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Main Lithium Chemistries for Energy Storage

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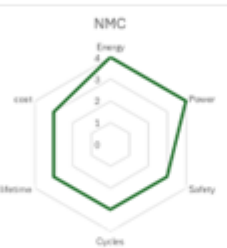
Chemistry	LTO	LFP	NMC	NCA
	Lithium Titanate	Lithium Iron Phoshate	Nickel Manganese Cobalt	Nickel Cobalt Aluminium
Chemistry Comparison				
Brand Chemistry Type	Zenaji	Sungrow, Enphase MPS, Tesla PW3 BYD, Pylontech Powerplus, Gen Z	Solaredge, CATL Tesvolt, Samsung	Tesla Powerwall 2
Advantages	Safest, no thermal runaway Fantastic cycle life, fast recharge time, low degradation no SEI	2nd Safest technolgy. (Phosphate), low cost, do not contain heavy metals	Good Energy density, Can be tailored for energy or power great flexibility. Fast recharge/discharge	High energy density, fast charge capability, good cycle life
Disadvantages	Lower energy density. Most expensive up-front cost	Slower recharge times, low energy density.	high cost, safety concerns, susceptible to thermal runaway. Environmental concerns (cobalt)	high cost, safety concerns, low thermal stability. Environmental concerns (cobalt)

C-Rates Explained

- The C-Rating of your battery refers to the amount of current that your battery can provide based on the nominal rated battery capacity.
- Lead batteries nominal capacity changes based on the rate of discharge whereas a lithium batteries nominal capacity remains the same.
- Each lithium chemistry has its own charge and discharge characteristics
- If the number is in front of the C it is a multiple. If after the C it is divisible

C- Rates examples

C-Rate			Time	
10	C	0.1	6	Min
8	C	0.125	7.5	Min
5	C	0.2	12	Min
2	C	0.5	30	Min
1	C	1	1	Hour
0.5	C	2	2	Hours
0.333	C	3	3	Hours
0.2	C	5	5	Hours
0.1	C	10	10	Hours
0.05	C	20	20	Hours

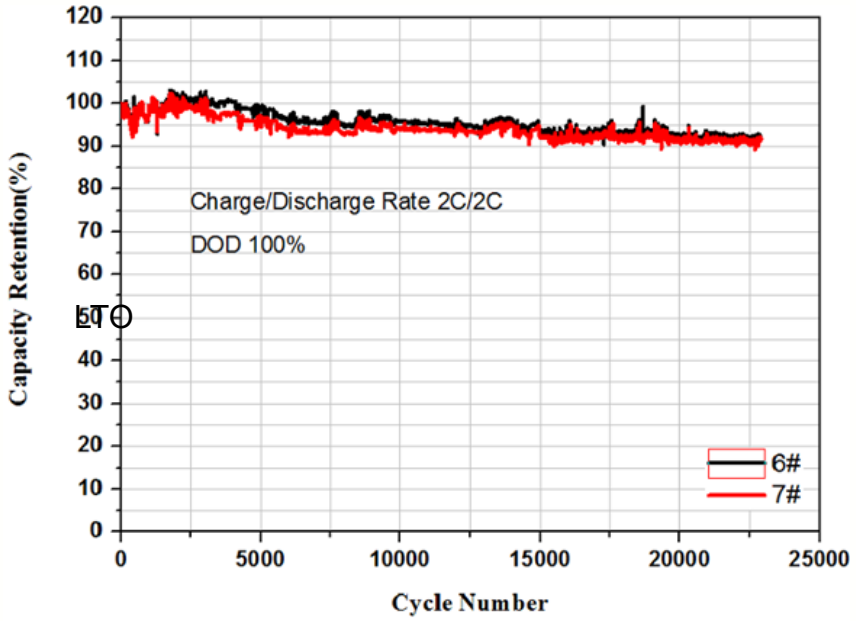
Capacity	C-Rate				
kWh	8	2	1	0.5	0.333
10	80	20	10	5	3
15	120	30	15	8	5
20	160	40	20	10	7
25	200	50	25	13	8
100	800	200	100	50	33

