

High-Power-Density BBU and CBU Design for Evolving AI Data Center Power Architectures

Takuya Tsutsumi
Panasonic Energy Co., Ltd.
Data Center Power Solution Business Unit
PM General Manager

Hank Tsuda
Panasonic Energy Sales Company of America
Data Center Power Solution Engineering
Director

[Agenda]

1. Panasonic Contribution for OCP
2. Market Trends and Challenges
3. Challenge#1 Device(cell) Evolution
4. Challenge#2 Module/System Evolution
5. Summary / Call to Action

Panasonic contribution for OCP

Panasonic has shipped over 600M lithium-ion batteries for critical infrastructure applications — with a flawless safety record and zero incidents. As a trusted Power Solution Provider, we deliver customized solutions to meet the evolving demands of mission-critical systems.

Key Technologies for Safety

- Smoke/Fire
  - Anti-Propagation
- Internal Short
  Over Heat ・・・
  - CID/Vent
    Separator Shutdown
- External Short
  - Switch
- Over Charge
  Over Dischg.
  ・・・
  - Control Charge
    Control Dischrg. ・・

Mechanical BBU Tech.
- ✓ Fire Blocking

Electrical BBU Tech.
- ✓ BMU Tech.

Cell Tech.
- ✓ Heat Tech.
- ✓ Prod. Control

Complying **UL9540A** with Patented Labyrinth wall.

Collaboration! UL Solutions

Actual Experience & history

NVIDIA

Turing T4	Ampere	Hopper H100/H200	Blackwell GB200/GB300	Rubin

IT gear
server, storage, switch

PDU
Power Delivery Unit

PSU
Power Supply Unit

BBU Panasonic ENERGY
Battery Backup Unit

2027~ HPRv2 12kW
2025~ HPR5.5kW
Output power
x3 times
HVDC 1MW
Power Rack
2023~ ORv3
PMM
Shelf
2015~ ORv2
DCDC integrated
Module
Peak Shaving
function added

OPEN Compute Project

Cell	Module	System	Solution

Market Trends and Challenges

As data center power architectures evolve, the roles and functional requirements of BBUs and CBUs are becoming increasingly diverse. However, achieving both high power density and safety remains a key challenge.
Panasonic addresses this challenge through continuous module innovation enabled by advances in device technology.

GPU	Ampere	H100	H200	GB200	GB300	Rubin	Rubin Ultra	Feynman
Rack Power	～50kW	100kW		200kW	300kW	～1MW		～2MW?
BBU	3kW			5.5kW		12kW		
Cell	80W			120W		200W => 300W		

Increase Power density & Secure Safety

Backup
BBU

Backup
Peak shaving
BBU
3kW
+DCDC, Shelf, PMI/PMM

BBU
5.5kW

Load smoothing
CBU
(Capacitor Bank Unit)

BBU
12kW

SideRack

Power Efficiency Improvement

Grid stability &
Power availability
BESS

'22 '23 '24 '25 '26 '27 '28

- **Challenges#1 : Device(cell) evolution ➡ Balancing higher power density and safety**
- **Challenges#2 : Module/System evolution ➡ 2.0 MW Side Rack with new device**

