

# Lithium-Ion Battery Business

COP21 Delta EMEA Partner Event  
8th Dec. 2015





# Contents

- ✓ **LIB business transfer and collaboration**
- ✓ **MHI LIB development milestone**
- ✓ **Plant relocation**
- ✓ **Product platform and application**
- ✓ **Back-up slides:**
  - **Specifications**
  - **Applications**



# Li-ion battery cell Business Transfer and Collaboration

## Press Information

April 18, 2014 No.1792

**MHI to Sell Lithium-ion Rechargeable Battery Business Assets, Including Machinery, to Delta Electronics of Taiwan  
— Management Resources to be Shifted to Energy Storage System Products —**



Delta Confidential

Onward and Upward  
130<sup>TH</sup>  
ANNIVERSARY

7

2014/01 MHI to Sell Lithium-ion Rechargeable Battery Business Assets, Including Machinery, to Delta Electronics of Taiwan | Mitsubishi Heavy Industries, Ltd. ...



## Press Information

April 18, 2014 No.1792

**MHI to Sell Lithium-ion Rechargeable Battery Business Assets, Including Machinery, to Delta Electronics of Taiwan  
— Management Resources to be Shifted to Energy Storage System Products —**

Tokyo, April 18, 2014 - Mitsubishi Heavy Industries, Ltd. (MHI) has concluded an agreement with Delta Electronics, Inc., a leading manufacturer of electronic devices in Taiwan, under which MHI will sell Delta its business assets, including machinery, in lithium-ion rechargeable batteries. As a result MHI will shift its management resources into operations in energy storage system (ESS) products employing lithium-ion rechargeable batteries.

Delta Electronics is the core enterprise of the Taiwan-based Delta Group. The company undertakes operations encompassing a diverse lineup of electronic products including power and thermal management solutions, and as an enterprise of global scale it has approximately 200 facilities worldwide including production, sales and R&D functions.

ESS products today are expected to record sustained market growth ahead as core devices for achieving power network stabilization in tandem with the introduction of wind power, solar power and other renewable energies, and for adjusting power supply vis-à-vis demand in order to save energy.

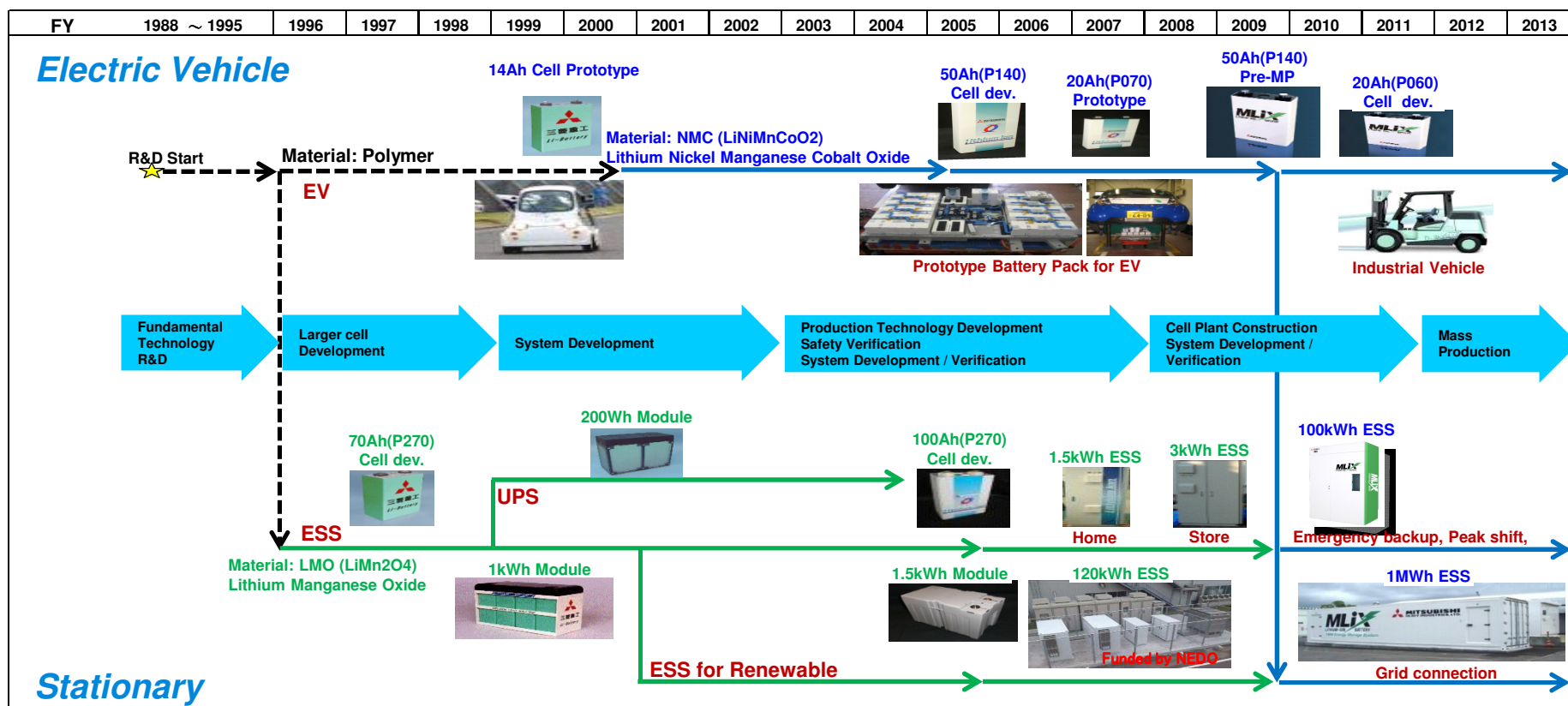
The lithium-ion rechargeable batteries developed by MHI are light in weight, compact in size and high in reliability. The company boasts an abundant track record in this field, its batteries being widely used in diverse products ranging from electric buses to ESS products, including container-based systems. Following the sale, MHI will focus on expanding the market for ESS products.