What does it mean when you see a battery advertised as 1MW/2MWh?
This means the battery can deliver 1MW for 2 hours. The power output is 1MW whilst the total storage capacity is 2MWh

LiB Cell Design

Cylindrical	Prismatic	Pouch
		
Most widely used ease of manufacturing good mechanical stability can withstand high internal pressures without deforming	Safest format safety function layer, multi-layered separator, safety vent safety fuse and overcharge safety device	Most efficient use of space lowest weight for capacity able to be moulded into shape space to allow for swelling

Capacity Degradation as a function of cycles



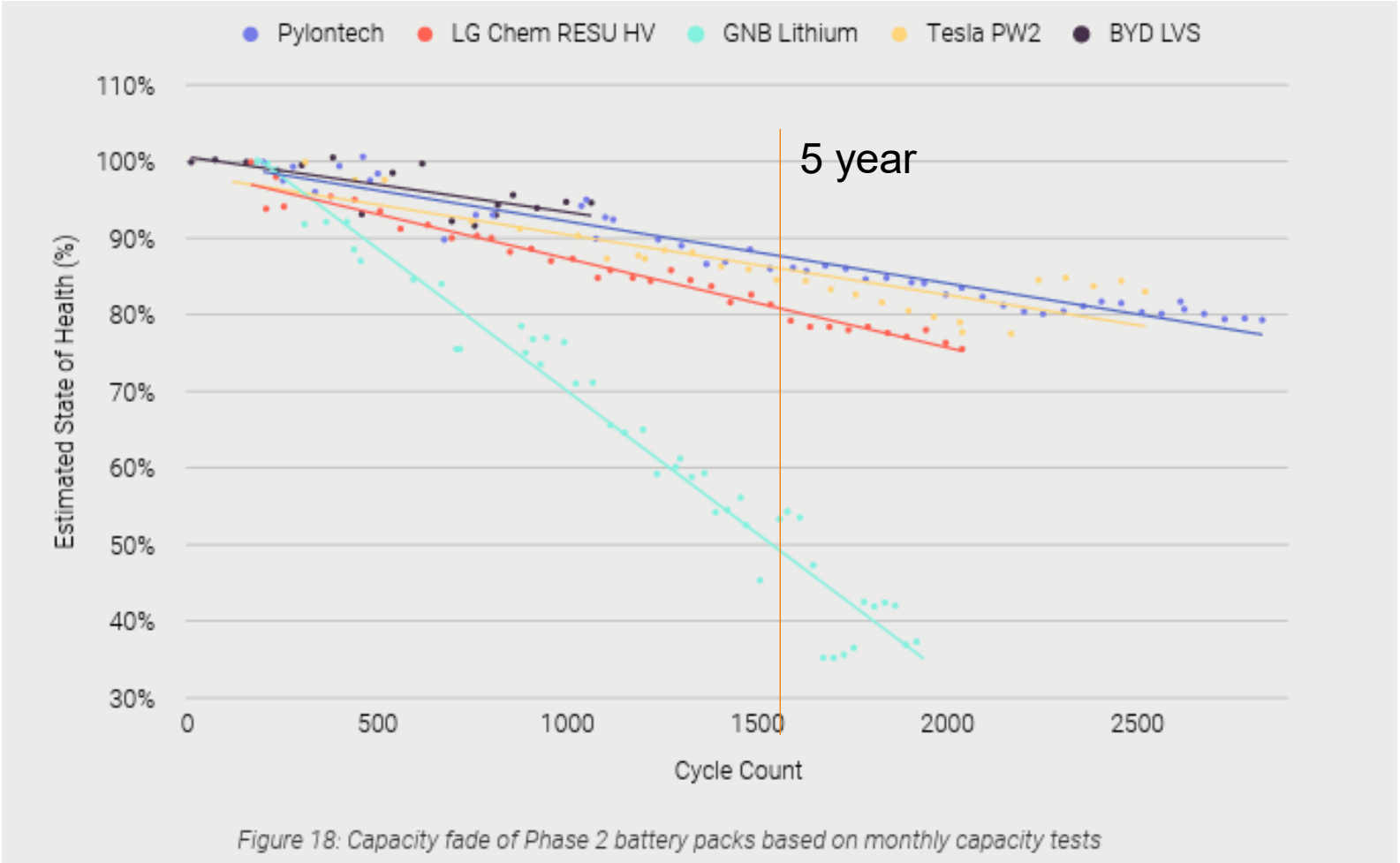
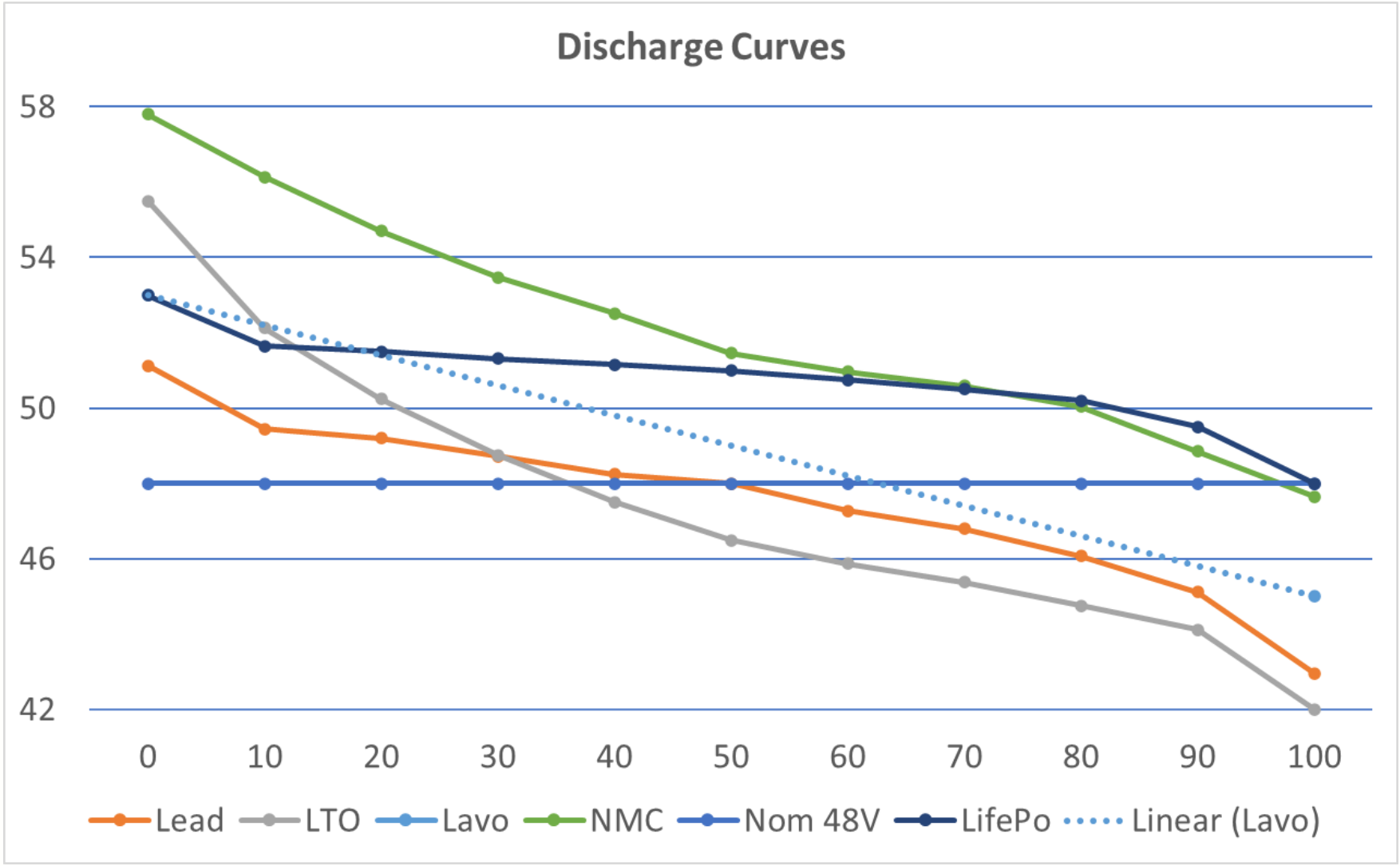