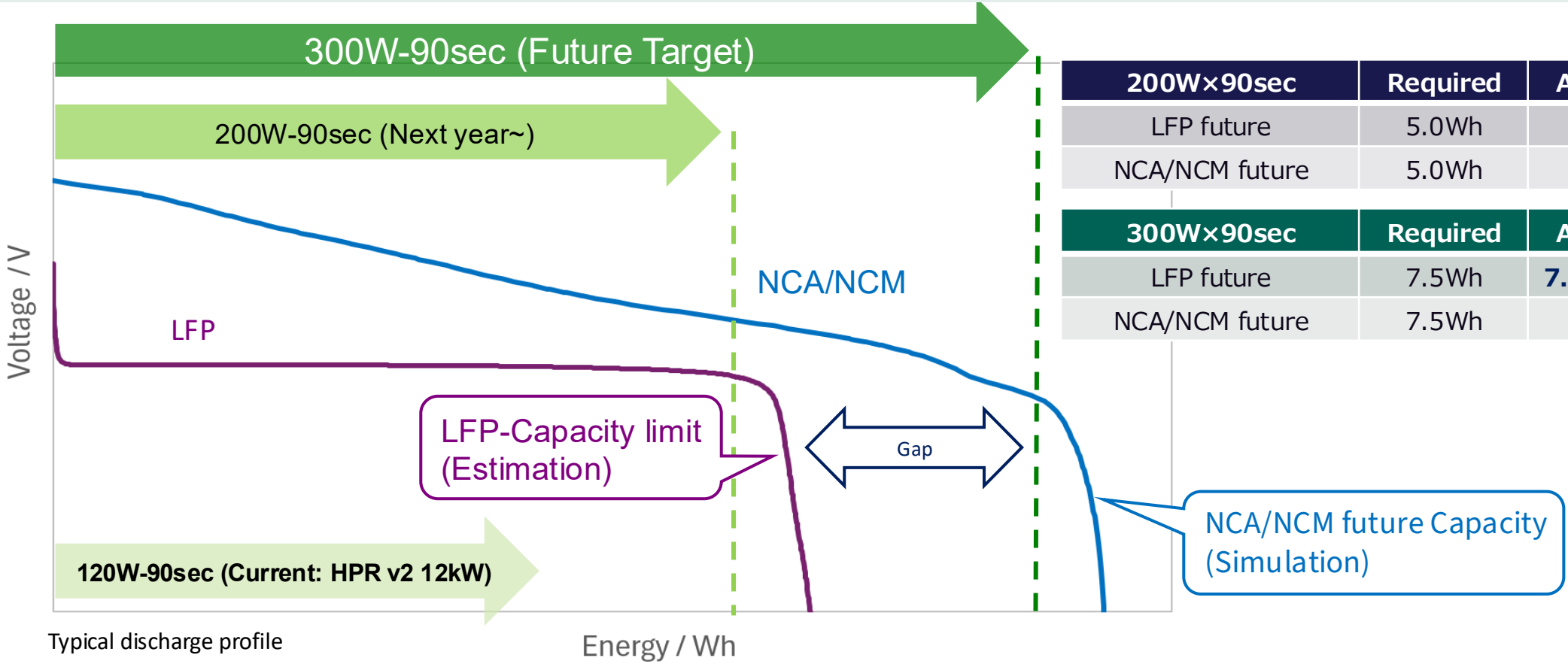
Challenge#1 : How to achieve Power and Safety

NCA/NCM and LFP chemistries each offer distinct performance advantages, depending on the application requirements. Panasonic's approach is to optimize the balance of power performance, energy density, and safety to deliver the most effective solution for each use case.

	LCO	LMO	NCA	NCM	LFP
Discharge Capacity (mAh/g)	150-160	100-120	180-220	150-220	110-130
Average Voltage (V)	3.7V	3.8V	3.6V	3.6V	3.3V
Output Power (Impedance)	★★ INDEX：85	★ INDEX：70	★★★ INDEX：100	★★★ INDEX：100	★ INDEX：75
Thermal Stability	★	★★	★	★	★★★
Cell recycling	★★	★★	★★★	★★★	★

Challenge#1 : How to achieve Power and Safety

LFP technology is advancing but may face practical limitations in supporting the highest power-density applications. As industry requirements move toward 300W-per-cell performance and rack power levels exceeding 2MW, high-power NCA and NCM chemistries become increasingly important. The key challenge for the industry is achieving these higher power levels while maintaining the highest standards of safety and reliability.



Typical discharge profile

200W×90sec	Required	Available	Margin
LFP future	5.0Wh	6.3Wh	+21%
NCA/NCM future	5.0Wh	9.8Wh	+49%

300W×90sec	Required	Available	Margin
LFP future	7.5Wh	**7.5Wh less**	-
NCA/NCM future	7.5Wh	8.25Wh	+9%

Challenge#1 : How to achieve Power and Safety

Leveraging NCA/NCM + LFP type composite can enhance thermal stability which is a battery safety improvement. This approach will provide a meaningful advancement in battery safety and system resilience for next-gen applications.