Leveraging the new agreement, going forward MHI and Delta Electronics also plan to join forces in pursuing further development of the lithium-ion rechargeable battery business, including ESS products. At the same time, MHI will continue to work toward the realization of an ever more energy-efficient, low-carbon society through expanded adoption of stationary large-capacity ESS's, electric buses, etc.

About Delta Electronics, Inc.  
The company founded in 1971, is the global leader in power and thermal management solutions, as well as a major source for industrial automation, data center, ICT components, displays and networks. As an energy-saving solutions provider, Delta's businesses encompass power electronics, energy management and smart green life. Delta is as an enterprise of global scale with approximately 200 facilities worldwide including production, sales and R&D functions.

MHI: Mitsubishi Heavy Industries, Japan

Page Top





# Plant Relocation

|                                    | 2014 |   |   |   |    |    |    | 2015 |   |   |   |   |   |   |   |   |    |    |    | 2016 |   |   |
|------------------------------------|------|---|---|---|----|----|----|------|---|---|---|---|---|---|---|---|----|----|----|------|---|---|
|                                    | 6    | 7 | 8 | 9 | 10 | 11 | 12 | 1    | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1    | 2 | 3 |
| <b>Business transfer agreement</b> |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>New factory building</b>        |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Production training</b>         |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Inventory production</b>        |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Production line dismantle</b>   |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Shipping</b>                    |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Reinstallation</b>              |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Verification</b>                |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |
| <b>Start production</b>            |      |   |   |   |    |    |    |      |   |   |   |   |   |   |   |   |    |    |    |      |   |   |





## ***TY5 New Plant for Li-ion Battery***

- ***Location: Taoyuan Guishan***
- ***Fully automated production line***
- ***Factory capacity: 200MWh/Year***
- ***Official opening: January 2016***



***ESS Demo Site in TY5***





### **Energy Efficiency**

- ✓ Green building design reduced 19.4% energy consumption
- ✓ Solar power system

### **Water Efficiency**

- ✓ 1955 tons rainwater and condensate recovery system used to flush toilets and watering
- ✓ Water saving sanitary lower 78.6% consumption
- ✓ Drought-enduring landscape design

### **Sustainable Sites**

- ✓ Large planting area reduce heat island effect and CO<sub>2</sub> emissions
- ✓ Insulated walls and roofs

### **Indoor Environment Quality**

- ✓ Low fugitive emission painting material
- ✓ Indoor air quality monitor system

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## **Delta Green Building**

### **Resource Recycling**

- ✓ 95.2% construction waste recycling
- ✓ 39.2% recyclable building material
- ✓ 23.1% building material from local

