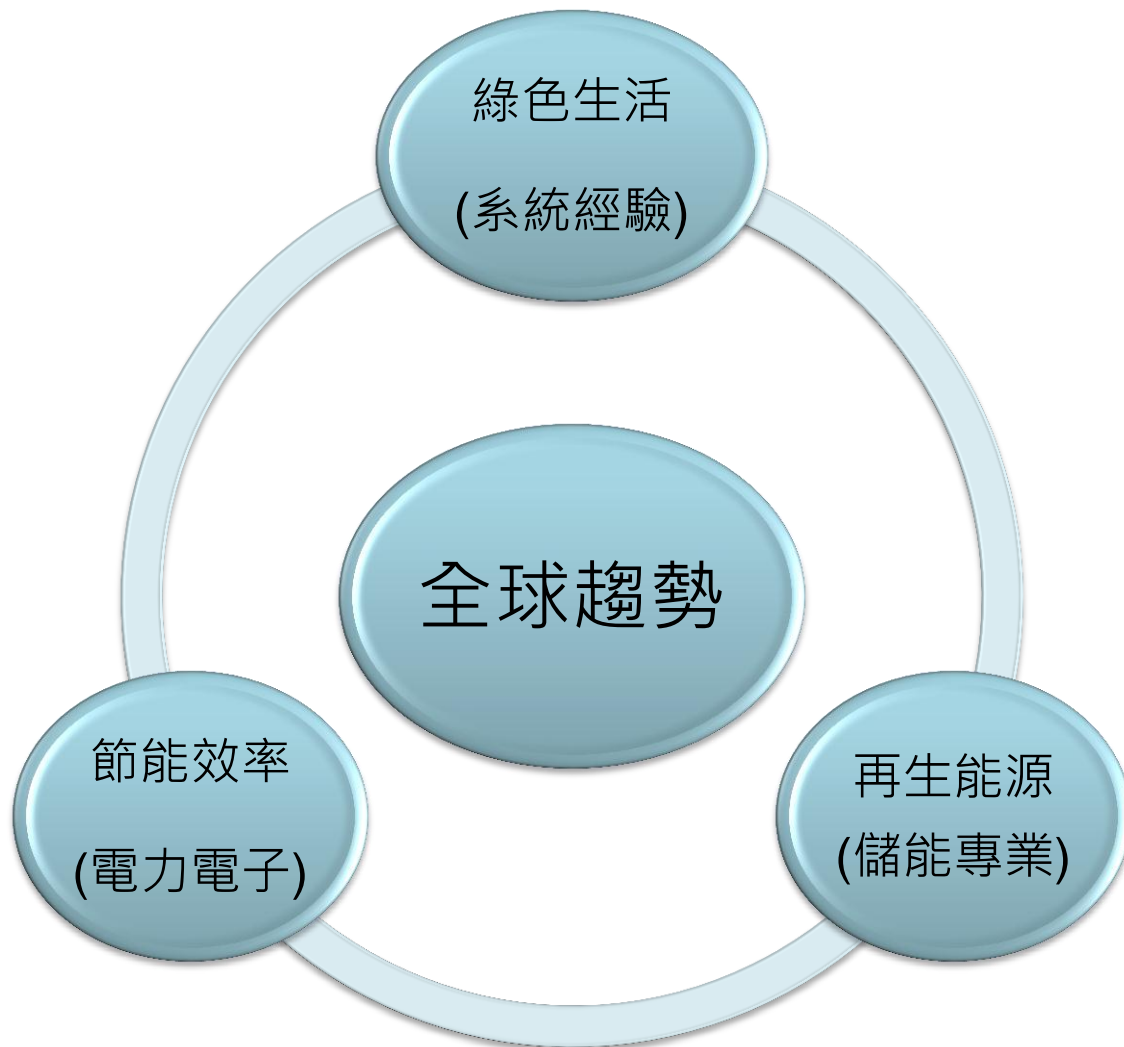


# BMS市場分析與趨勢

創揚科技股份有限公司

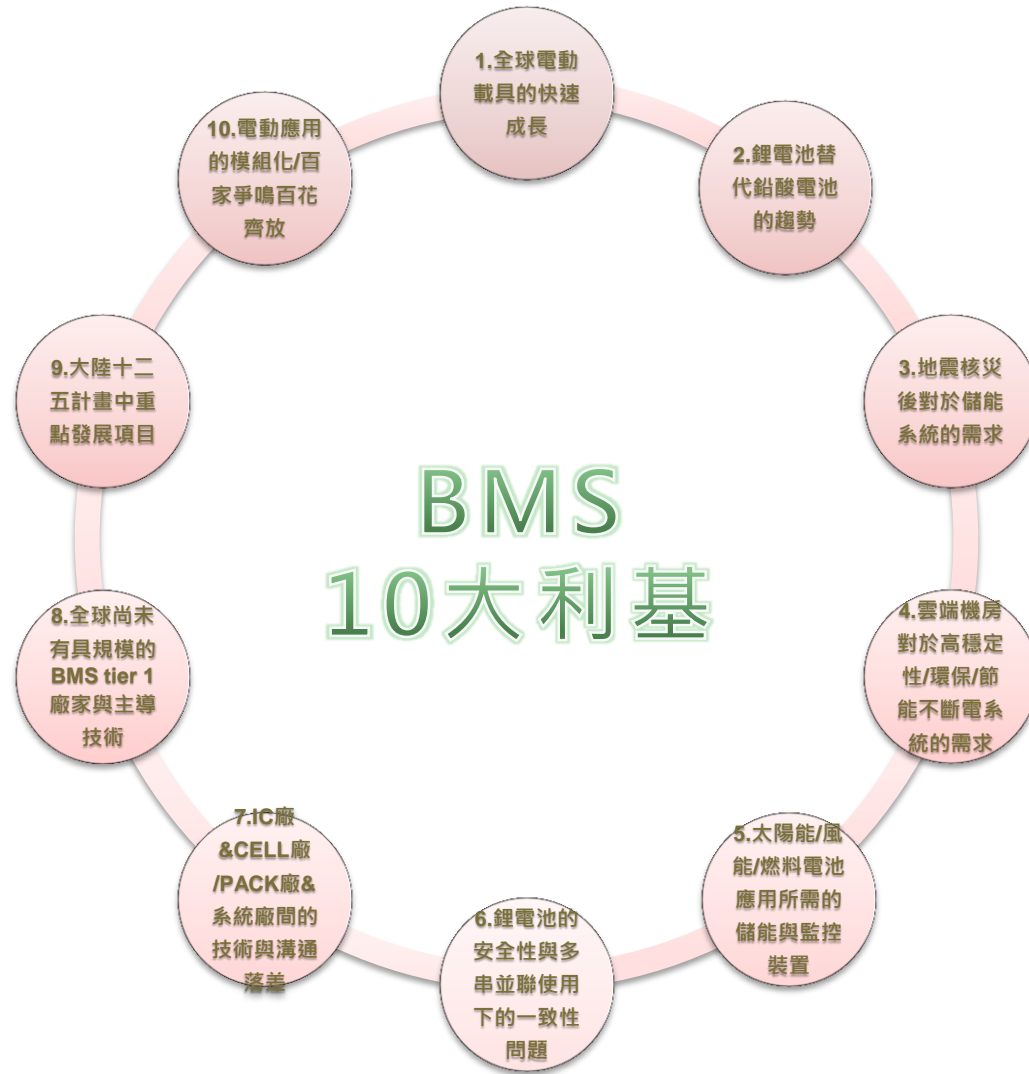
李泰安 Angus Lee



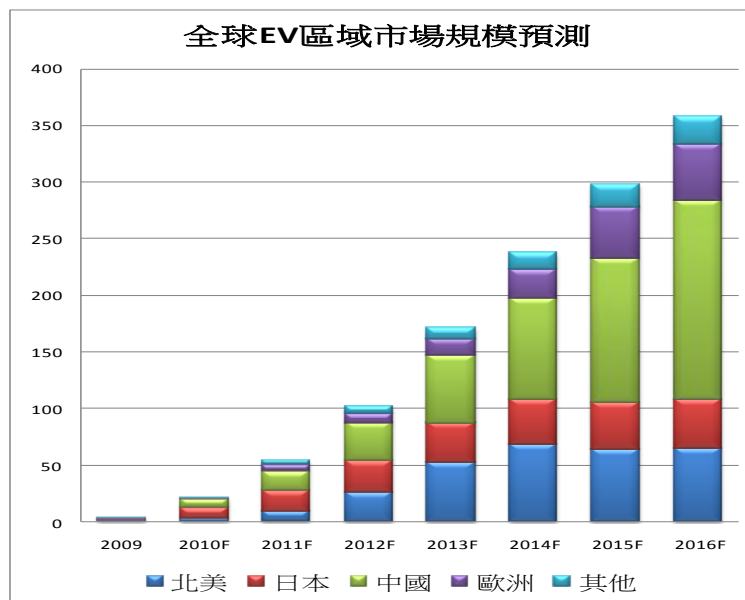
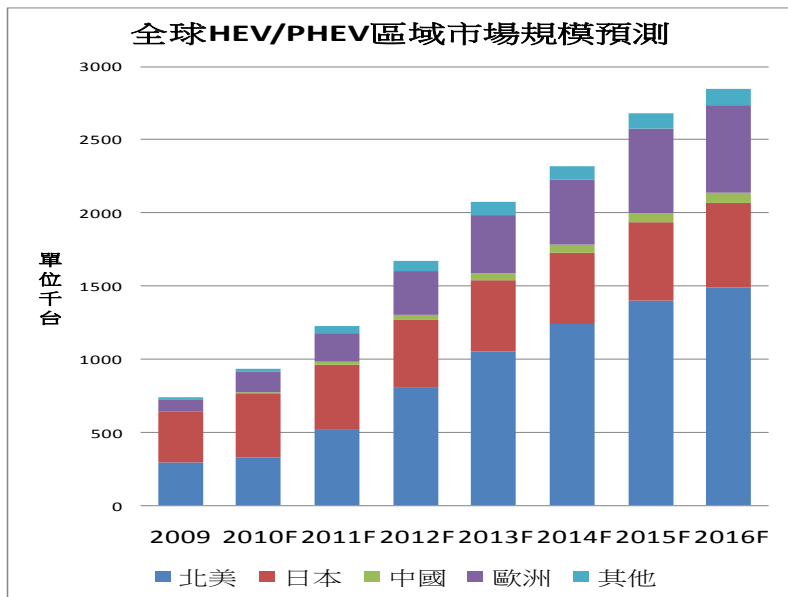
公司名稱：創揚科技股份有限公司

Digi-Triumph Technology Inc.