Hot plate test behavior

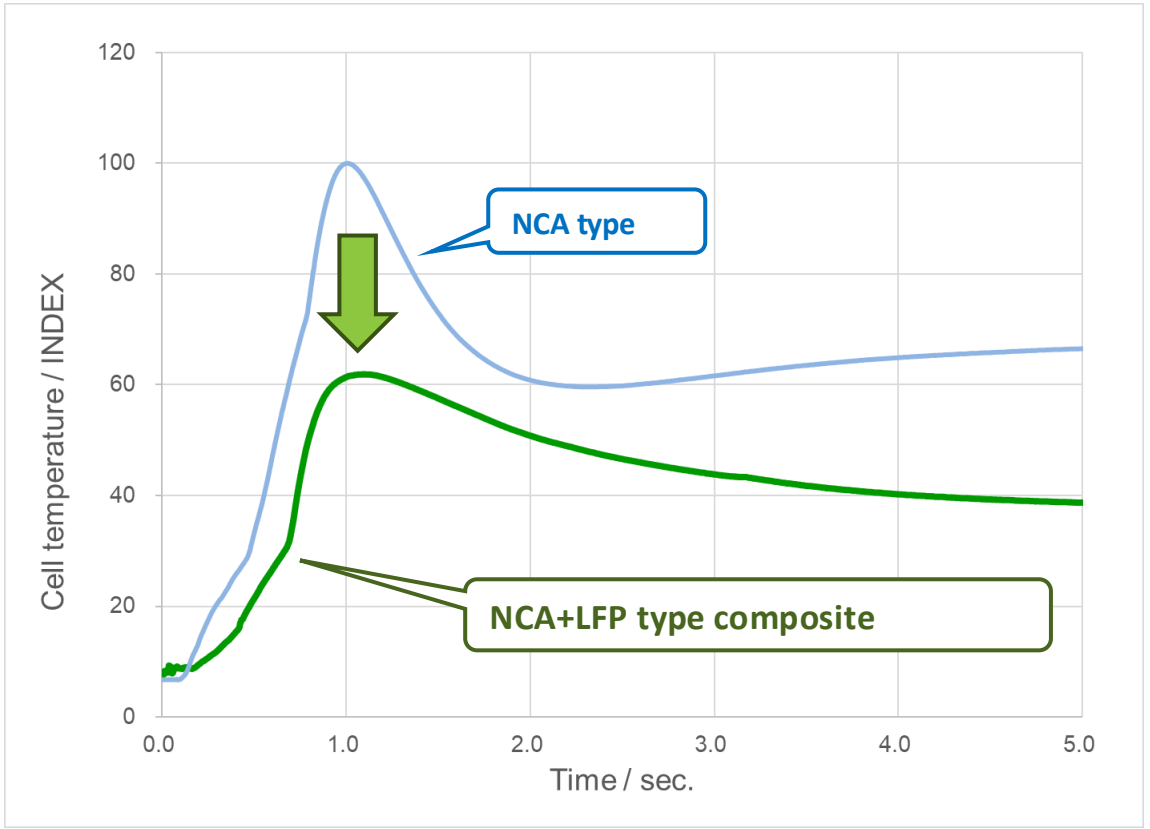
NCA type



NCA + LFP type

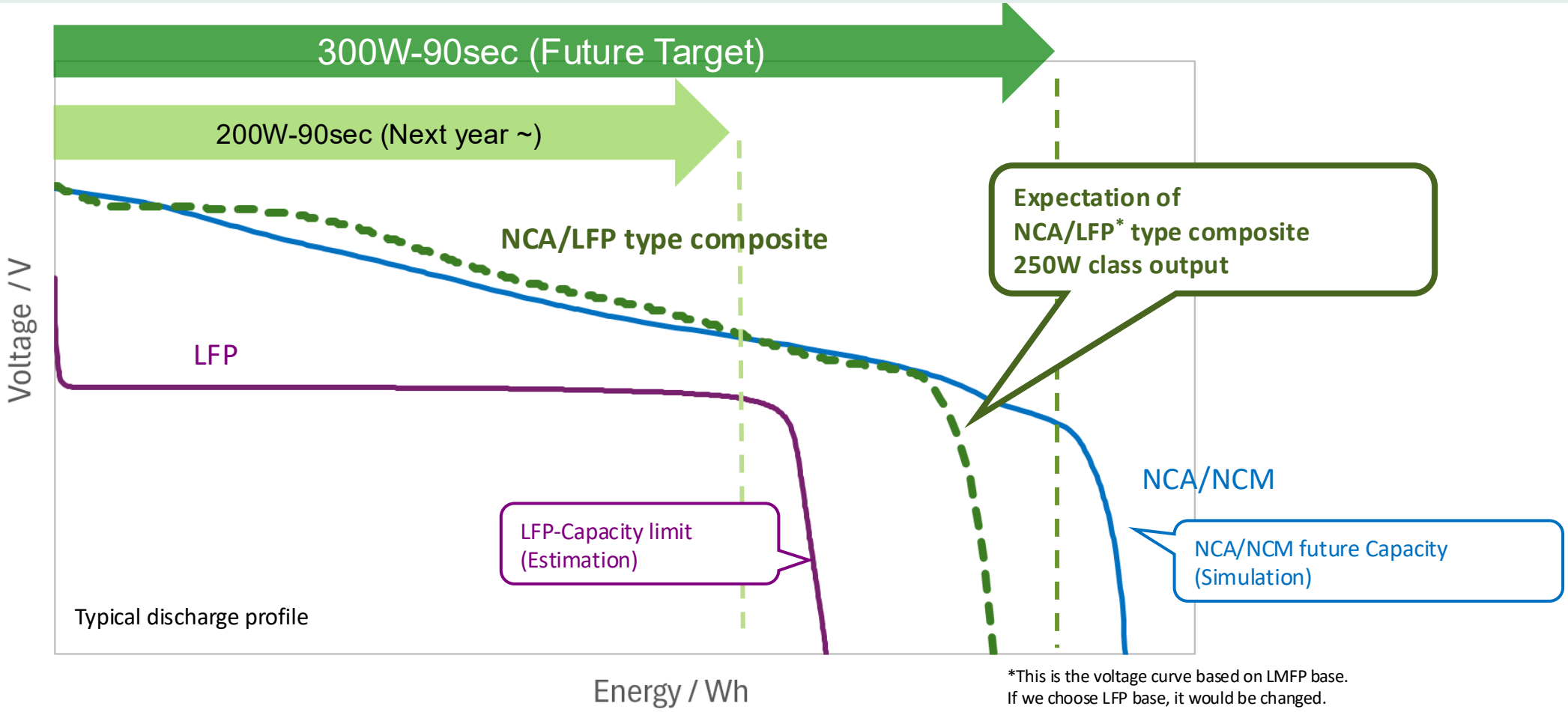


Nail penetration test – Temp. profile



Challenge#1 : How to achieve Power and Safety

NCA/LFP type composite materials are designed to combine the high-power capabilities of nickel-based