

THE SILENT REVOLUTION

*Energy Storage as the Key Piece of
the Renewable Energy Puzzle*

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The Kettle



Agenda

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About Me



About BYD – Company Fact Sheet



BYD is the Global Specialist and Leader in Batteries

- ✓ Holds **20% of global market share** of lithium ion batteries (Source: marketresearch.com)
- ✓ Over **20 years' experience** in designing and manufacturing batteries



BYD is the Largest Manufacturer of Battery Electric Vehicles

- ✓ Holds **11% of global market share** of electric vehicles (Source: EV-Sales, 2015)
- ✓ **230% Year on Year Increase** in e-vehicles sold in 2015 (6,600 buses and 61,722 cars)



BYD is the Only Player with Complete Vertical Integration

- ✓ 180,000 employees
- ✓ Rated **8th world's most innovative** company (Bloomberg business & BCG 2010)
- ✓ Annual sales of **US \$12 billion** in 2015



About SRE – What We Do



BYD's responsibility is to produce the best batteries in the market.

- ✓ Top performance
- ✓ Top reliability
- ✓ Competitive price



SREnergy's responsibility is to ensure that UK consumers and businesses benefit from those batteries. We do this by offering:

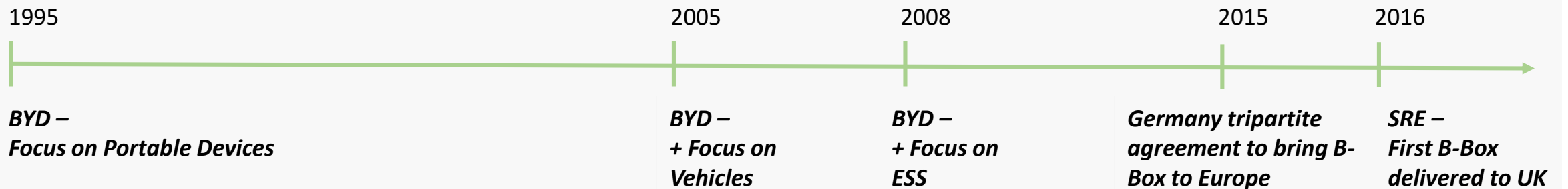
- ✓ Free aftersales service for the BYD B-Box or B-Plus
- ✓ Free pre-sales info service (www.sreenergy.co.uk)
- ✓ Management of 10 yr warranty commitment from BYD
- ✓ Free training to UK installers
- ✓ Marketing and PR for Europe