- 核心技術與業務主軸：
- 創揚科技專精於以化學能作為電力儲能之媒介之研發，此外於直交流電轉換之能量儲存、轉化、高效率應用之解決方案與電源管理系統等相關技術亦有技術優勢。因此，創揚科技目前的業務主軸分為四大類：
- (1)客製化電池模組方案ODM/OEM業務。
- (2)新能源之儲能管理控制系統。
- (3)移動式電源方案。
- (4)以自有品牌Just POWER進行電池應用相關產品銷售。
  
- 產品涵蓋：
- **A>客製化移動儲能方案**--手機/GPS/NB/Smartphone/Netbook/IPC/軍工規應用之鋰離子電池組/充電器生產製造及ODM/OEM業務
- **B>新興能源之儲能管理系統**---太陽能/風力發電儲能系統生產製造
- **C>移動式儲能與行動電源產品與方案**
- **D>UPS不斷電電源供應系統/ E-Bike/電動摩托車電池模組**生產製造及銷售
- **E>自有品牌Just POWER**電子式保暖器/電子發熱控制元件/消費性產品鎳氫電池/電池組/充電器消費性產品生產製造

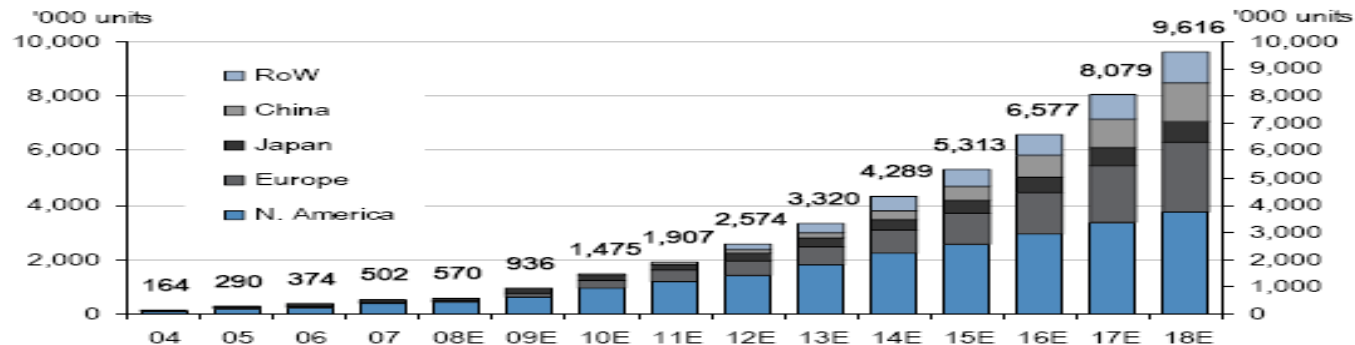


# 市場機會：1. 電動載具快速成長(HEV)

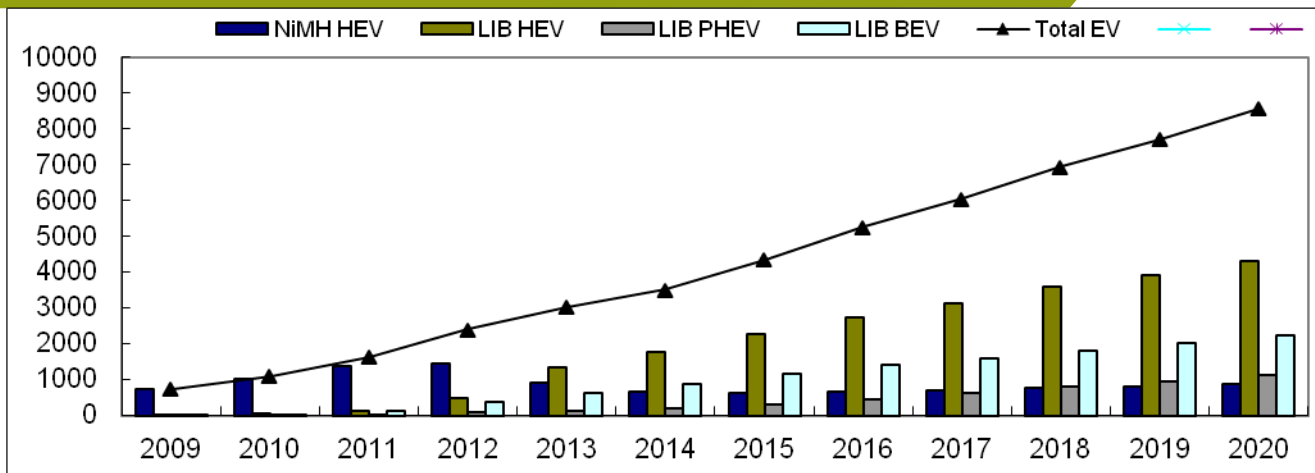


## Demand Analysis

Figure 13: Projection of HEV market demand by region



Source: Marklines, J.P. Morgan estimates.



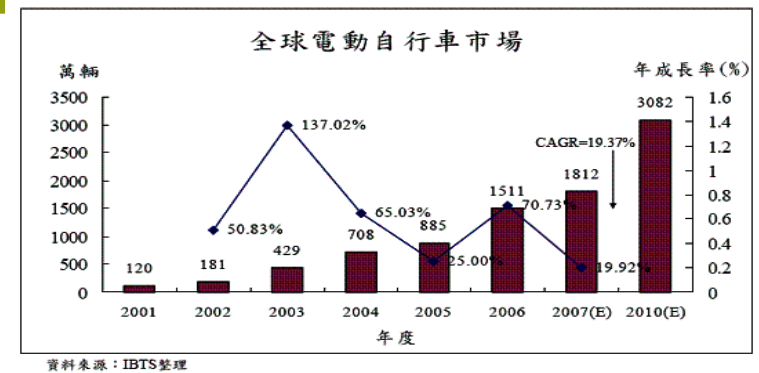
•左列IIT數據不含中國大陸市場。

•中國大陸2020年市場量，依其政策目標概估BEV與PHEV約150萬輛HEV為750萬輛。

單位：千輛	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>NiMH HEV</b>	722	1,026	1,376	1,449	916	666	616	660	716	766	816	866
<b>LIB HEV</b>	8.4	42	129	473	1,346	1,776	2,279	2,744	3,139	3,584	3,919	4,319
<b>LIB PHEV</b>	0.7	5	19	95	126	190	300	460	615	795	965	1,136
<b>LIB BEV</b>	2	16	120	391	635	877	1,147	1,402	1,587	1,802	2,012	2,252
<b>Total EV</b>	733	1,089	1,644	2,408	3,023	3,509	4,342	5,266	6,057	6,947	7,712	8,572

# 切入市場機會：1. 電動載具快速成長(E-Bike & others)

- 1. 自行車在2009年的國際金融風暴中還能逆勢成長
- ，歐洲更在短短一年間便有150%的成長
- 2. 歐美日本等先進國家或是金磚四國新興地區
- 政府也大力支持電動自行車相關產業
- 3. 環保意識高漲、健康概念、政府政策鼓勵以及高油價
- 的多重影響，所有產業中唯獨電動，紛紛以補貼、減稅等方式鼓勵民眾消費電動自行車。
- 以2011年而言，全世界約產出2000萬台電動自行車，目前以鋰電池驅動的約占10%，使用鋰電池驅動是未來主流
- 4. 二戰後嬰兒潮所造就的已開發國家人口老化趨勢，未來需要更省力、並維持身體健康、環境友善的通勤工具，因此老人代步車/電動輪椅產業蓬勃發展
- 5. 中國大陸禁摩令與各國對於機車排氣要求的越趨嚴厲，加上國際對於電動機車的安全法規陸續公布，使機車電動化加速進行，從2010年起預估電動機車年成長率達250%



## 市場機會：2. 鋰電池替代鉛酸電池的趨勢

Items	LiFePO <sub>4</sub> Battery	Lead-Acid Battery
Effective Capacity (%)	95%	60%
Life cycle @ 100% DOD	1000~1500	200~300
Life cycle @ 50% DOD	~2600 (7.1 years)	~500 (1.7 years)
50% Self-Discharge(During storage)	30~36 months	5~6 months
Price level	3~4	1.0
Install direction (refer to next page)	Any direction	Only Terminal upside
Safety	No acid leak	Acid leak risk
Environment pollution	No pollution	Very serious
Memory effect	No memory	Yes
Operating temperature (°C)	-20~70	-25~55
Weight	1	Triple
Integrated management system	Can add on	Can not

- 由於鉛酸電池製造過程與使用的電解液具有高污染性，從2011年起中國這個最大的鉛酸電池製造與消費國大力取締鉛酸電池廠並輔導轉型生產鋰電池
- 從2010/Q2開始鉛酸電池價格不斷攀升，相對地鋰電池每安時每年降幅約20%



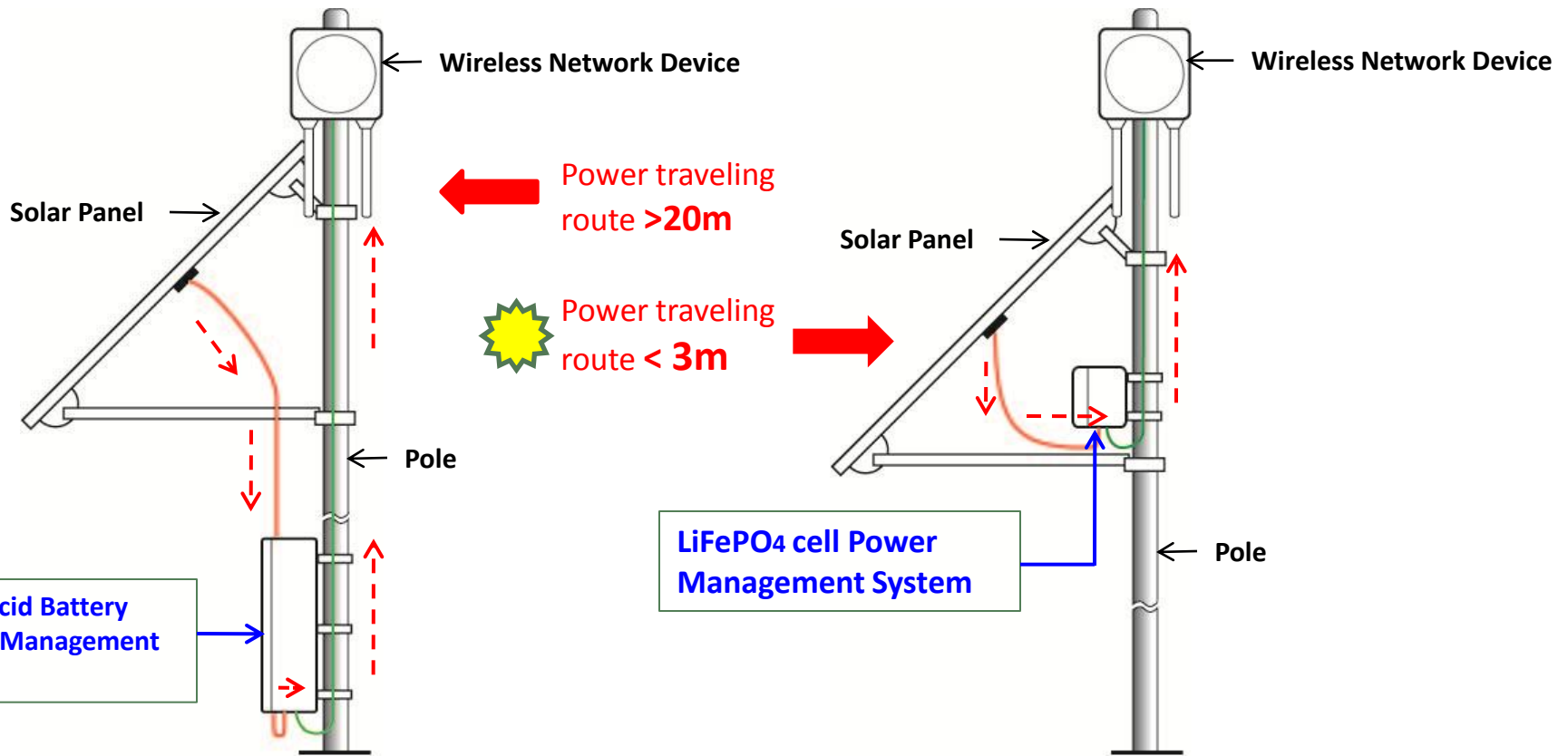
# (LiFePO<sub>4</sub> Battery vs. Lead-Acid Battery) 特性比較--以太陽能系統為例