cathode technologies with the thermal stability benefits of LFP. This approach has the potential to support next-gen rack designs exceeding 2MW while maintaining a strong safety profile.



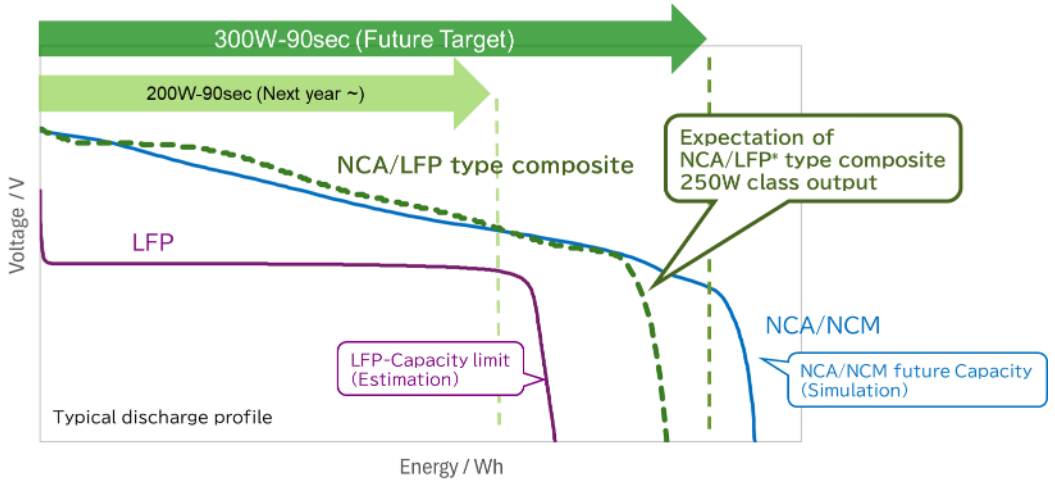
*This is the voltage curve based on LMFP base.
If we choose LFP base, it would be changed.