About SRE – How We Work

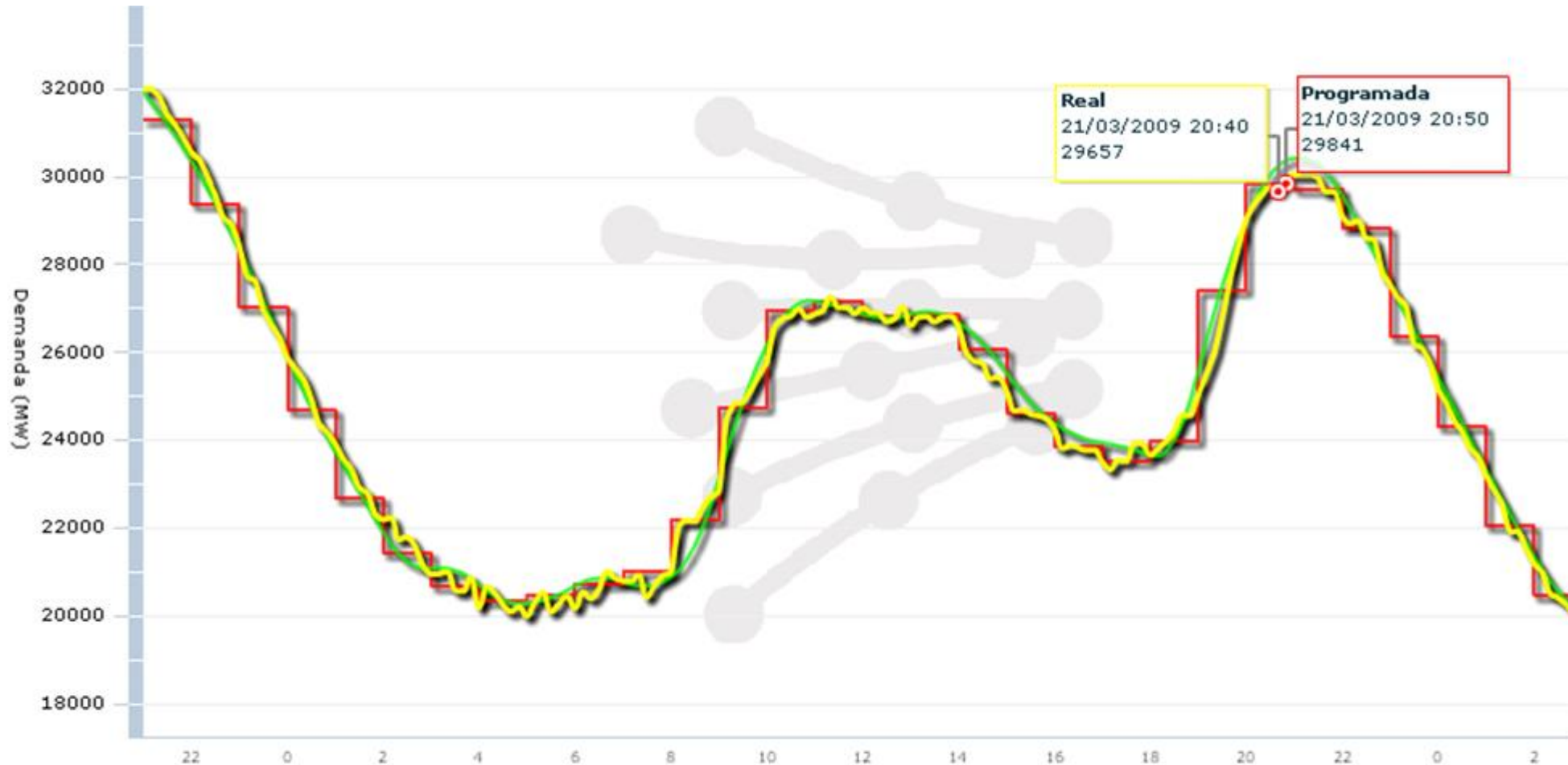
How We Work?



Why Now in the UK?