## I. Current Solution (use lead-acid battery)

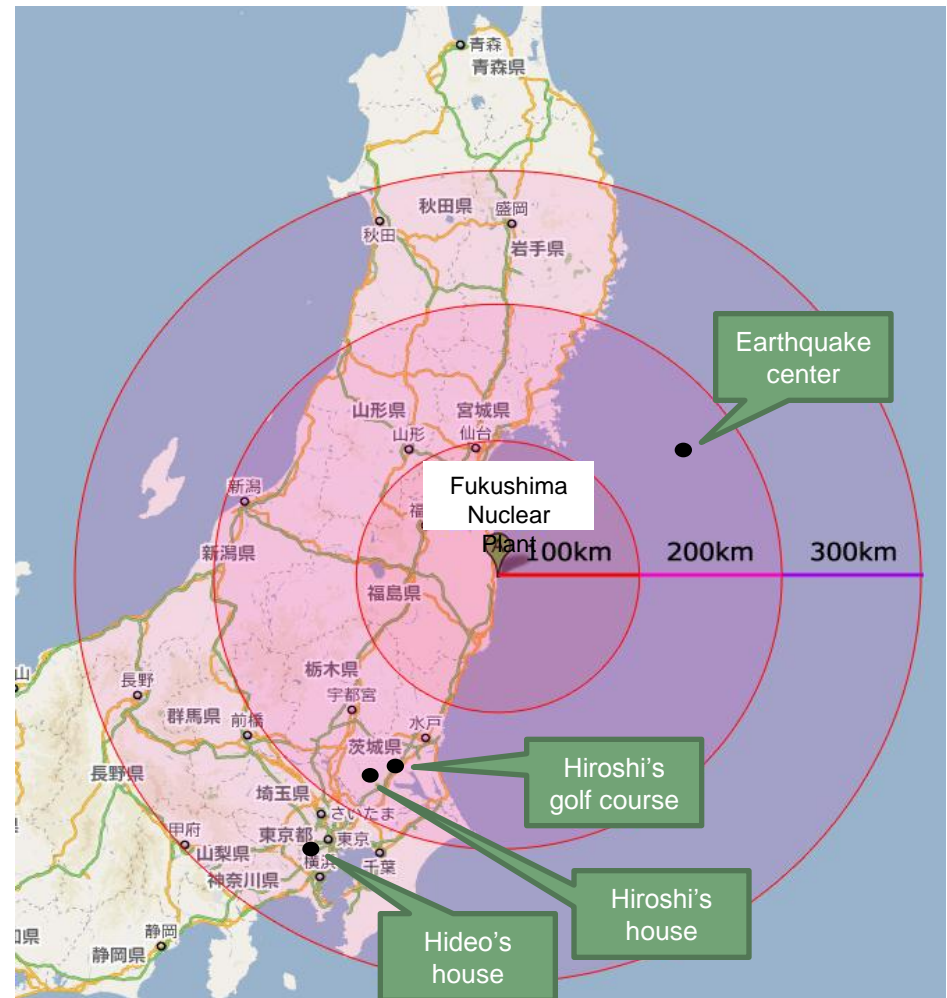
- ❑ Bulky and heavy - can only be placed near ground
- ❑ Tremendous energy loss - long traveling route from solar panel to device
- ❑ Maintenance & vandalism concern

## II. *INNOVATED* Solution (use LiFePO<sub>4</sub> cell)

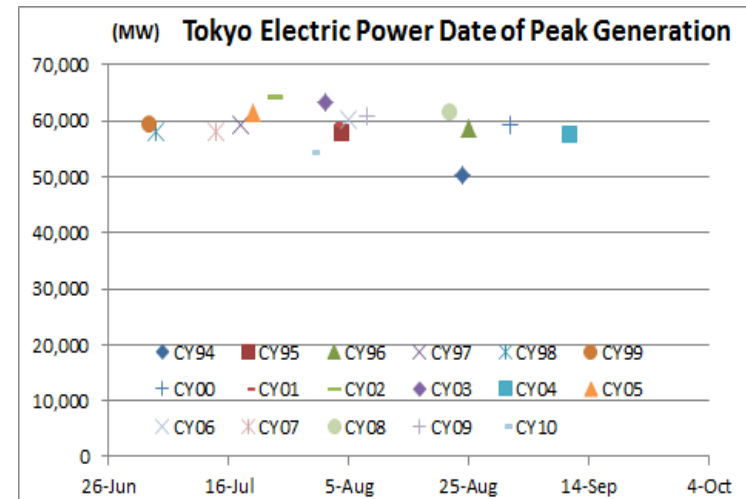
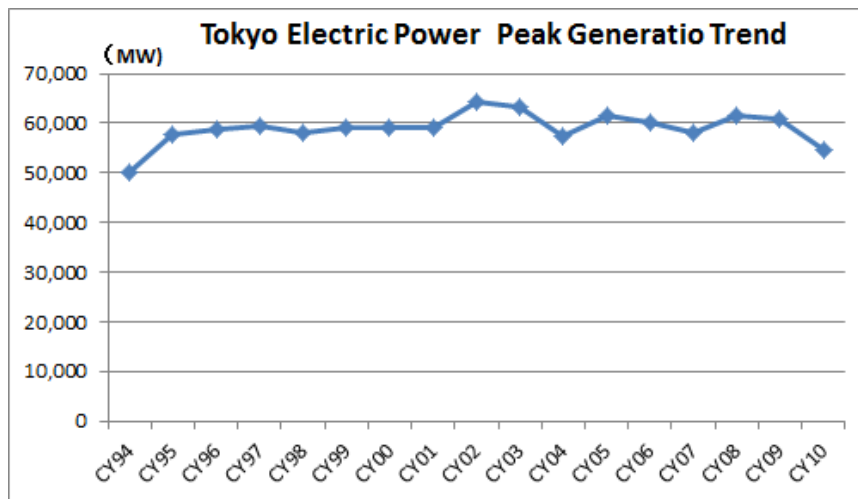
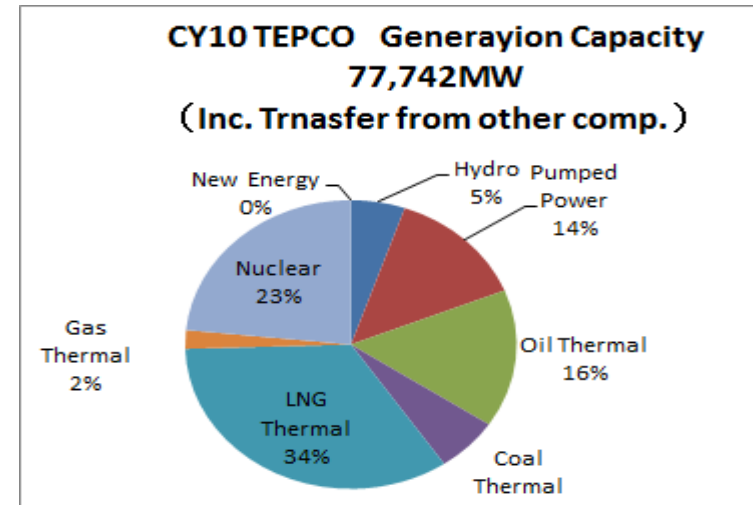
- ✓ Compact & lightweight – installed near device end
- ✓ Much less energy transferring loss – very short traveling route from solar to device
- ✓ Maintenance-free & safe from theft and vandals



- Power shortage !
  - Power saving is first priority  
LED sales good  
Electric fan/Radio/D-size dry cell
  - New energy Introduction  
PV/Wind worked in affected area
  - Any kind of power supply got attention  
Electric generator  
UPS (Data center)  
Cellular base station  
Home use ESS  
Fuel cell  
PV
  - Electricity prices increase?
  - All electric products need battery ?
- Radioactivity
  - Deceasing traveller and foreigner workers
  - Some factory is moving to west side
  - North side golf course is empty,,,



- Actually, Kanto area need more power!
  - July to August timeframe
  - 10-20% shortage
  - Government target: Save 15%  
(Exception : Hospital and Train )

