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Energy Management and Sustainability on the Road to 10G

Ensuring HFC Network Resiliency During Extended Utility Outages

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2021 Fall Technical Forum
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Background

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High-Speed Data for millions of users

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Increase in
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HFC can meet future bandwidth needs with the 10G initiative, but **how can we ensure power availability for this critical HFC service?**

Extended Outages: Key Challenges

Definition of Extended Outage:

"An outage that goes beyond the typical site backup time (4 hrs.) plus typical portable generator run time (8 hrs.) = 12 hrs."

Typical HFC powering site:

- Designed for 3-4 hrs of backup
- 3 or 6 batteries
- Space for additional cabinets limited
- High cost of permits for additions or service changes

Extended Backup Options: Generators

PORTABLE GENERATOR

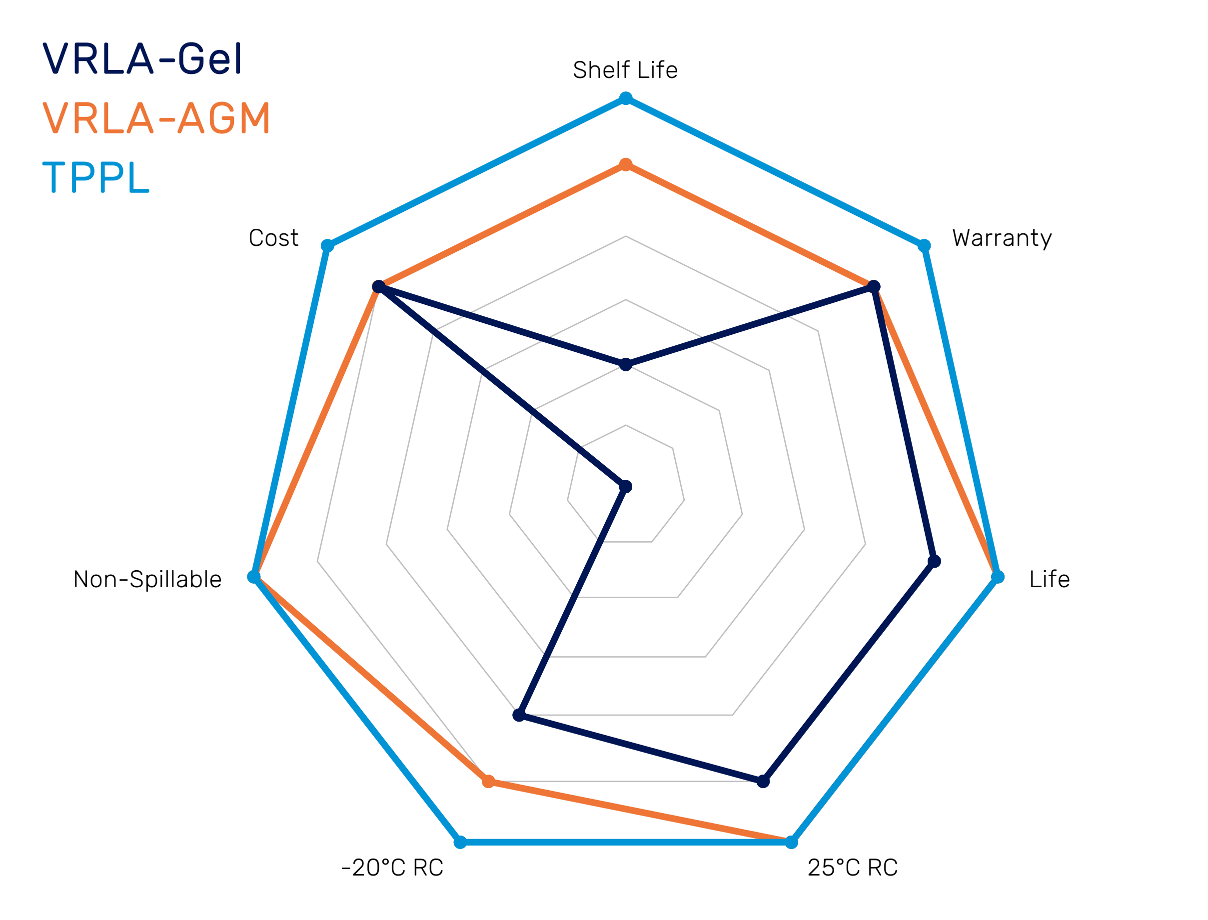
- Flexible option for backup
- Operational strategy
- Size ↑, runtime ↑, ease of deployment ↓