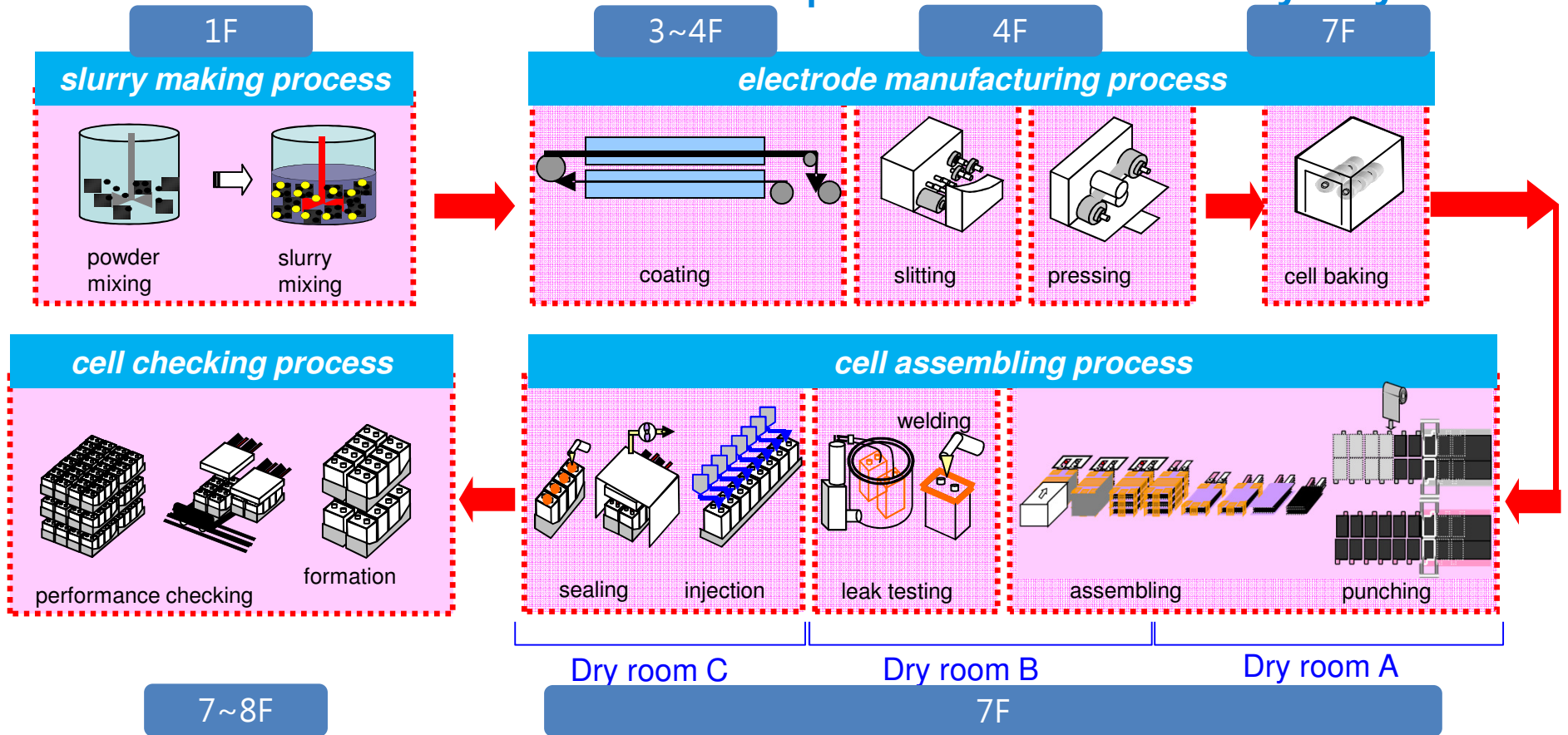


### **Target to achieve Green Building Gold recognition:**

- ✓ **LEED (U.S.)**
- ✓ **EEWH (Taiwan)**












# MFG process & Factory layout






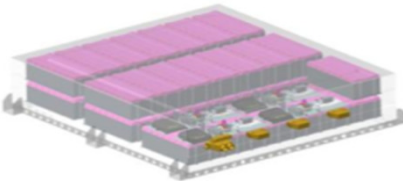




# Target Applications

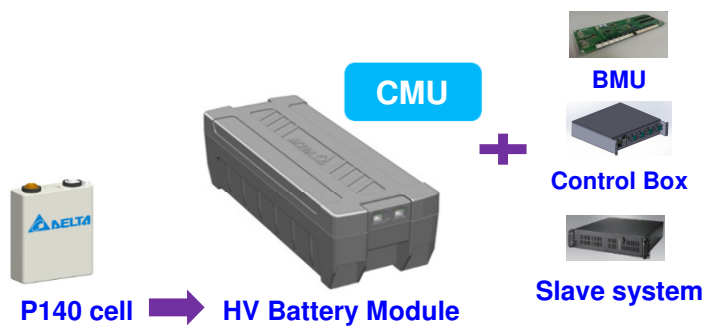
|   |                              |   |   |  |
|---|------------------------------|---|---|--|
|  | <i>RE &amp; Grid support</i> | <br>PV Power    | <br>Wind Power | <br>Grid        |
|   | <i>DC Backup</i>             | <br>Data Center | <br>Telecom    |  |
|   | <i>Electric Vehicles</i>     | <br>eBus      | <br>eTruck   | <br>eForklift |