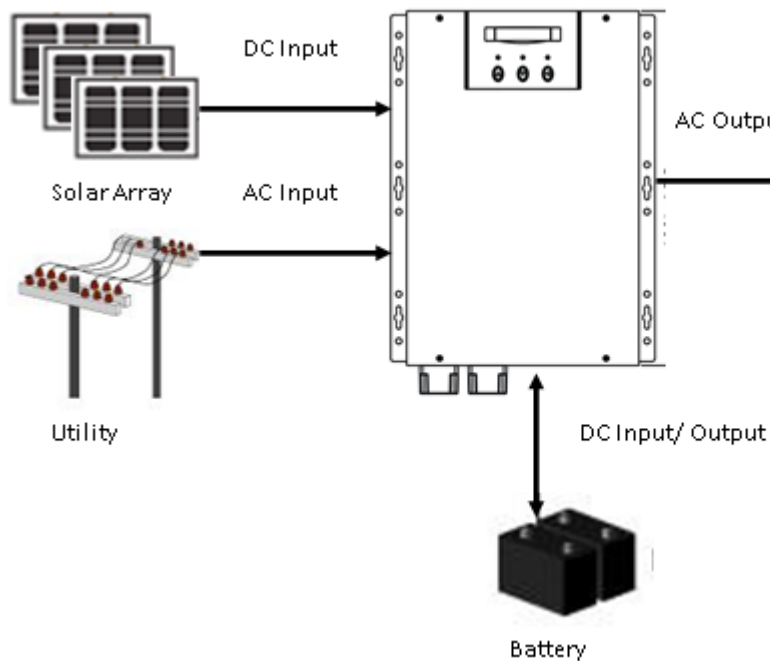


Company	Device	Capacity (kWh)	Ah	Voltage	Serial	Parallel	Cell	AC Output	Price (k JPY)	Unit Price (JPY/kWh)	Shipment Plan (Y)	Cell Demand (kWh)	Remarks
Edison Power	ESS (EP-1000)	1	40	25	7	1	Kokam Pouch 40Ah	Yes 2	800	800	1,000	1,000	AC100V Output x 2
Edison Power	ESS (EP-2500)	2.5	100	25	7	1	Kokam Pouch 100Ah	Yes 2	1,500	600	500	1,250	AC100V Output x 2
Edison Power	ESS (EP-5000)	5	200	25	7	1	Kokam Pouch 200Ah	Yes 2			100	500	AC100V Output x 2
ZMP	e-nuvo BMS-L/J	3.1	10	77.7	21	4	Japan	Option	2,360	761	100	310	RS232C/485/CAN Communication
ZMP	e-nuvo BMS-L/K	3.1	40	77.7	21	1	Korea (Kokam?)	Option	1,930	623	100	310	RS232C/485/CAN Communication
SANYO	ESS (Shop)	1.6	33.6	48.1	13	24	SANYO 18650	Option	950	588	10,000	16,162	EVB-101
SANYO	ESS (Home)	1.6	33.6	48.1	13	24	SANYO 18650	Yes	1,250	773			EVB-101
SANYO	ESS (Home)	3.2	67.2	48.1	13	24	SANYO 18650	Option	1,500	464			EVB-101
SANYO	ESS (evacuation center)	8.1	168.0	48.1	13	24	SANYO 18650	Option	Unknown	Unknown			EVB-101
SANYO	Emergency System	4.8	134.4	48.1	13	24	SANYO 18650	Yes	Unknown	Unknown	3	14	Emergency System (PV+LIB+LED) Tokushim 3sets
Panasonic	Solar Street Light	0.8	17.6	46.8	13	8	SANYO 18650	None	1,500	1,821	2	2	PV 10W
Panasonic	ESS (Home)	1.5	58	25.2	7	20	Panasonic 18650	None	Unknown	Unknown	500	731	Release June 2011
SONY	ESS	1.2	24	51.2	16	12	SONY 26650	None	200	163	30,000	36,864	LFP
Toshiba	TV Backup	0.1	6.6	14.8	4	3	Unknown 18650	Unknown	45	-	6,000	586	19inch TV
Toshiba	ESS	1.0	20	48	20	1	SCiB Prismatic 20Ah	Unknown	450	469	500	480	Release June 2011
Toshiba	ESS	2.9	60	48	20	3	SCiB Prismatic 20Ah	Unknown	600	208	200	576	Release June 2011
Toshiba	ESS	4.8	100	48	20	5	SCiB Prismatic 20Ah	Unknown	1,000	208	100	480	Release June 2011
GS Yuasa	ESS	2.6	100	25.9	7	10	GSY Prismatic 10Ah	Unknown	1,575	608	500	1,295	For office server and PC backup
GS Yuasa	ESS	2.6	100	25.9	7	10	GSY Prismatic 10Ah	Unknown	2,625	1,014	100	259	Signal backup
GS Yuasa	ESS	17.8	600	29.6	8	60	GSY Prismatic 10Ah	Unknown	5,775	325	100	1,776	Factory backup
Elly Power	ESS	2.2	50	44.8	14	1	Elly 50Ah	Yes 2	864	386	10,000	22,400	2Years Lease
NEC	ESS			48.1	13		NEC Energy	Yes					In-Hpuse
BYD	ESS(HES A1000)	2.4					BYD	Unknown	1,000	417			
BYD	ESS	19.2					BYD	Unknown					
BYD	ESS	500.0					BYD	Unknown					
MHI	Apartment	30.0					MHI 48Ah	None	10,000	333	9	90	Apartment power (Elevator)
MHI	Apartment	60.0					MHI 49Ah	None	20,000	333		180	Apartment power (Elevator)
MHI	Apartment	90.0					MHI 50Ah	None	30,000	333		270	Apartment power (Elevator)
Itochu	ESS	6.0					Ener1	Unknown	1,000	167	0	0	Home use
Smart Energy Group	ESS (CNO-b-4)	4.0					Unknown	YES	945	236	1,000	2,000	Assembled in China
Smart Energy Group	ESS (CNO-b-8)	8.0					Unknown	YES	1,890	236		4,000	Assembled in China
Daiwa House	PV Independent Power	2.2	50	44.8	14	1	Elly 50Ah	Yes 2	2,520	1,125	500	1,120	PV 520W 100sets Shipment in April
Shin-Kobe	ESS (Factory)	6,000	-	-	-	-	Lead Acid	Unknown	700,000	117	3	18,000	Factory backup 17users Life
MHI	ESS	40.0	200	199.8	54	4	MHI 50Ah	Unknown	Unknown	Unknown	5	200	Apartment power for shared place (Light)
Re+	PV Independent Power	0.2	18	12	1	1	Lead Acid	Yes 1	50	250	1,000	200	PV + ESS
Re+	ESS	0.2	18	12	1	1	Lead Acid	Yes 1	30	150		0	ESS Sales
Re+	PV Independent Power	0.5	40	12	1	4	Lead Acid	Yes 1	170	340		0	PV 55W
Studio del Solar	PV Independent Power	0.007	-	-	-	-	Lead Acid	Option	65	9,286	100	1	PV 30.5W
Studio del Solar	PV Independent Power	0.02	-	-	-	-	NiMH	Option	77	3,850	100	2	PV 30.5W
Lets Corporation	PV Independent Power	0.9	-	-	-	-	LIB	Yes 1	250	278	100	90	PV 52W
Yutaka Electric	UPS101OSP	1.0	-	-	-	-	Lead Acid	Yes 1	248	248			UPS + Backup
Nextenergy and Resource	PV Independent Power	0.125	-	-	-	-	Lead Acid	Yes	100	800	100	13	
Nextenergy and Resource	PV Independent Power	0.5	-	-	-	-	Lead Acid	Yes	350	700	100	50	
E Solution	Solar Power Track(2t)	50	1,000	48.0	-	-	Lead Acid	Yes 2	15,000	300	1	50	PV 3,000W

Total 111,260 kWh  
LIB 92,854 kWh  
Lead Acid 18,313 kWh

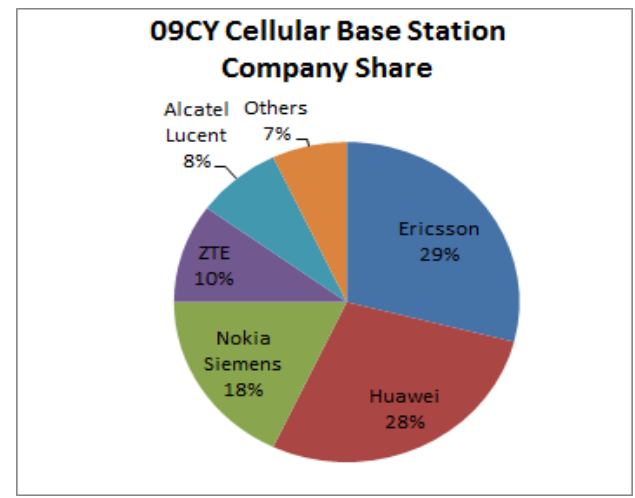
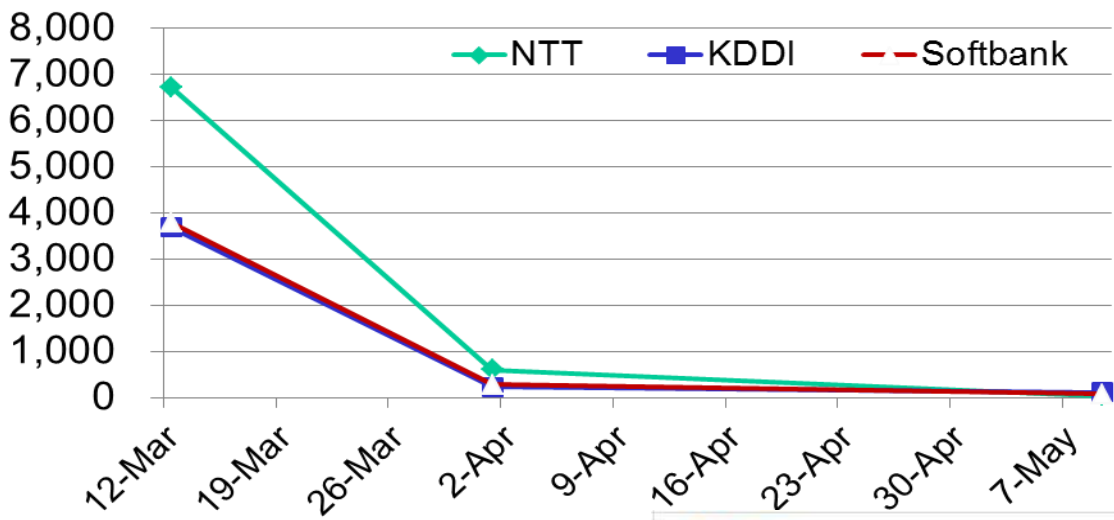
- ELLIY Power
  - Production 2.5k, Shipment <1.0K, Cell failure
  - Cell improvement and brand new ESS planning
- SANYO
  - DCB-101 improvement and target is small shop
  - 3.2kWh ESS, AC input/output for home use
- Toshiba
  - TV back up battery for blackout case (3hours)
  - Panasonic is following
  - SCiB ESS Development
- NEC
  - ESS development in company use



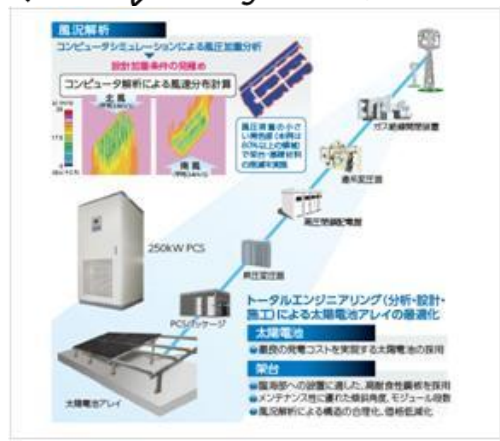


1. Solar & AC hybrid
2. Remote control & web base monitor
3. Support all kinds battery material
4. High charge current
5. 5 models

Energy shortage damaged Japan cellular base station & telecom company.