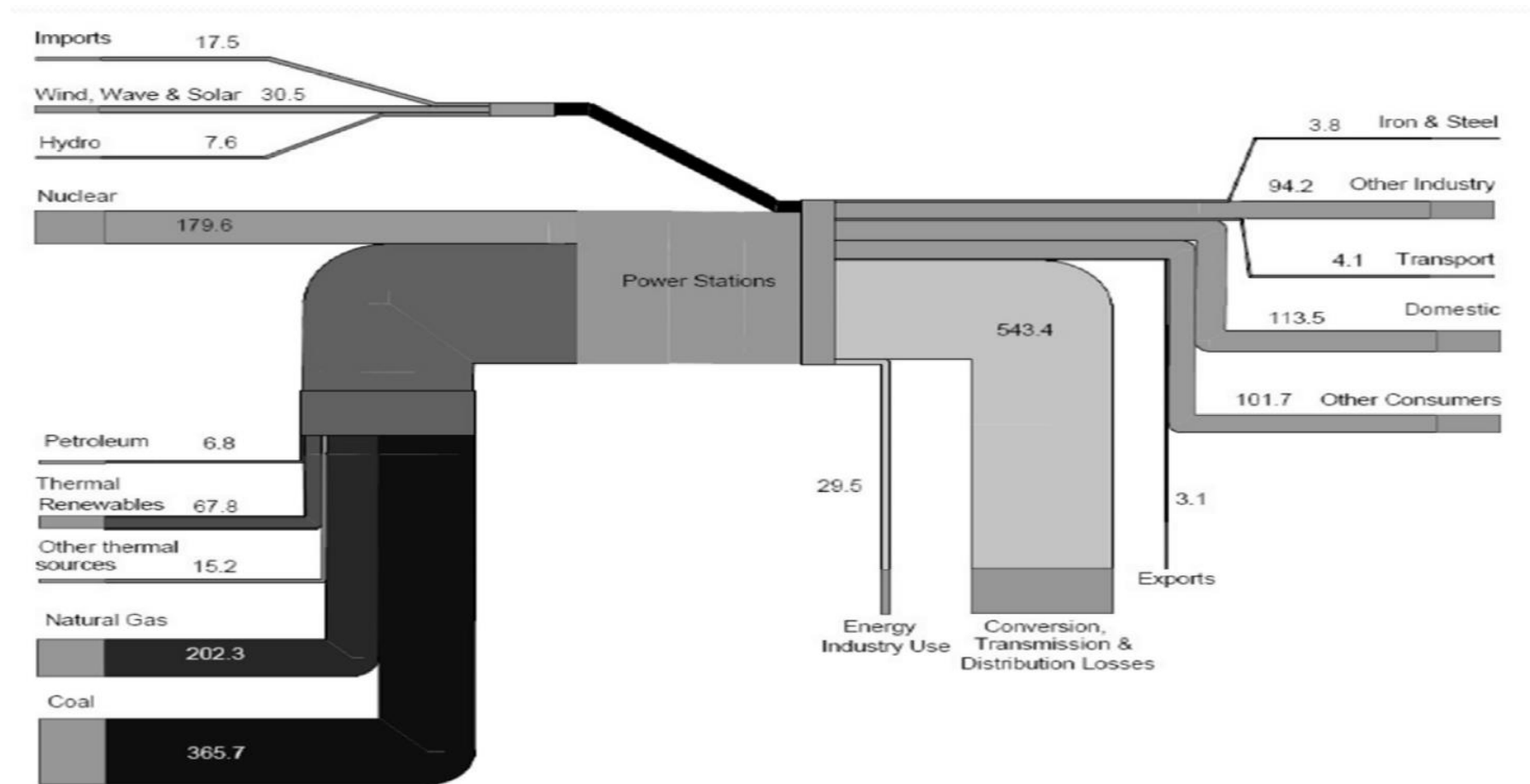
Matching supply and demand



Valores de demanda (MW) a las 03:00 del 22/03/2009 ■ Real = 19992 ■ Prevista = 19993 ■ Programada = 19458

Why energy storage?

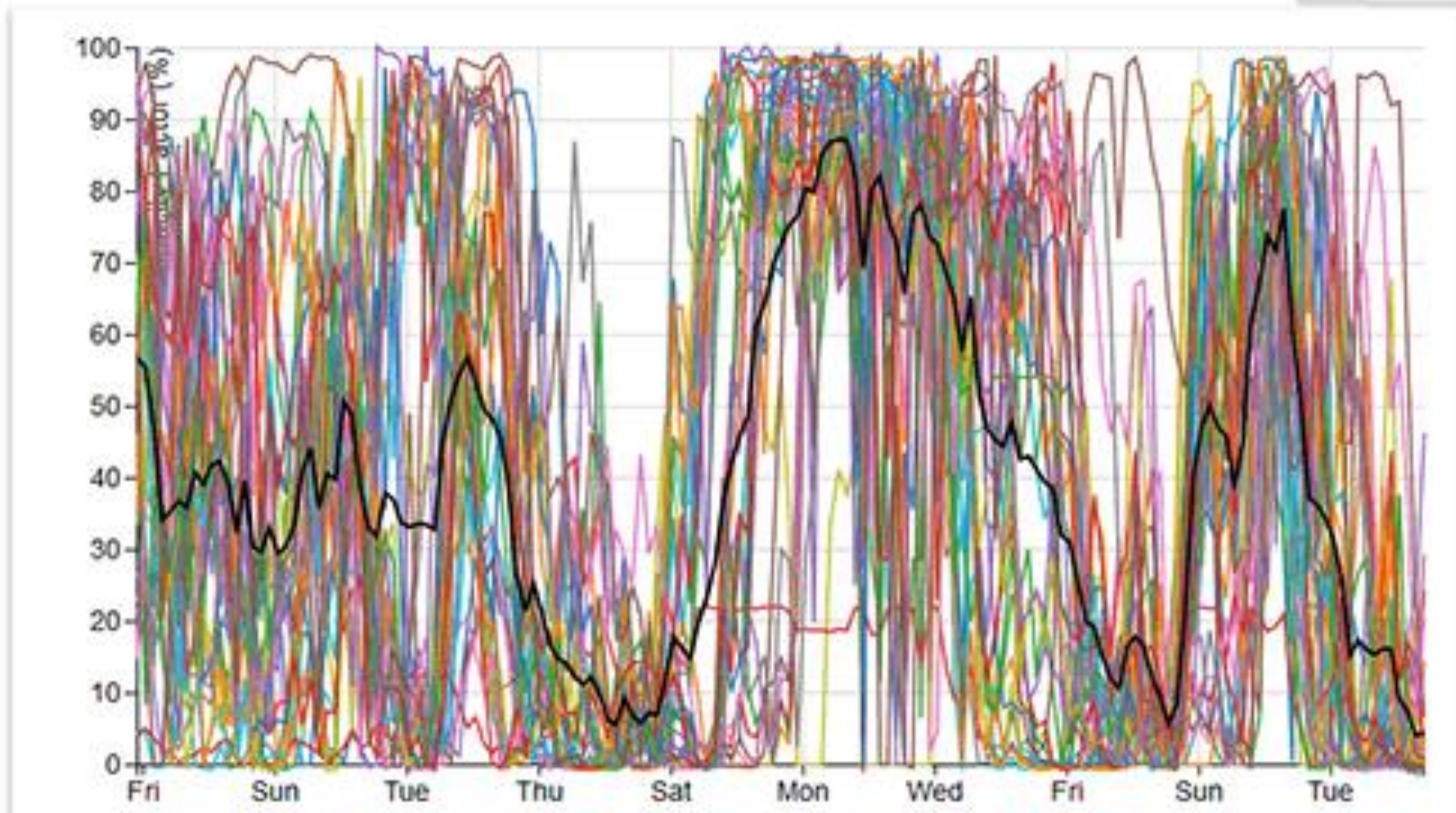
Do you know what this is?