# Target Applications

|   |                              |  |   |
|---|------------------------------|--|---|
|  | <b>RE &amp; Grid support</b> | <u>Rack to Container</u> <ul style="list-style-type: none"> <li>• Micro scale : &lt; 10 kWh</li> <li>• Middle scale : 50~500 kWh</li> <li>• Large scale : &gt;MWh</li> </ul> |    |
|   | <b>DC Backup</b>             | <u>Module to Rack &amp; Cabinet</u> <ul style="list-style-type: none"> <li>• 2~50 kWh</li> <li>• 48~480 Vdc</li> </ul>   |    |
|   | <b>Electric Vehicles</b>     | <u>Module to Pack</u> <ul style="list-style-type: none"> <li>• 100~300 kWh</li> <li>• 400~750 Vdc</li> </ul>   |  |

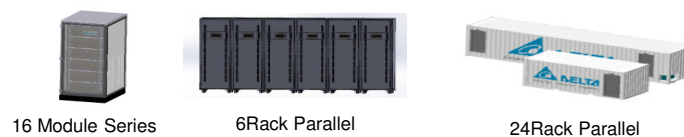
# Battery Modules

HV  
system



## Energy Storage System

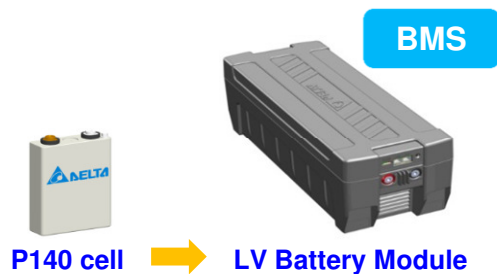
### A Flexible system structure



- Micro Scale : < 10kWh
- Middle Scale : 30-200KWh
- Large Scale : >200KWh to 1MWh

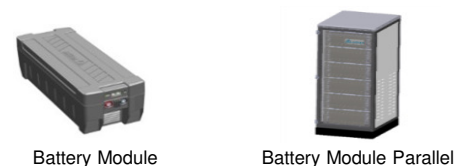
### Cabinet / Container

LV  
system



## DC Backup Solution

### A flexible combination



- 2.6-50kWh
- 48V DC

### Module & Cabinet

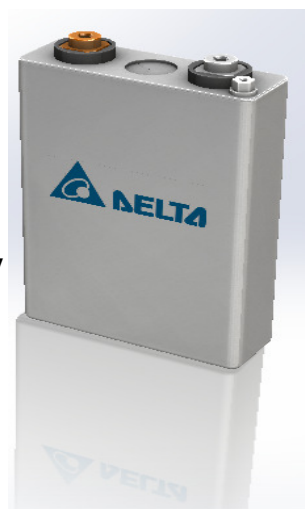
## Application



## Back-up Slides

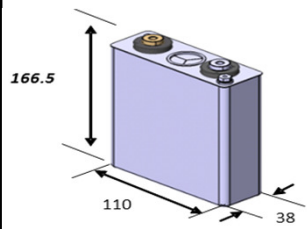


- **Cell Format - Prismatic**
  - ✓ Heat release advantage
  - ✓ Effective placement
- **Case - Al can/ Laser welding**
  - ✓ Less sensitive to heat impact
  - ✓ Robust sealing structure & quality
- **Electrode type - Stacking**
  - ✓ Long life advantage
  - ✓ Electrode design flexibility
- **NMC/Graphite system**
  - ✓ Performance balance
  - ✓ Long life advantage
- **Excellent discharging & cycle characteristics**