- Movement
- Low power supply → PV Installation
- Long time back up → Large capacity ESS (>3 hours LIB or Fuel cell)

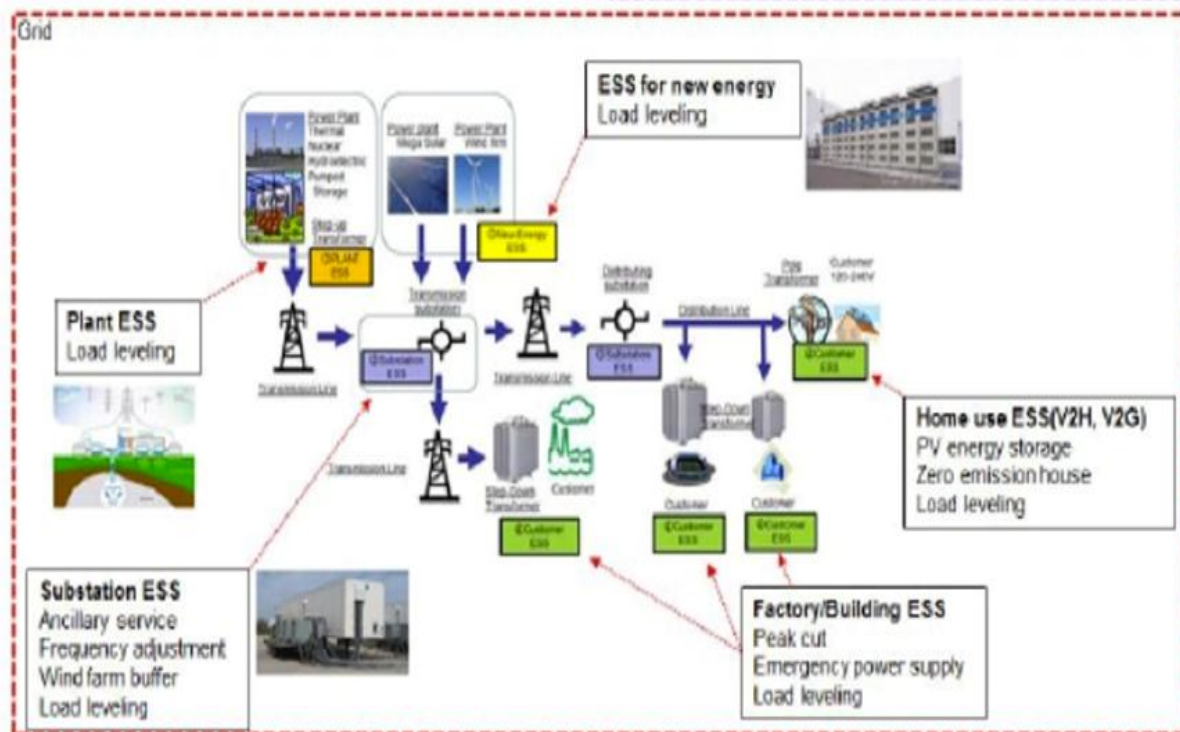


型式	LL1500-W
電池構造	制御弁式鉛蓄電池 (VRLA)
公称容量 (10 HR)	2 V-1,500 Ah
寸法	高さ 507 mm
	幅 172 mm
	長さ 437 mm
重量	110 kg
期待寿命*	使用期間: 17年 総放電量: 4,720 kWh
SOCの使用範囲	SOC30~90%
制御電圧	1.80~2.42 V/セル
均等条件	当社推奨条件
使用温度	5~35°C

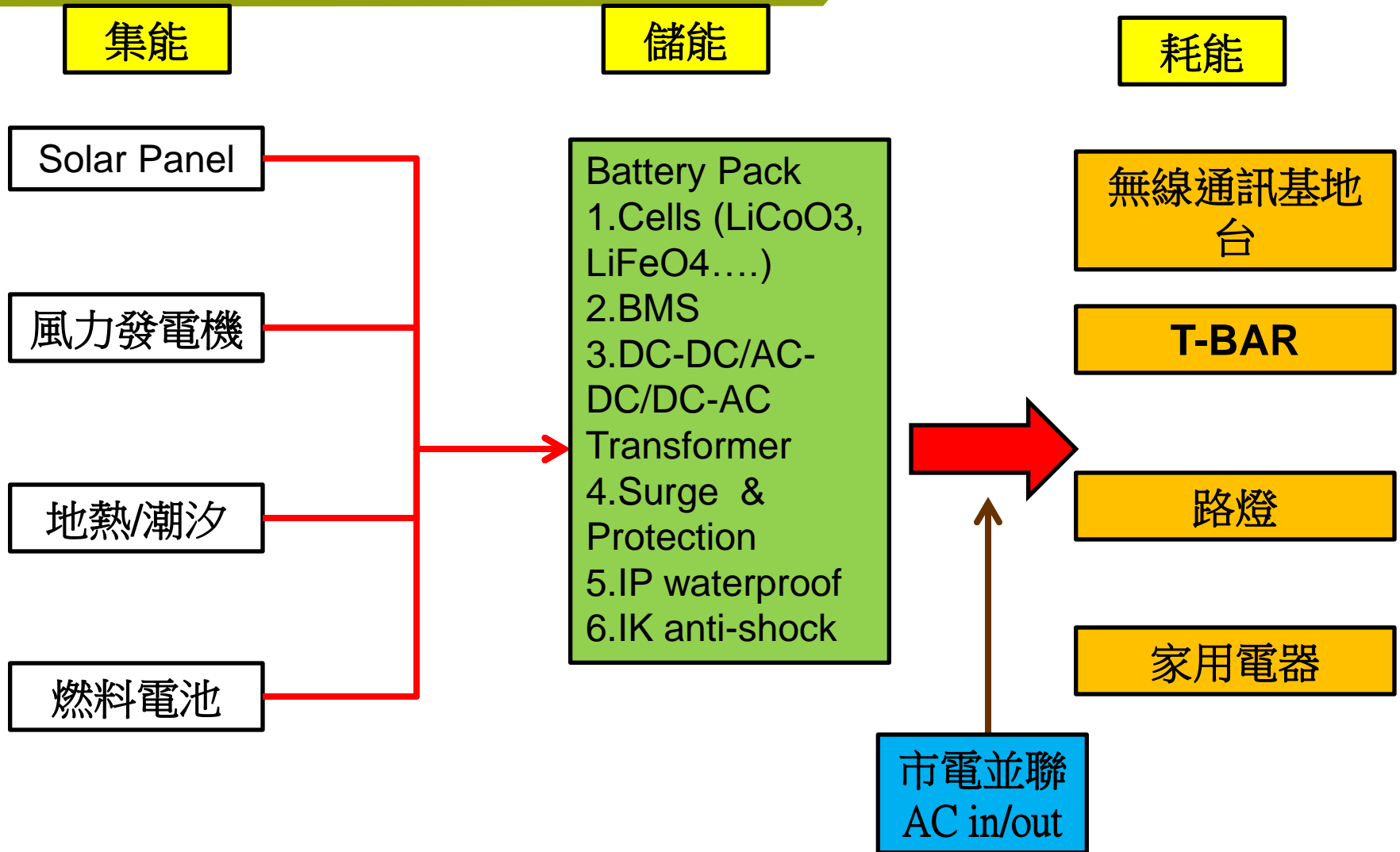


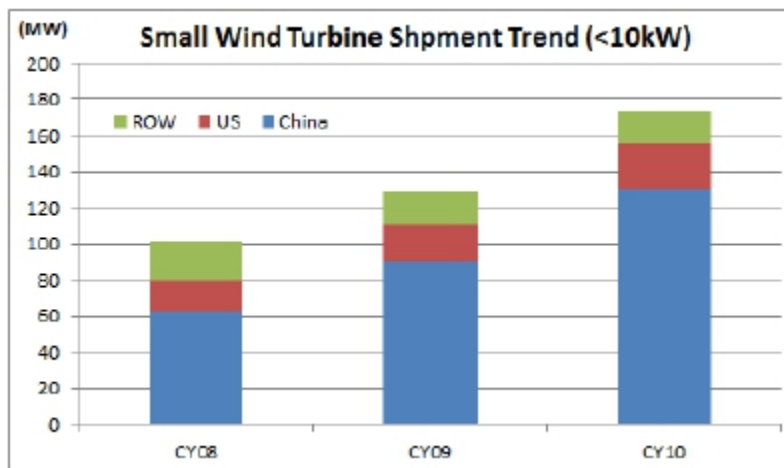
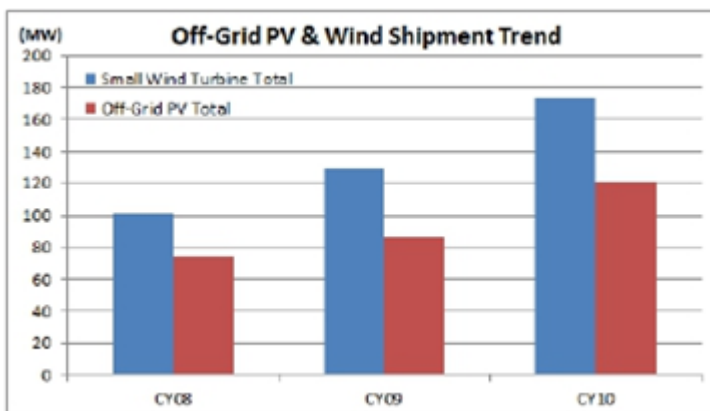
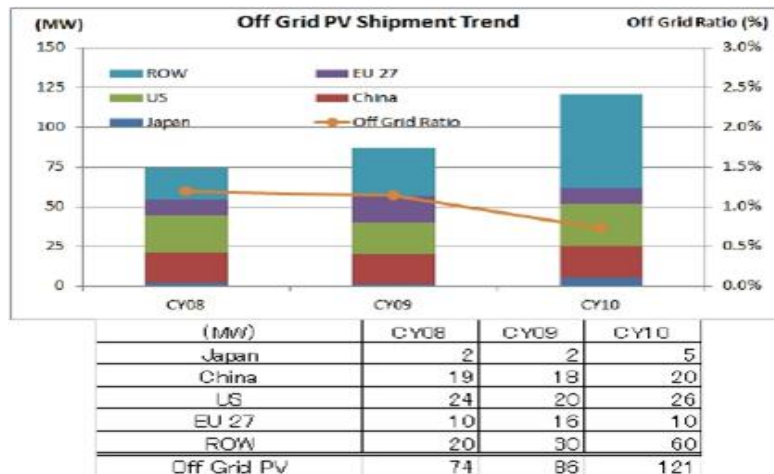
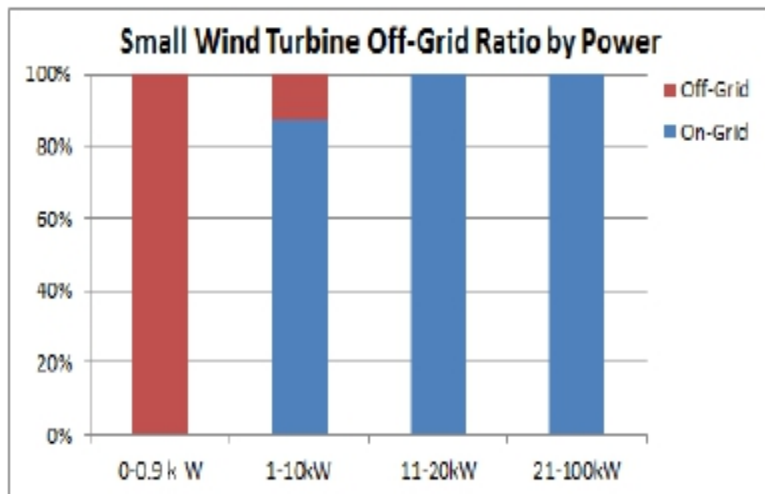
電池ユニットの外観 (LL1500-W 8 V-1,500 Ah)