STATIONARY GENERATOR

- Ideal for centralized power
- Large footprint, higher TCO
- LNG provides extreme runtime

Extended Backup Options: VRLA Batteries

- Valve-Regulated Lead-Acid
- Longer life than flooded
- Non-liquid electrolyte (Gel vs. AGM)
- Standard Case size 27 or 31 for HFC
- AGM most resistant to extreme temps
- AGM is rated non-spillable

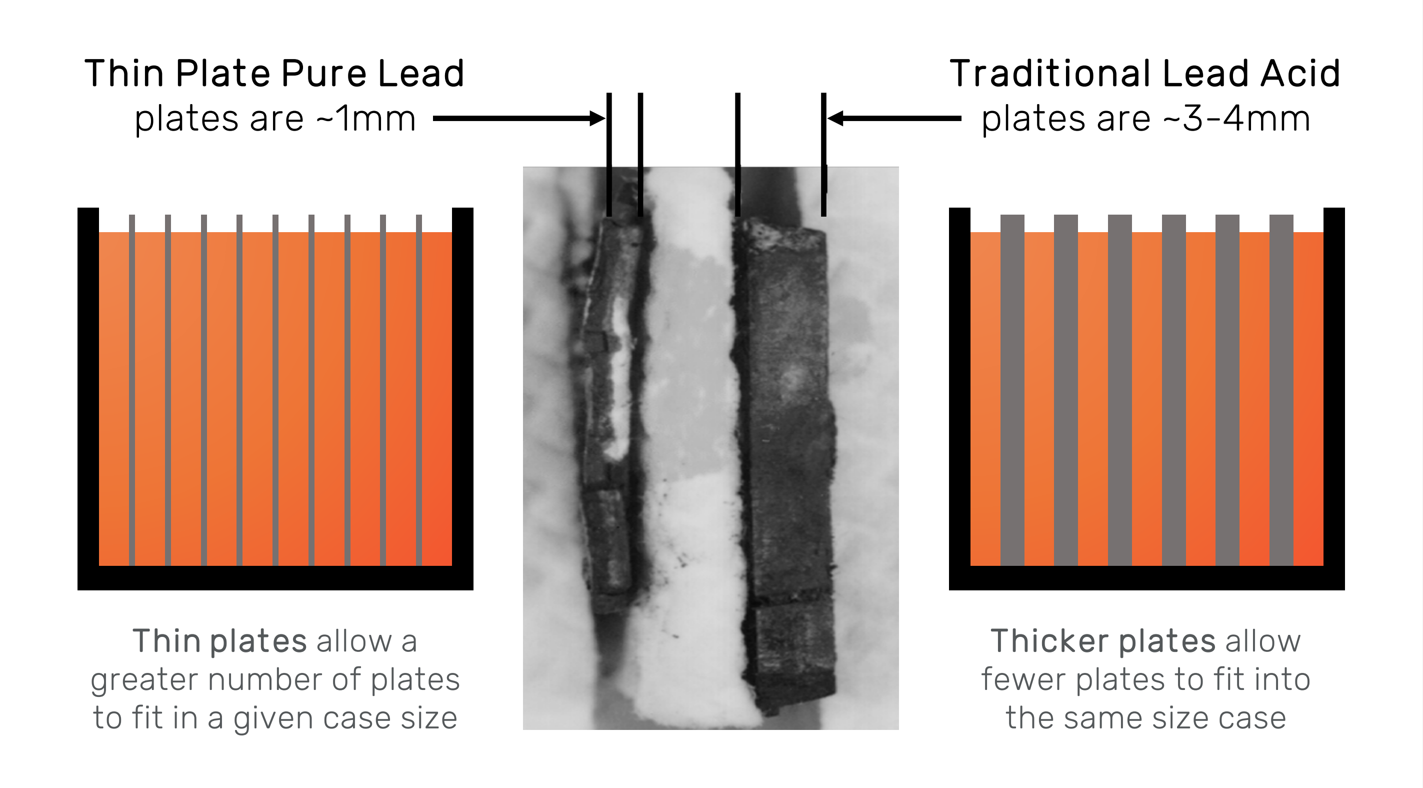


Extended Backup Options: TPPL Batteries

High-Capacity Lead-Acid Batteries

Thin Plate Pure Lead

- Thinner plates =
  - Higher energy density
  - Higher current capacity
  - Faster charging
- Pure lead
  - Reduces positive grid corrosion
  - Longer service life
- Maximum runtime:
  - Case size 31 → 114 Ah
  - High capacity TPPL – 210 Ah



Extended Backup Options: Lithium Ion Batteries

- Accelerating R&D driven by EV market
- Store and release energy by shuttling Lithium Ions between electrodes
- Variance in electrode chemistry defines cell voltage and energy density
- Nickel-Manganese-Cobalt (NMC) and Iron Phosphate (LFP) most common
- Significant increase in energy density over Lead-Acid