## Li-ion Battery Cell

### P140 Features & Specification

| Dimension<br>(Including terminal) | mm              |  |
|-----------------------------------|-----------------|---|
| Material                          | -               | NMC/Graphite  |
| Weight                            | kg              | 1.4   |
| Volume                            | cm <sup>3</sup> | 700   |
| Nominal capacity<br>(0.2CA, 25°C) | Ah              | 50  |
| Nominal voltage<br>(50%DOD)       | V               | 3.7   |
| Nominal Energy<br>(0.2CA, 25°C)   | Wh              | 185   |
| Voltage range                     | V               | 4.15-2.70   |
| Volume density                    | Wh/L            | 264   |
| Energy density                    | Wh/L            | 132   |



# Delta Lithium-ion Battery Module

**DBS48V50P**

*Long service life battery ideal for 48V application*

## Special Features

### High Safety

- Certification: UN38.3, UL1973
- Advanced BMS to protect battery module from abnormal conditions

### Retrofit Application

- Direct replacement of Lead-acid battery pack

### Flexible Capacity Expansion

- Parallel expansion by Master-Slave structure up to 255 modules

### Excellent Manageability

- Front-end panel access
- User-Friendly signal indication for the status of battery system
- Allowed for multi-units or multi-sites remote management



|                       |   |
|-----------------------|---|
| Nominal Voltage       | 51.8V   |
| Nominal Capacity      | 50 Ah   |
| Nominal Energy        | 2.59 KWh  |
| Dimension (mm)        | 199 (W)x 187 (H)x 543 (L)                               |
| Weight                | ~26Kg   |
| Certifications        | UL1973, UN 38.3   |
| Cycle life @ 25° C    | 10% - 90% SOC*1≥4,000 cycles                            |
| Operating Temperature | Charge: 0° C to +45 ° C<br>Discharge: -20° C to +45 ° C |
| Interface             | CAN 2.0B (500kHz)                                       |
| Discharge Rate        | Max. 1.3C (65A)   |

\*1) SOC is "State Of Charge"





## **DBS48V50P**

### **Applications**

- Energy Back-up & storage for residential, commercial and industrial needs
- Direct replacement of conventional 48V lead-acid battery system
- Telecom Back-up power
- Forklift



**Forklift**



**Data Center**



**Telecom**

## **Application**

### **Standalone Application**

With a built-in BMS, it can be used for standalone operation.



**Capacity: 48V/ 50Ah**

### **Flexible Capacity Expansion**

Parallel expansion by Master-Slave structure up to 255 modules without additional BMS



**Max Capacity: 48V/ 50Ah \* 255 (max.)**



# Delta Lithium-ion Battery Module

**DBSHV50S**

*High Voltage design applied for high power application*

## Special Features

### High Safety

- Certification: UN38.3, UL1973
- Built-in CMU (Cell management unit) to monitor individual cell voltage, temperature and manage cell balance.
- Built-in isolated CAN Bus among CMUs & BMU for high voltage battery string operation

### Easy installation and Service

- Plug-in power bus connection
- High voltage protection during installation and service
- Isolated CAN Bus cable (loop connection or daisy chain) for high voltage battery string.

### Flexible Capacity Expansion

- Series Expansion up to ~900VDC
- Parallel expansion up to MWh capacity

### Excellent Manageability

- A Delta design BMU (Battery Management Unit) is provided to manage and protect individual cell of each module
- Multi-units or multi-sites management is feasible with BMU plus extra master-slave control



|                       |   |
|-----------------------|---|
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| Weight                | ~26Kg   |
| Certifications        | UL1973, UN 38.3   |
| Cycle life @ 25° C    | 10% - 90% SOC*1≥4,000 cycles                            |
| Operating Temperature | Charge: 0° C to +45 ° C<br>Discharge: -20° C to +45 ° C |
| Interface             | CAN 2.0B (500kHz)                                       |
| Discharge Rate        | Max. 4C (200A)  |

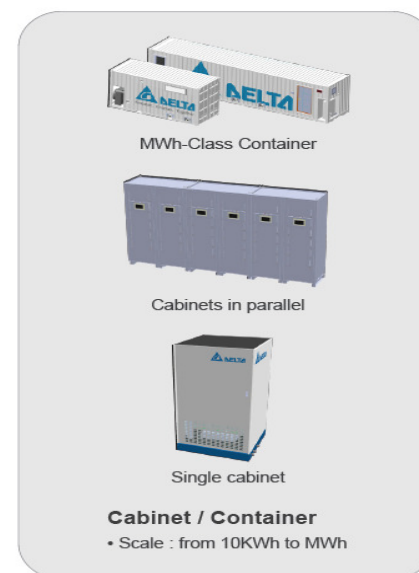


## Applications

- Residential & Commercial energy Storage
- Utility level energy storage and ancillary services