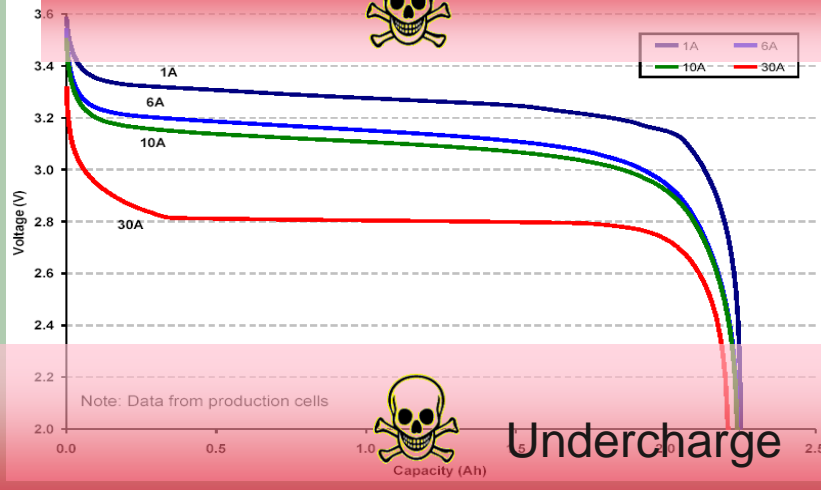


## 市場機會：6. 鋰電池的安全性與多串並使用下的一致性問題

應用	儲存電池能量大小	與NB用18650電池相比	BMS價格/佔BOM比
電動船E-Boat	 備150KWh以上電池	 等同 18650 x 18750	10000USD/10%
電動巴士E-bus	 備150KWh以上電池	 等同 18650 x 8250	6000USD/10%
純電動車	 備50KWh以上電池	 等同 18650 x 3125	5000USD/15%
油電混合動力車	 備10KWh以上電池	 等同 18650 x 125	300USD/2%
重型機車/高球車	 裝備5KWh以上電池	 等同 18650 x 725	200USD/10%
輕型電動機車	 備1KWh以上電池	 等同 18650 x 125	80USD/10%
電動自行車	裝備240Wh以上電池	 等同 18650 x 35	15USD/5%
筆記型電腦	 備66Wh電池	 等同 18650 x 6	6USD/2%
智慧型手機	 裝備6Wh電池	 等同 18650 x 0.8	3USD/2%

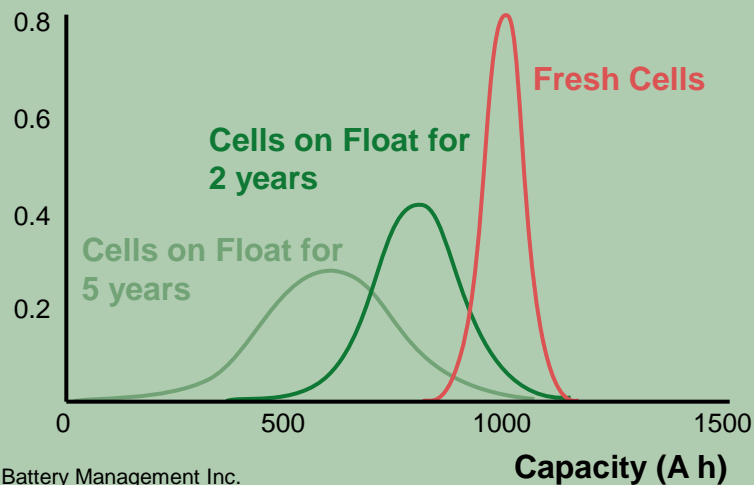


## Overcharge



## Undercharge

### Capacity Distribution Function



Source:  
ESTCO Battery Management Inc.

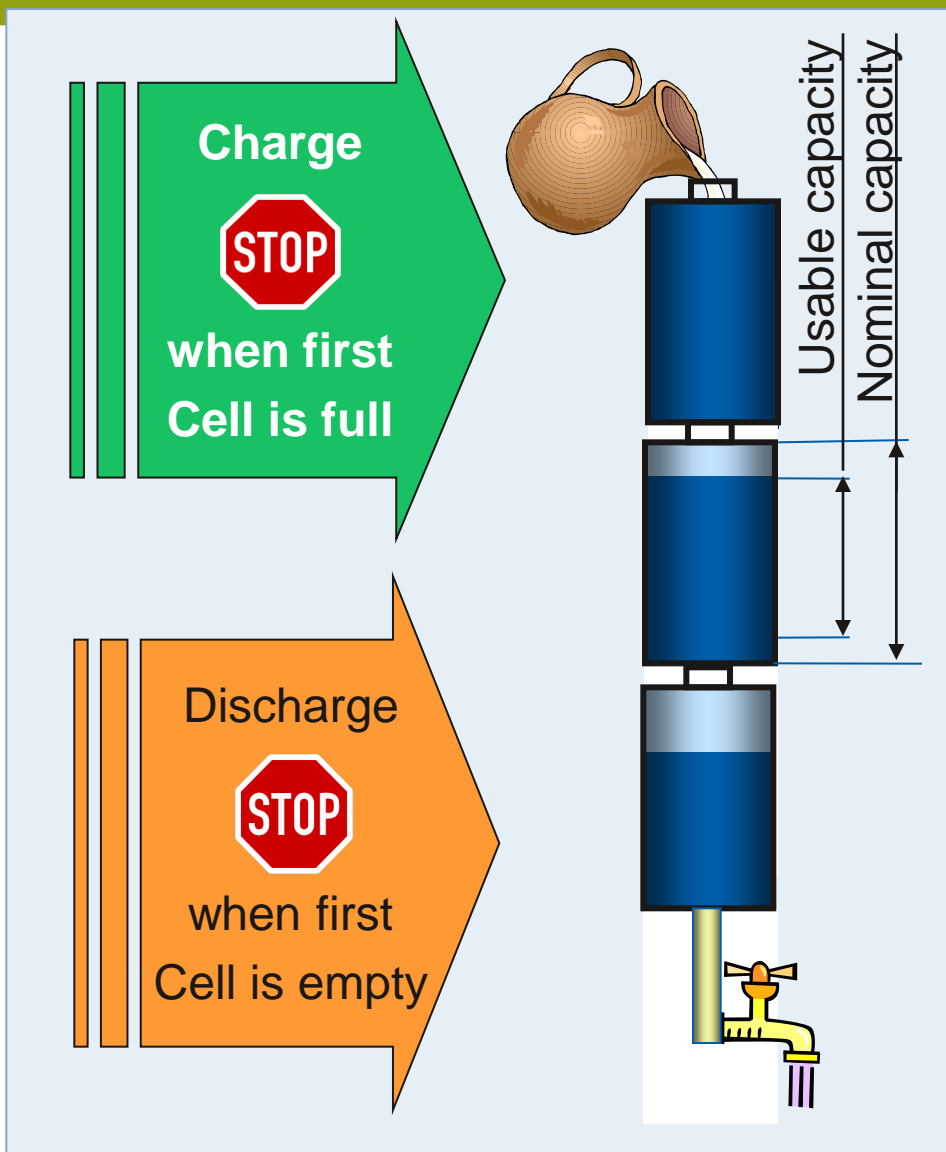
## Li-ion Battery

### • Characteristics

- One Li-ion battery cell has nom. Voltage between 3.2V and 3.8V
- Each cell voltage depends on the state of charge.
- Overcharge, Undercharge, Over  $T^\circ$  and Under  $T^\circ$  will damage the cell
- 10 to 12 cells in serial are assembled to build a battery pack
- For example 10 packs are in serial to build a 400V battery

### • Objectives

- Safety and extension of battery life time
- Balancing of cell charge and discharge
- Extension of driving range
- Compensation of manufacturing difference
- Compensation of aging difference
- Performance of active cooling (air or liquid)



## Li-ion Battery cell Balancing

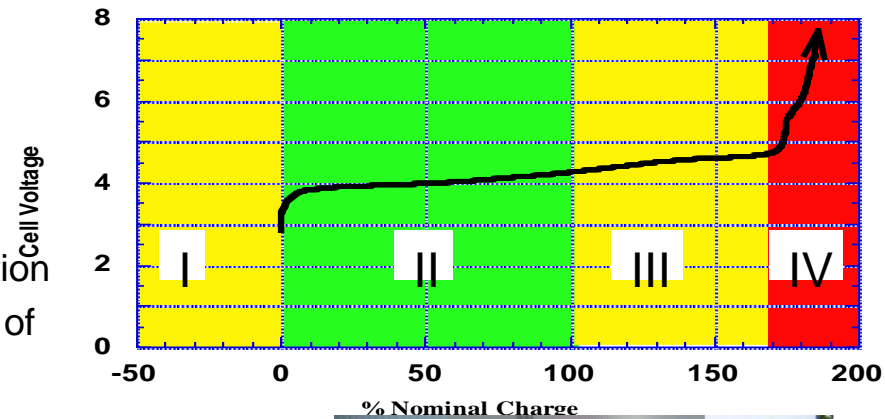
### • Solutions

- Passive balancing with resistance
  - waste of energy
  - limited balancing current
- Active balancing with capacitance
  - allows top and bottom balancing
  - medium current up to 1,5A
- Active balancing with transformer
  - allows top, bottom, pack balancing
  - high current up to 10A





- Region I: overdischarge
  - Benign failure
- Region II: normal operation
- Region III: cell degradation
  - Li plating begins
  - Electrolyte decomposition
  - Excessive de-lithiation of cathode

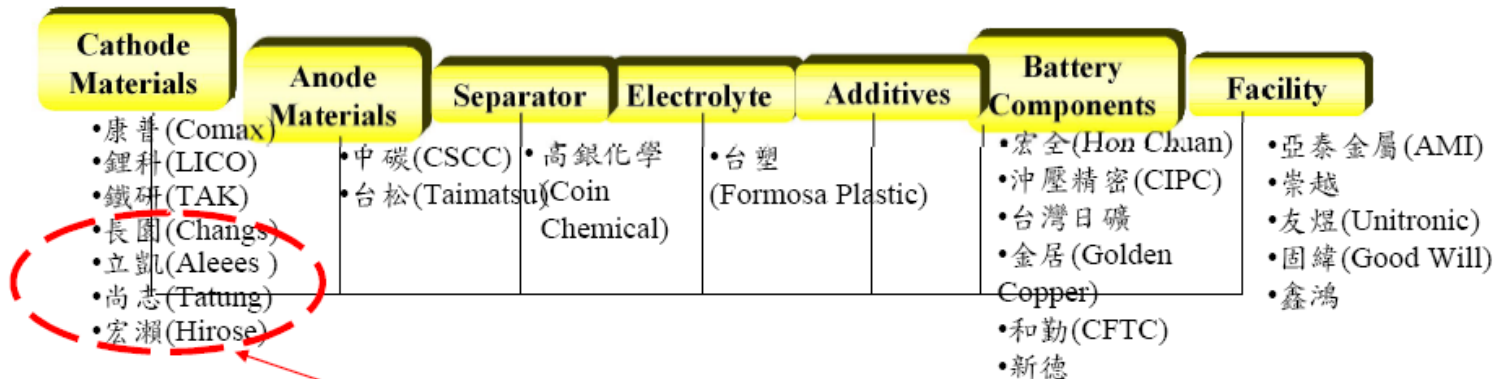


- **Region IV: risk of thermal runaway**

- Complete delithiation of cathode
- Impedance/voltage/heating increases

上游廠家以材料為主

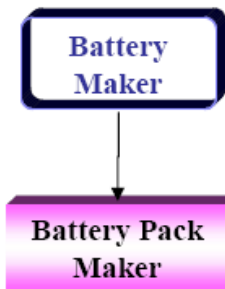
•Upstream Industry:



LiFePO<sub>4</sub>

•Midstream Industry:

Li-Ion/power Battery



- 能元科技 (E-ONE Moli)
- 有量 (Amita)
- 動能科技 (EXA Energy)
- 威力 (Power Source Energy)
- 台灣超能源 (Ultralife, Taiwan)

- 興能高科技 (SYnergy)
- 必翔電能 (Pihsiang)
- 昇陽 (PSI)
- 精極 (LION)

Making power Li-batteries for Milwaukee, BMW, AC Propulsion,, Ford, Fisker, etc.