Source: Dukes 2013

Why energy storage?

Volatile renewable supply



Challenge 1 - Safety



Understanding different battery technologies

There are two main technologies of lithium ion, currently in the market:

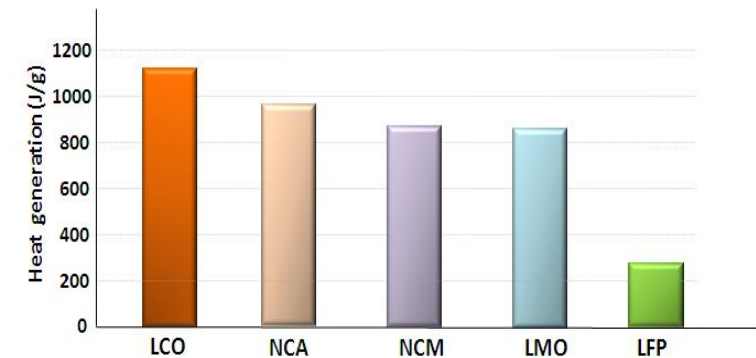
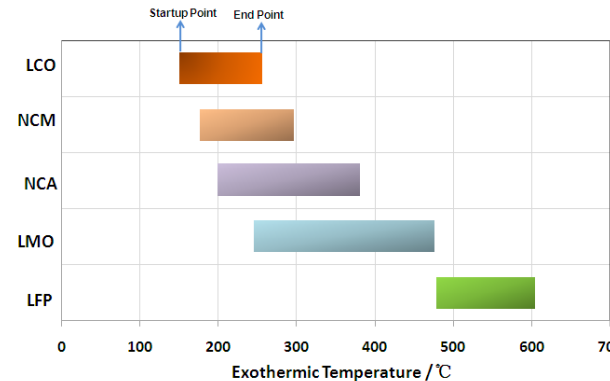
1. Nickel Cobalt Manganese (NCM)

- ✓ Used by Panasonic (Tesla), LG and Samsung
- ✓ High energy density for more compact batteries

2. Lithium Iron Phosphate (LFP)

- ✓ Used by Sony and BYD
- ✓ Very good thermal stability, which allows higher power output with greater safety and cycle life.

Battery Technology – Thermal stability and safety



Battery Technology – Strengths and weaknesses

Chemistry	Cell Quantity	Safety	Life	Power Density	Regeneration Acceptability	Energy Density	Cost
LMO/C	⊙	○	○	⊙	○	⊙	⊙
NCA/C	○	△	○	⊙	⊙	⊙	△
NCM/C	○	△	○	⊙	⊙	⊙	△
LFP/C	⊙*	⊙	⊙	⊙	⊙	○	⊙
LMO/LTO	○	⊙	⊙	⊙	⊙	○	△
NCA/LTO	△	○	⊙	○	○	○	△
NCM/LTO	△	○	(⊙)	○	○	○	△
LFP/LTO	△	⊙	⊙	△	△	△	○

⊙ Good ○ Fair △ Poor () estimated

*LFP battery can be made into large cell, which decreases the quantity and also make battery management simpler.