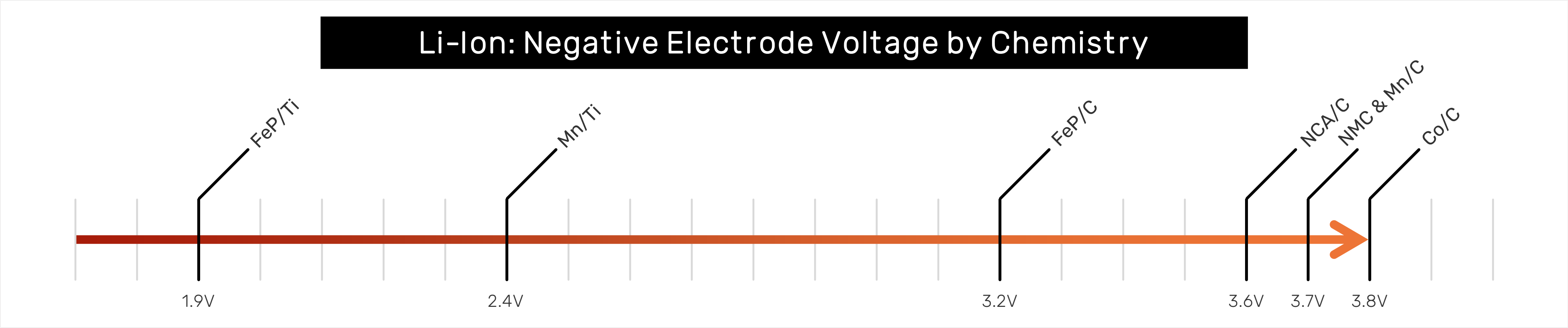


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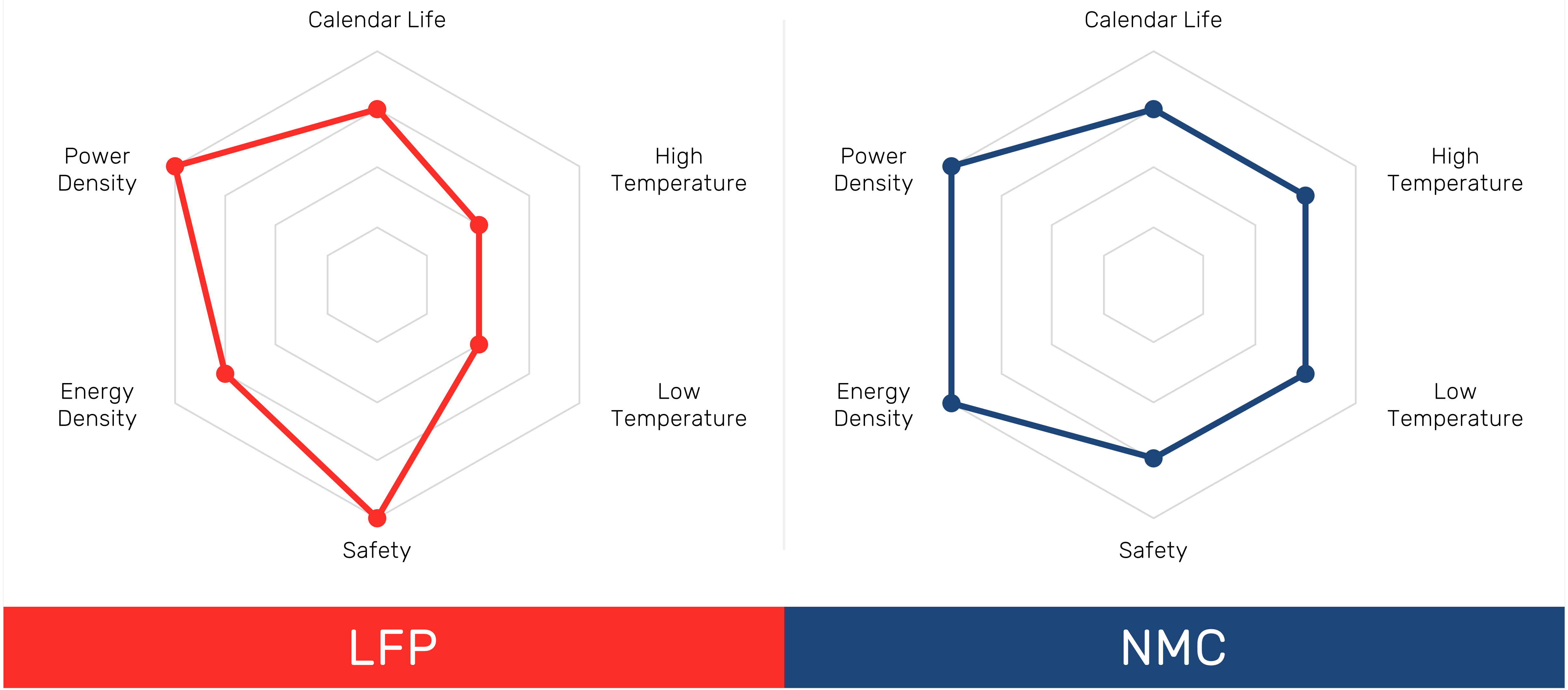