World leading Power Wheel maker. Making power system for MICROCAR, LIGIRT, etc.

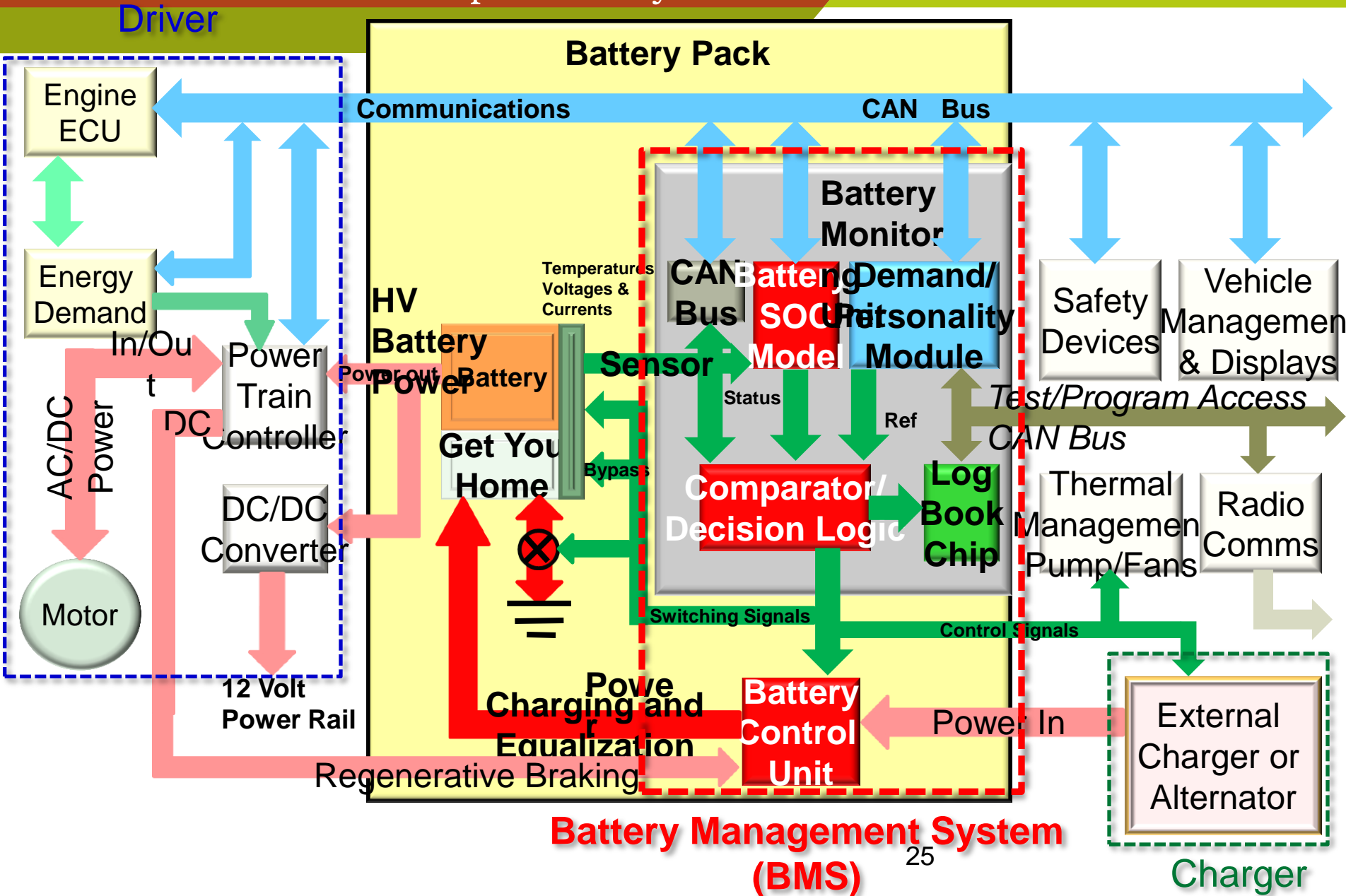
World #1 Battery pack maker

Provide battery pack to Stuttgart City for LEV city

中游組裝廠以組裝製程與機構設計為強項

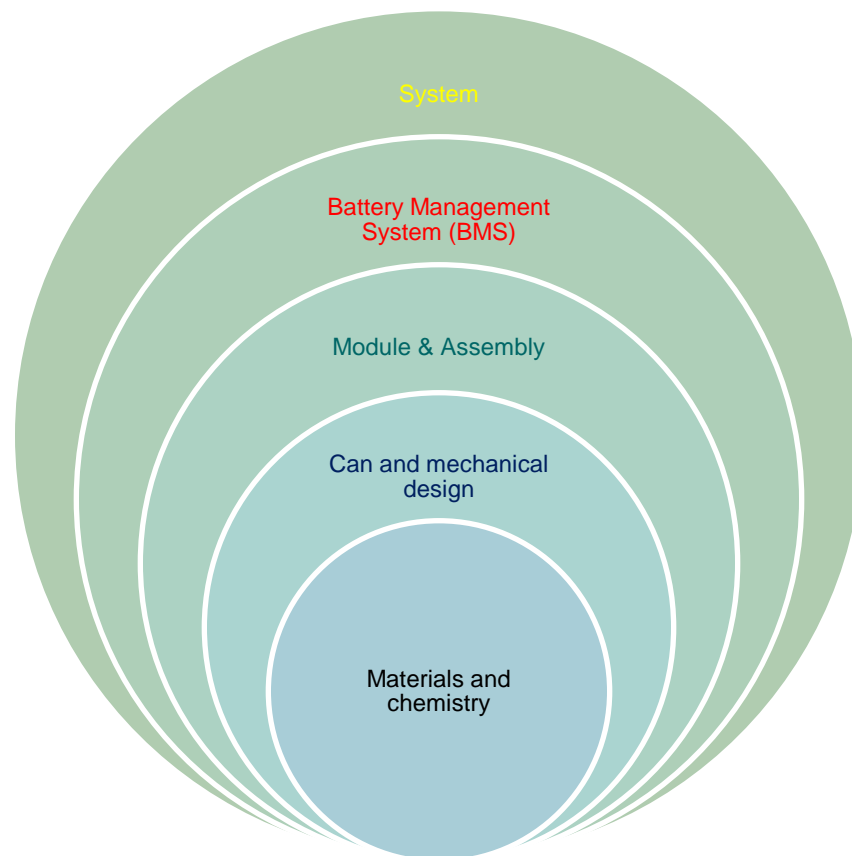


# Work Flow of pan-EV System



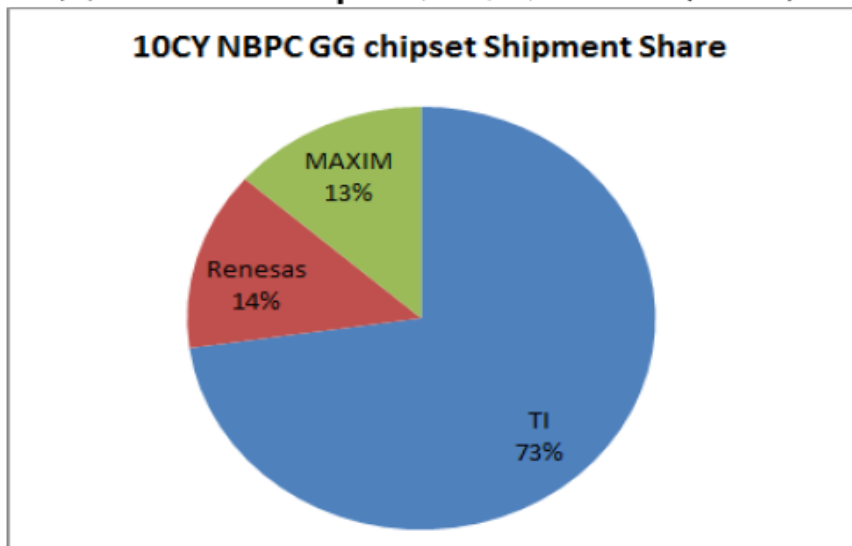
**Battery Management System (BMS)**

- 材料與化學體系 - 均一性高品質材料、適合的電池體系配方、穩定可靠的隔膜與添加劑、安全性高的電解液
- 電池芯罐體與機構設計 - 需要氣體壓力反應時間、物理性限流與保險線機制、高強度且具散熱性罐體、防爆線、鐳射密封

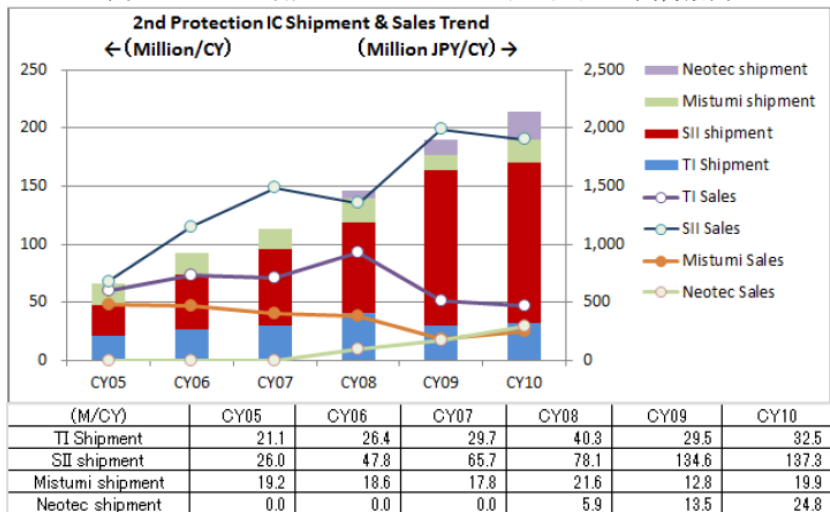


- 子模組與組裝 - 需考慮電芯特性、溫度與機構強度與耐溫耐震性等機械性表現
- 電池管理系統  
BMS - 控制、保護、管理、紀錄、計算、平衡與調教所有電池芯。溫度控制、可靠度與耐用性與安全性管理
- 整體應用系統

圖III-11 GG Chipsetサプライヤシェア(10CY)



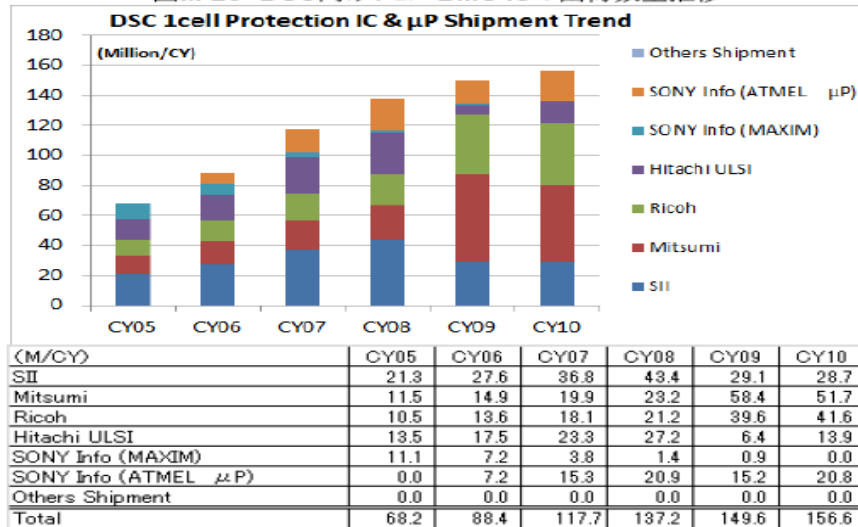
圖III-13 NBPC用2nd Protection ICサプライヤの出荷動向