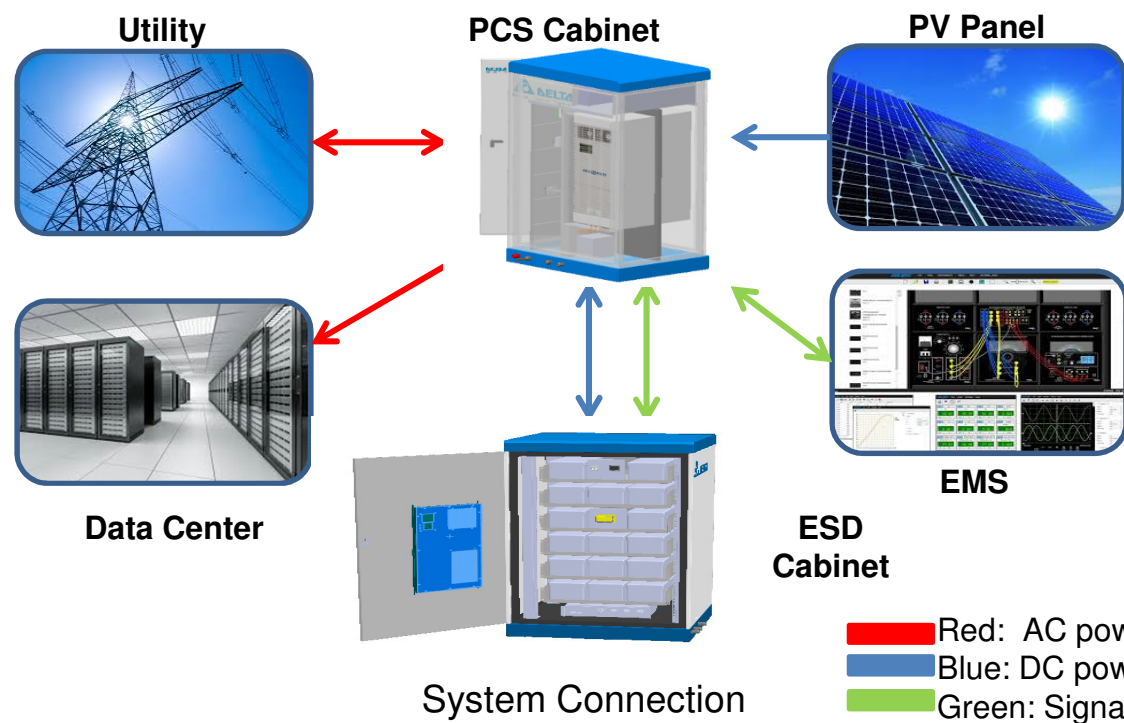
## Application





## Commercial ESS Features

30KW-100KW PCS w/ ESD 33/41KWh in one cabinet



### ■ Function

- Peak shaving
- Smooth intermittent renewable generation
- Power quality control

### ■ Applications

- Industrial
- Commercial




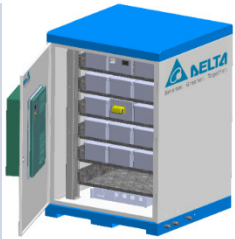
### ■ Benefits

- Control utility energy cost
- Reduce dependency on grid
- Have a backup power during grid outages



## Commercial ESD Cabinet

### 30KW-125KW PCS

| Product    | 224S-Indoor  | 224S-Outdoor  | 182S-Indoor  | 182S-Outdoor   |
|------------|--|---|--|--|
| Capacity   | 41.4KWh  |   | 33.7KWh  |  |
| AC voltage | 480VAC   |   | 380VAC   |  |
| DC voltage | 829V   |   | 673V   |  |
| Dimension  | Indoor : 900mm(D)x910mm(W)x1700mm(H)<br>Outdoor : 960mm(D)x970mm(W)x1800mm(H)      |   |  |  |
| Drawing    |  |  |  |  |

Remark: The dimension is shown for reference, it depends on actual design and installation