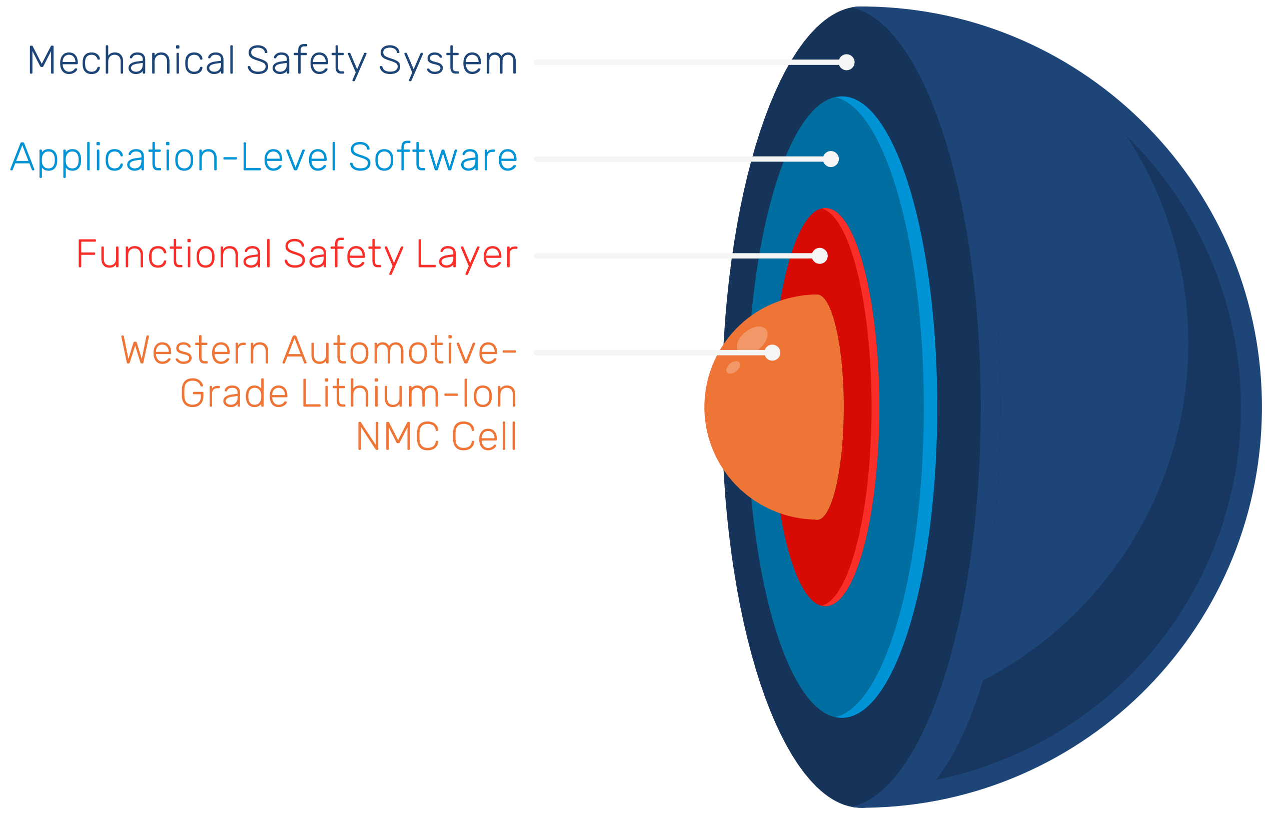
Figure 3- Spider chart showing key attributes of LFP & NMC Lithium Ion batteries