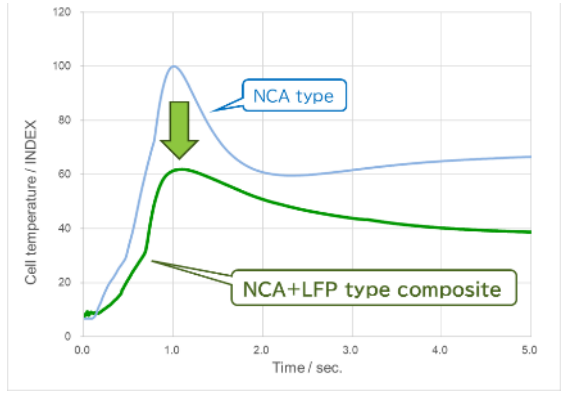
Challenge#1 : How to achieve Power and Safety

To address the growing power demands of AI infrastructure, Panasonic is advancing a hybrid NCA/LFP lithium -ion battery platform. This innovative chemistry approach is designed to deliver cell power levels exceeding 250W while maintaining safety characteristics comparable to leading LFP-based solutions.

	NCA/NCM	LFP	NCA/LFP type* composite
Discharge Capacity (mAh/g)	150-220	110-130	**140-210**
Average Voltage (V)	3.6V	3.3V	**3.4～3.6V**
Output Power (Impedance)	★★★ INDEX：100	★ INDEX：75	**★★～★★★ INDEX：85~**
Thermal Stability	★	★★★	**★★**
Cell recycling	★★★	★	**★★**

*Including LMFP





No Fire



Challenges#2 : Expanded System Capabilities with New Cell

Panasonic's next-generation cell technology is designed to enable higher-power energy storage architectures for emerging AI and data center applications. The platform supports 2.0 MW-class side-rack configurations today while providing a pathway toward future 4 MW-class containerized ESS solutions.



10ft Container BBU

Power rack x 8

4.5MW for 300s backup

3.4MW for load smoothing

Side Rack

900 kW



Same Size & Platform



Side Rack

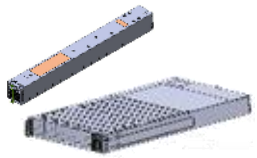
1.5 MW / 2.0 MW(DC input) **for 90s backup**

Output Power

1.6 x / 2.2 x

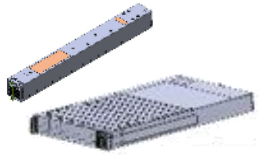
In-Rack

72 kW/shelf



HPR v2

Same Size & Platform



In-Rack

118 kW for 90s backup

Output Power

1.6 x

LFP Comp. applied

Li-ion Battery



LFP composite cell (>250W) Japan or US production

Current Cell (120W, 9.0Wh, NCA type) → Next Gen. High Power (200W)

CY2025	CY2026	CY2027	CY2028	CY2029

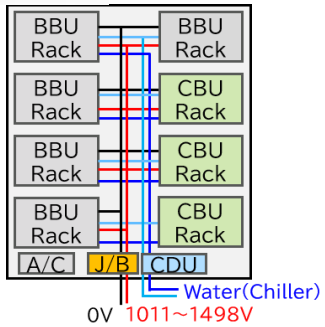
Specifications shown are based on preliminary estimates from BBU perspective only.

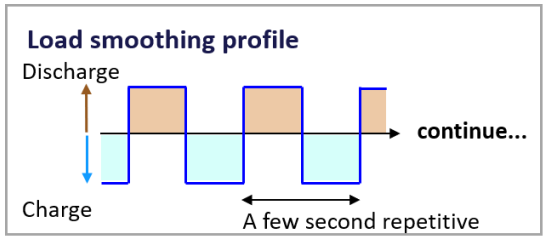
Challenges#2 : Expanded System Capabilities - Configuration

Flexible energy storage architectures combining lithium-ion batteries (LIBs) and lithium-ion capacitors (LICs) can address a broad spectrum of power backup and load-balancing requirements.
This hybrid approach enables solutions optimized for both energy duration and high-power response across all applications