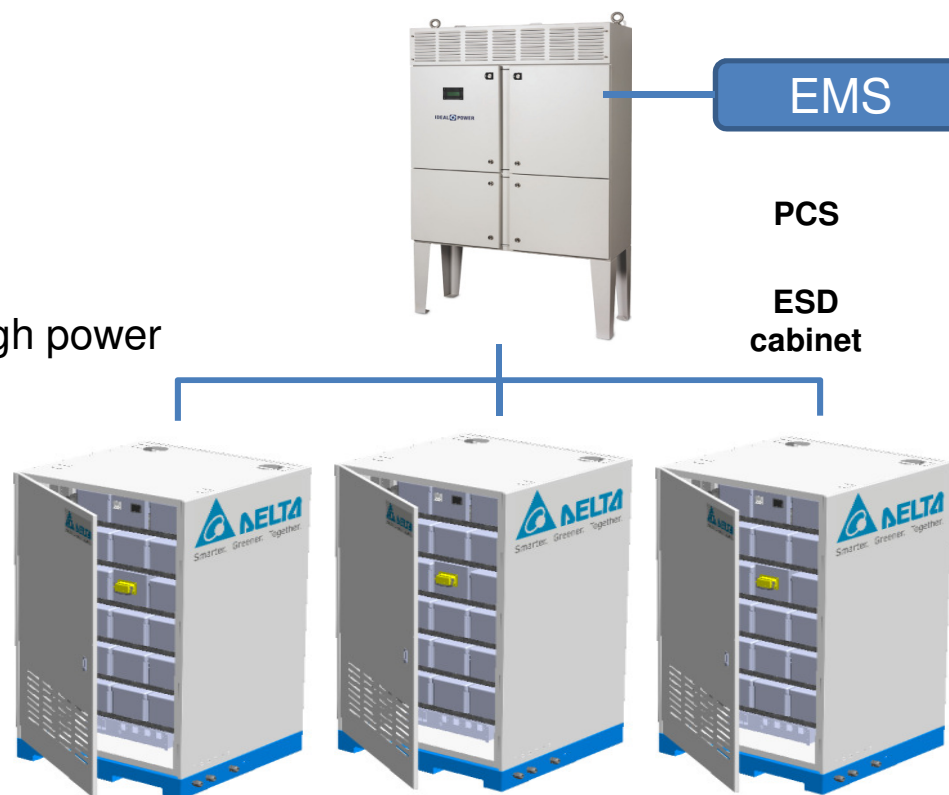


## Commercial ESD Cabinet Application

100KW / 120KWh

Application example :

- PCS (power conditioning system)
- ESD
  - DBHSV50S module in series for high power
  - 41.4KWh / Cabinet
  - 3 cabinets in parallel operation