Layered Safety Design for Lithium Ion Batteries



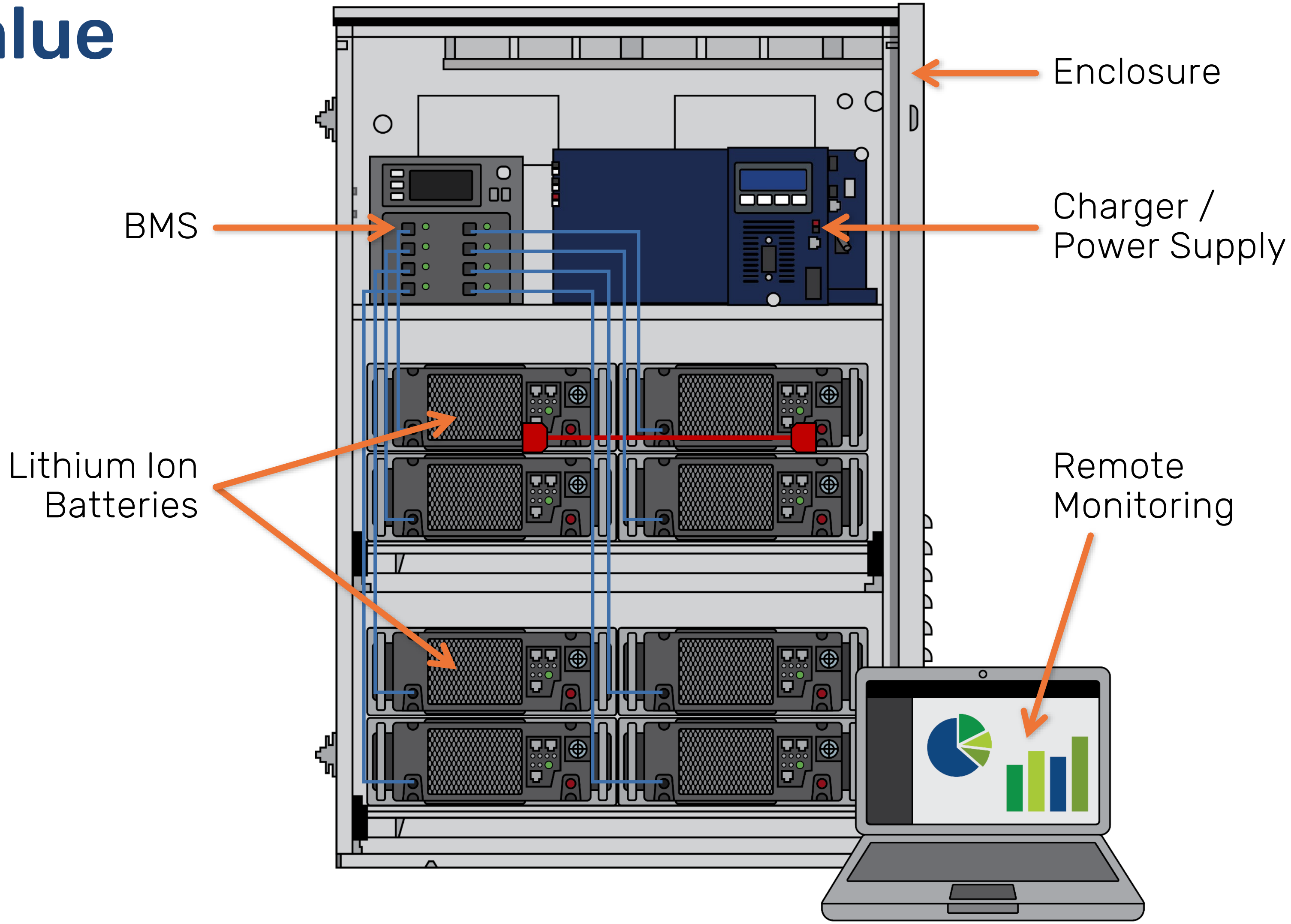
Layer 1: The tray is designed to physically protect the battery from mechanical abuse