10ft Container BBU





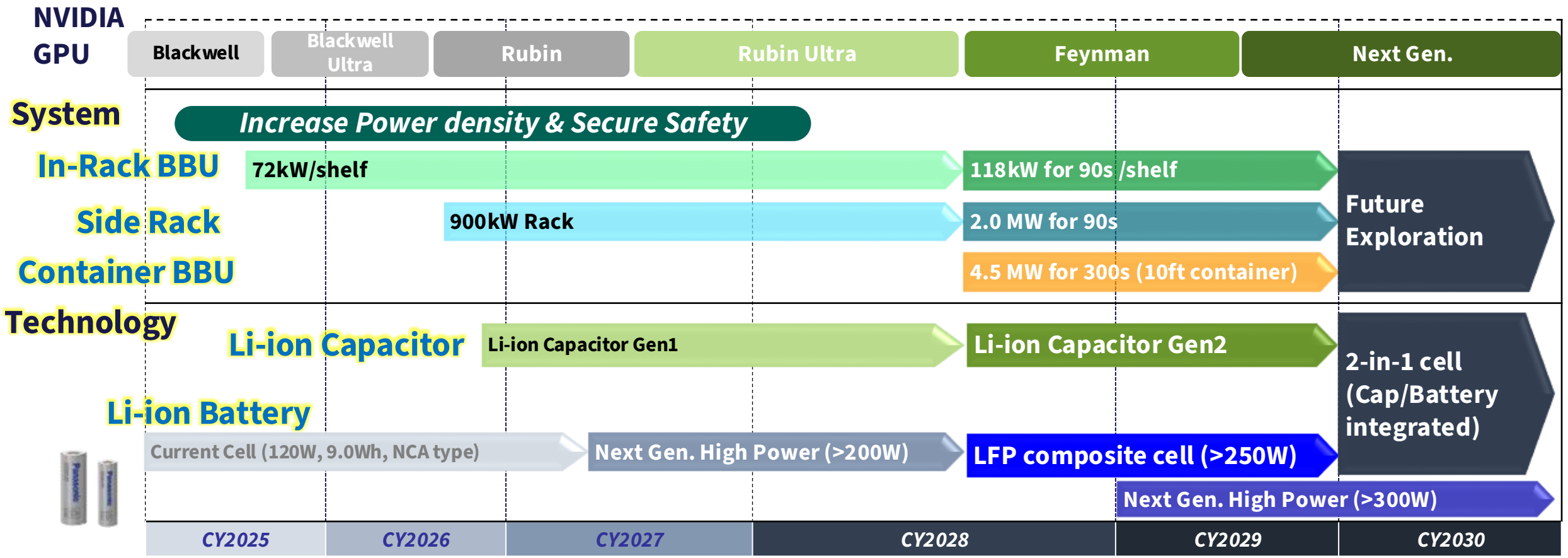


Options	Maximize Backup Power	Balanced	Maximize Load Smoothing Power
Rack Configuration	8x BBU racks **(LFP type composite cells)**	5x BBU racks 3x CBU racks	8x CBU racks (LIC cells)
300s Backup Power	4.5 MW (share SOC with load smoothing) **8 MW** (not share SOC)	**4.6 MW**	300 kW
Load Smoothing Power **(1s charge + discharge)**	3.4 MW	**4.2 MW**	**10 MW**
Output Voltage	1,000 – 1,500V dc		
Safety	**Complied** with NFPA/UL and other standards for Data Center Use With LFP type composite and LiC		

Specifications shown are based on preliminary estimates and are provided for conceptual evaluation purposes only.

Summary - Future Tech Roadmap

Panasonic is advancing next-generation energy storage technologies to help enable higher-power, safer, and more resilient data center infrastructure.
Through continued innovation, we are supporting the evolving requirements of AI-driven digital infrastructure.



Call to Action



Co-Designing the Future HVDC Containerized BBU/ESS



Function & Requirements

- Define future backup, buffering, and load smoothing needs.
- Establish clear system-level requirements and performance objectives from the outset.

Cell & Battery Architecture

- Translate system-level requirements into optimized cell performance specifications.
- Optimize chemistry and form factor for HVDC applications.

System Design

- Develop scalable enclosure, thermal management, and safety architectures designed for future growth.
- Enable infrastructure platforms that are ready for the power and reliability demands of AI-scale data centers.

OCP Collaboration

- Contribute reference architectures and design guidelines through OCP Energy, Power Delivery, and DC-MHS.

Let's Join Forces and Innovate!

*MHS=Modular Hardware System

Thank You!