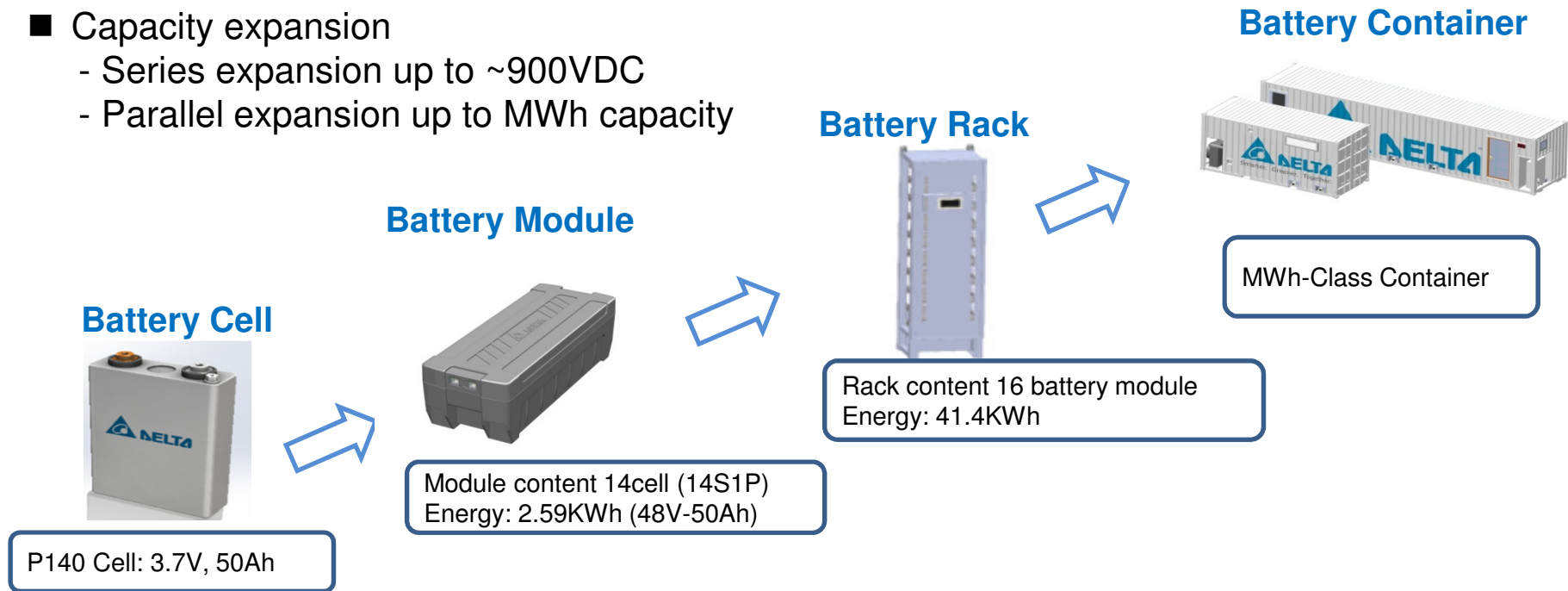




# Energy Storage Container

## MWh Application

- With Delta PCS to provide complete solution for customer
- Capacity expansion
  - Series expansion up to ~900VDC
  - Parallel expansion up to MWh capacity



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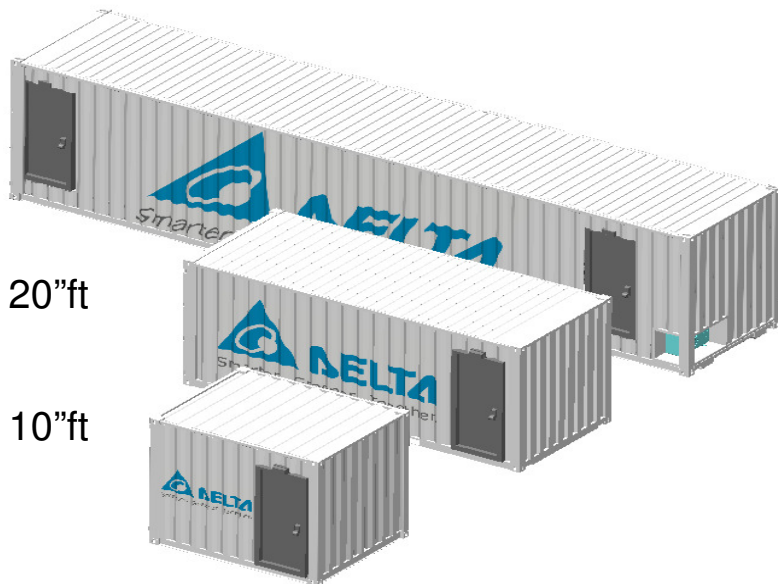
## Energy Storage Container

Space & Capacity expansions

40''ft

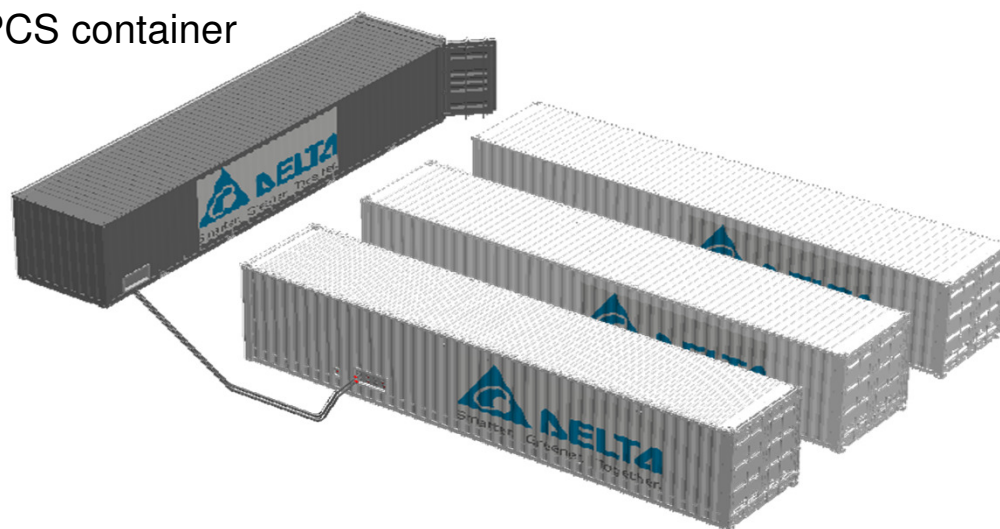
20''ft

10''ft



Space  
Expansion

PCS container



Containers

Capacity  
Expansion

# Smarter. Greener. Together.

To learn more about Delta,  
please visit [www.deltaww.com](http://www.deltaww.com)