圖III-34 各社のPT用パック BMS機能一覧

PT Maker	Pack/Cell				BMS						
					Protection (Charge/Discharge Control FET)		Monitor				Others
	Voltage (V)	Capacity (Ah)	Cell Number	Cell Supplier	Over Charge	Over Discharge	Voltage	Current	Temperature	Gas Gauge	Fuse
Bosch	28.0	3.3	8S1P	Panasonic	NO	NO	Yes (Protector)	NO	YES	NO	YES (SC Protector 15A)
	36.0	1.5	10S1P	SONY	NO	NO	Yes (Total Pack Volt.)	NO	YES	YES	YES (Current Fuse)
Makita	14.4	3	4S2P	SONY	NO	NO	Yes (Amp + ADC)	YES	YES	YES	YES (SC Protector 15A)
	18.0	3	5S2P	SDI	NO	NO	Yes (Amp + ADC)	YES	YES	YES	YES (SC Protector 15A)
Ryobi	14.4	1.5	4S1P	SONY	NO	NO	Yes (Total Pack Volt.)	NO	YES	NO	NO
Milwaukee	14.4	1.5	7S1P	Eone	YES	NO	Yes (Custom IC)	NO	YES	YES	NO
Hitachi	14.4	3	4S2P	SANYO	NO	NO	Yes (Protector)	NO	YES	NO	YES (PTC)
Panasonic	14.4	1.5	4S1P	SANYO	NO	NO	Yes (Protector)	NO	YES	NO	YES (SC Protector)

圖III-26 DSC向け1セルBMS ICの出荷数量推移



## 七大戰略性新興產業範疇

### 新能源

包含水電、核電、風力發電、太陽能發電、沼氣發電，以及地熱利用、煤的潔淨利用等。

### 新材料

微電子和光電子材料和器件、新型功能材料、高性能結構材料、納米技術和材料等領域的科技攻關。

### 新一代信息技術

重點突破下一代網路與通訊、物聯網、雲計算等關鍵技術

### 生物

多發性疾病和新發傳染病防治要求的創新藥物，醫療器械關鍵核心技、先進醫療設備製造、加強幹細胞研究等。

### 高端裝備製造

航空航天、海洋工程裝備和高端智慧裝備。

### 新能源汽車

整車及動力蓄電池、驅動電機等關鍵零組件技術。

### 節能環保

減碳、無碳、去碳三個層級核心技術研發和市場推廣應用IGCC(整體煤氣化聯合循環發電)、循環流化床、**智能電網**

## 政府積極投入 衍生龐大商機

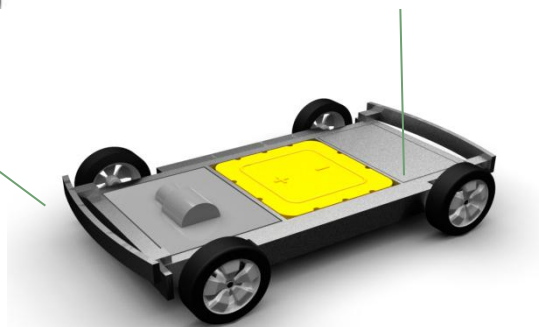
- 2009年中國財政部、國家發改委和7個省市共同創立了**20支**創投基金，多用於戰略性新興產業發展。
- 2010年中國宣布將在十年內投入**五兆**人民幣促進戰略性新興產業發展。
- 初期目標力爭**2015年**全國戰略性新興產業產值達**1兆**人民幣。

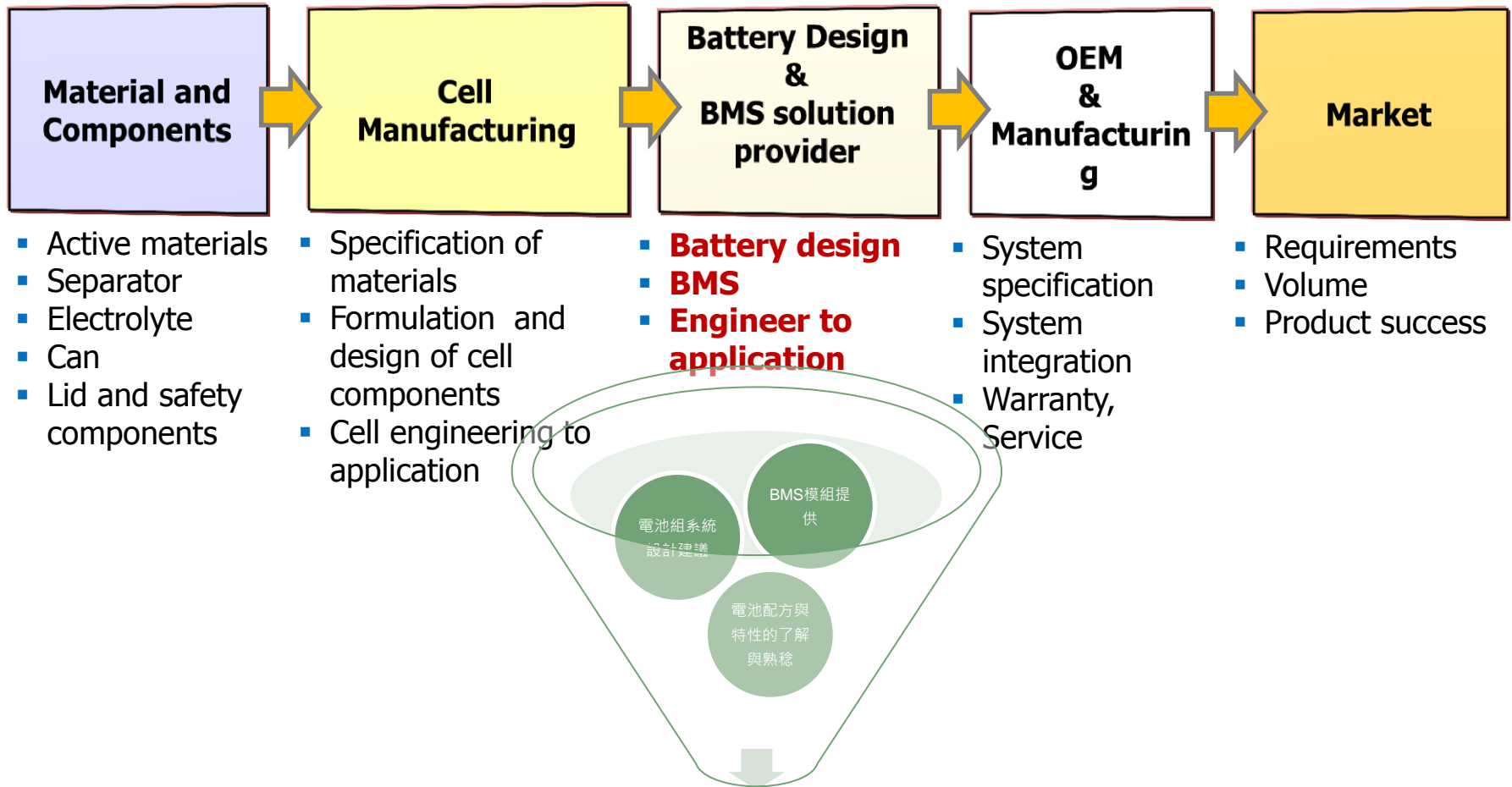
## 政府採購制度改革 培養早期市場

- 2007~2008年頒佈自主創新產品採購相關細則，明示政府採購應優先購買自主創新產品
- 自主創新產品必須擁有自主智財權與自主品牌，以《政府自主創新採購目錄》內容為限



美國Trexna公司剛剛在2011年4月宣佈一個獨特的EV共用平臺供DIY市場。使用共用EV底盤可以有幾個好處的客戶和製造商。客戶有更多的選擇自己想要的風格，而製造商將需要產生一個標準的平臺。這將大大降低開發成本，並有助於快速優化EV平臺。





創揚科技存在的價值





風電儲能系統



電動自行車 / 電動助行車



電動工具



電動輪椅



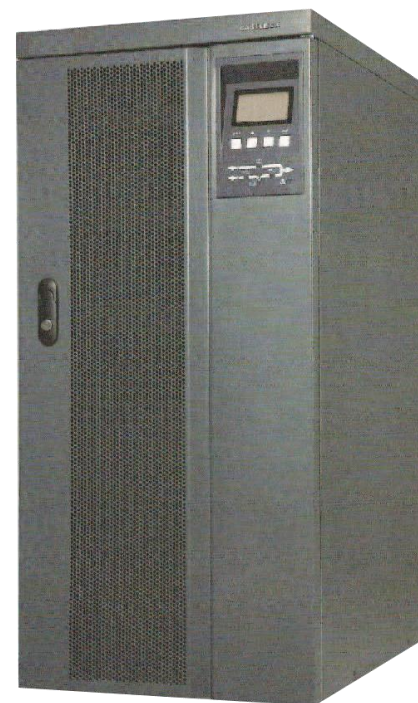
電動摩托車



汽車啟動電池



光伏路燈



不斷電備援系統  
(UPS)/ESS系統





電動巴士



電動船



電動汽車  
EV/HEV/PH  
EV/EVRe

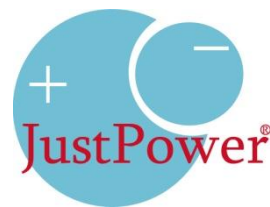


無人搬運車

- 1.支持4串到最多192串鋰離子電池模組系統
- 2.可應用於多種配方電池組(鉛酸、鎳鎘、鎳氫、鋰鈷、鋰錳、鋰鐵與三元或複合性材料離子電池)
- 3.電池保護功能(過充電、過放電、過溫度、過電流、短路)
- 4.即時電池狀態顯示與回報(SOC、SOH、SOE)並支持多種通訊協定(RS232、RS485、I2C、SMBus、Canbus、UART與RF無線傳輸)
- 5.提供高精度剩餘電量計算(gas guage)並支持LED/LCD顯示
- 6.溫度控制與友善的人機介面



- 7.主被動式電池平衡技術與模組平衡技術
- 8.支援系統開機與充電器狀態判斷、加解密與溝通功能，可提供電池交換站使用
- 9.自檢功能與錯誤警報功能，提供使用狀態記錄功能，可做為發生事故後之黑盒子
- 10.高抗干擾EMI/EMC設計，並可提供高電壓/電流與防水之特殊客制化產品設計
- 11.高精度前端AFE電壓電流偵測與低功耗元件設計
- 12.可程式化參數設定架構與後端DSP等級高速處理效能
- 13.模組間可堆疊成高電壓系統
- 14.遠端監事與遙控功能





Q & A

*Thank you for participation.*