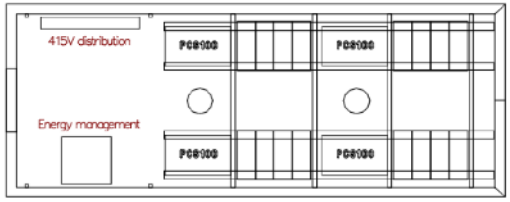
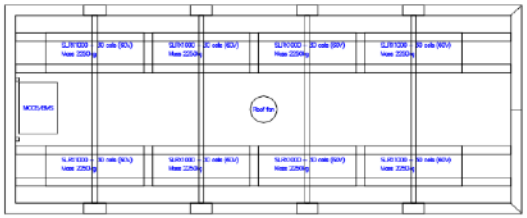
20ft shipping container populated with LIM50 -12 and LIM50 -8 modules and 4 PS100 inverters



20ft shipping container populated with 240 cells SLR1000



Lithium ion modules
+
Power Conversion
+
Energy Management

Lead Acid modules
+
Battery monitoring

Dual Chemistry summary

- Zero carbon economy targets are driving force for growing ESS business
- Electricity storage is now indispensable to allow further penetration of Intermittent renewables especially wind and solar
- Energy storage provides multiple benefits across a range of operating periods.
- Lithium ion and lead acid can work in a complementary way to provide economical and sustainable solutions for many services from the same system.
- The Gemini Dual Chemistry package combines the maximum storage function with minimum power and control overheads.
- The modular container designs provide a consistent set of solutions ranging from full lithium to full lead acid and all combinations between.
- Thank you for listening!