Layer 2: Monitoring of the whole system behavior and controls charge / discharge

Layer 3: Monitoring of each individual cell in the module to check for events that could cause harm

Layer 4: Would rely on this only in an "everything goes wrong" situation—cell construction is designed and built with a high level of safety

Lithium System Value



TPPL vs. Lithium Ion Attributes

Physical Attributes:

Chemistry	Energy Density	Form Factors	Weight	Physical Orientations	Include BMS Electronics
TPPL	High	Many	Heavier	Most	Not required
Lithium Ion	Higher	Limited	Lighter	All	Yes, required

Operational Attributes:

Chemistry	Ventilation	Cut Off Voltage	Cycling Capable	Partial SoC Operation	Recycling
TPPL	Limited	Variable	Limited	Limited	98%
Lithium Ion	None	Fixed	Significant	Excellent	Limited

Scenario 1

Power Supply Load: 4A

0 Amps — 12 Amps

Available Space: 1 Pole Mount Enclosure

None — Acres

Fuel Availability: No LNG

No — Yes

Security Concerns: Low Risk

Low-Risk — High-Risk

Lead-Acid	Lithium Ion	Portable Generation?
<21 hours	21-79 hours	>79 hours

Run Time Range with Best TCO

Scenario 2

Power Supply Load: 8A
0 Amps — *12 Amps*

Available Space: 2 Enclosures
None — *Acres*

Fuel Availability: Natural Gas
No — *Yes*

Security Concerns: Low Risk
Low-Risk — *High-Risk*

Lead-Acid	Lithium Ion	Curbside Generator
<38 hours	38-109 hours	>109 hours

Run Time Range with Best TCO

Scenario 3

Power Supply Load:	12A	0 Amps – 12 Amps
Available Space:	2 Enclosures	None – Acres
Fuel Availability:	Natural Gas	No – Yes
Security Concerns:	High Risk	Low-Risk – High-Risk

Lead-Acid	Lithium Ion	Curbside Generator
<25 hours	25-73 hours	>73 hours

Run Time Range with Best TCO

Conclusion

Lithium Ion Batteries

Standard TPPL Batteries

Portable Generators

You need a suite of solutions

High Capacity TPPL

Curbside Generators

New Technology R&D

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Thank You!

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