Figure 18: Capacity fade of Phase 2 battery packs based on monthly capacity tests

Discharge Curve Differences



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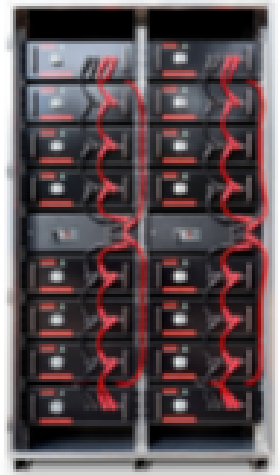
Managed versus Self-managed

Type	Image	Advantages	Disadvantages	Brands
Managed		Greater Optimization and monitoring, Faster charging, more dependable SOC data. Comprehensive monitoring covering voltage, current, SOC, temperature. Can even offer individual cell monitoring	External BMS/BMU, greater complexity, more prone to failure, loss of comms = shutdown. One battery fails and entire system can go offline. Reliant on each module having identical firmware	Pylontech, BYD, Tesvolt, Tesla, Sungrow, Enphase
Self-Managed		Integrated BMS in each module, Simpler charging, easy direct lead acid battery replacement, not reliant on comms. Bypasses failed module, easier installation	Less accurate SOC, no feedback to inverter via comms, limited remote monitoring, performance not as optimized as managed. Generally passive cell balancing	MPS, GenZ, Powerplus, Zenaji

Battery Installation Type

Stackable	Wall-mounted	Rack mounted
		
Modular good scalability earier to transport easier to install	Space saving ease of installation integrated design	High density energy storage Easy to maintain/ manage great scalability high reliability

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Design Example

	25kWh Usable Battery					Inverter
Battery	Unit Capacity	Quantity of Units	Usable	Units	Capacity Degradation	Victron
48V					Warrantied	38-66V
						1
Zenaji Aeon [LTO]	1.93	13	1	13	0.8	17
Total Storage		25.09				32.81
MPS [LFP]	5.1	5	0.9	6	0.7	8
Total Storage		25.5				40.8

Design Example

	25kWh Usable Battery					
Battery	Unit Capacity	Quantity of Units	Usable	Units	Capacity Degradation	Selectronic
48V					Warrantied	40-68V
						0.9
Zenaji Aeon [LTO]	1.93	13	1	13	0.8	18
Total Storage		25.09				34.74
MPS [LFP]	5.1	5	0.9	6	0.7	8
Total Storage		25.5				40.8

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Design Example

	25kWh Usable Battery					
Battery	Unit Capacity	Quantity of Units	Usable	Units	Capacity Degradation	SMA
48V					Warrantied	41-63V
						0.8
Zenaji Aeon [LTO]	1.93	13	1	13	0.8	21
Total Storage		25.09				40.53
MPS [LFP]	5.1	5	0.9	6	0.7	8
Total Storage		25.5				40.8

Design Example

	25kWh Usable Battery					Inverter		
Battery	Unit Capacity	Quantity of Units	Usable	Units	Capacity Degradation	Victron	Selectronic	SMA
48V					Warrantied	38-66V	40-68V	41-63V
						1	0.9	0.8
Zenaji Aeon [LTO]	1.93	13	1	13	0.8	17	18	21
Total Storage		25.09				32.81	34.74	40.53
MPS [LFP]	5.1	5	0.9	6	0.7	8	8	8
Total Storage		25.5				40.8	40.8	40.8

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Questions?

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