Introducing safety into the design

Testing Facilities

Since 2012, BYD's Test Centres are UL WTDP certified. This allows for reliable and fast new product validation

Performance Testing

- ✓ Electric performance
 - ✓ Environment test
 - ✓ Operating profile test
- (inc. Cell, module & pack testing)



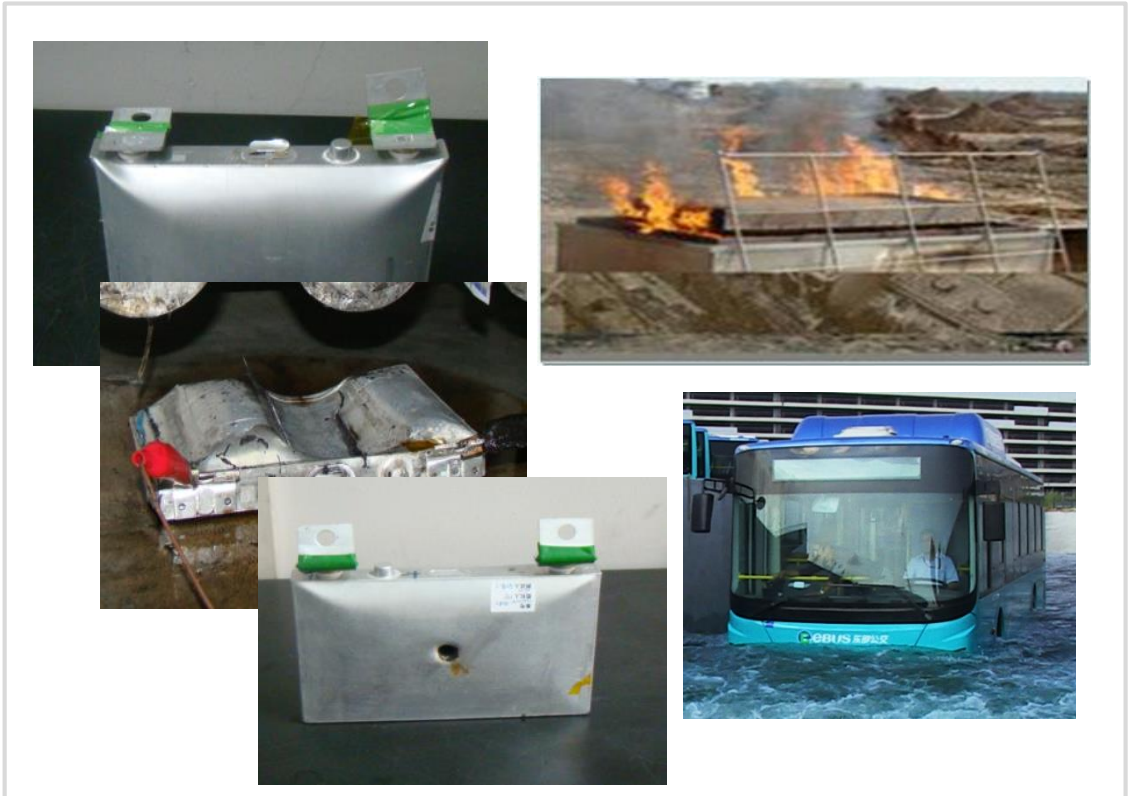
Safety & Reliability Testing

- ✓ Environment adaptability
 - ✓ Abuse test
 - ✓ Reliability test
- (inc. salt spray & soaking, thermal shock, vibration, crush & HALT)



Extreme Testing – Battery Cell, Pack & Application

Extreme electrical testing, piercing, crushing, environmental testing, fire, water, etc.



Challenge 2 – Justifying the investment



Understanding parameters that impact investment

How to determine the greatest long-term return, when selecting batteries:

- ✓ Batteries must be capable of **maximizing the total kwh** provided to the household/commercial system, in its lifetime, at the **minimum upfront costs**.
- ✓ **Main factors:** depth of discharge (DOD), nominal lifetime cycles, C-rate (power output) and efficiency. Weight is also included to provide an idea of the comparative size.

Company	Product	Chemistry	DOD	Nominal lifetime cycles	C-rate (discharge time)	Efficiency	Weight/kwh
Tesla (Panasonic)	Powerwall 7	NMC	90%	3650	0.47	92	15
LG Chemical	RESU 6.4 Main Pack	NMC	90%	6000	0.3	95	10
Pylon	Extra2000	LiFePO4	80%	4000	0.5	92	16
Aquion energy	Saltwater Battery	Saltwater	100%	2500	0.18	85	48
Narada	REXC	Lead carbon	80%	3000	0.33	97	38
BAE	Gel Secura PVV Solar	Lead acid	50%	3000	0.34	80	32
BYD	2.5Kw B-Plus Module	LiFePO4	100%	6000	1	97	16

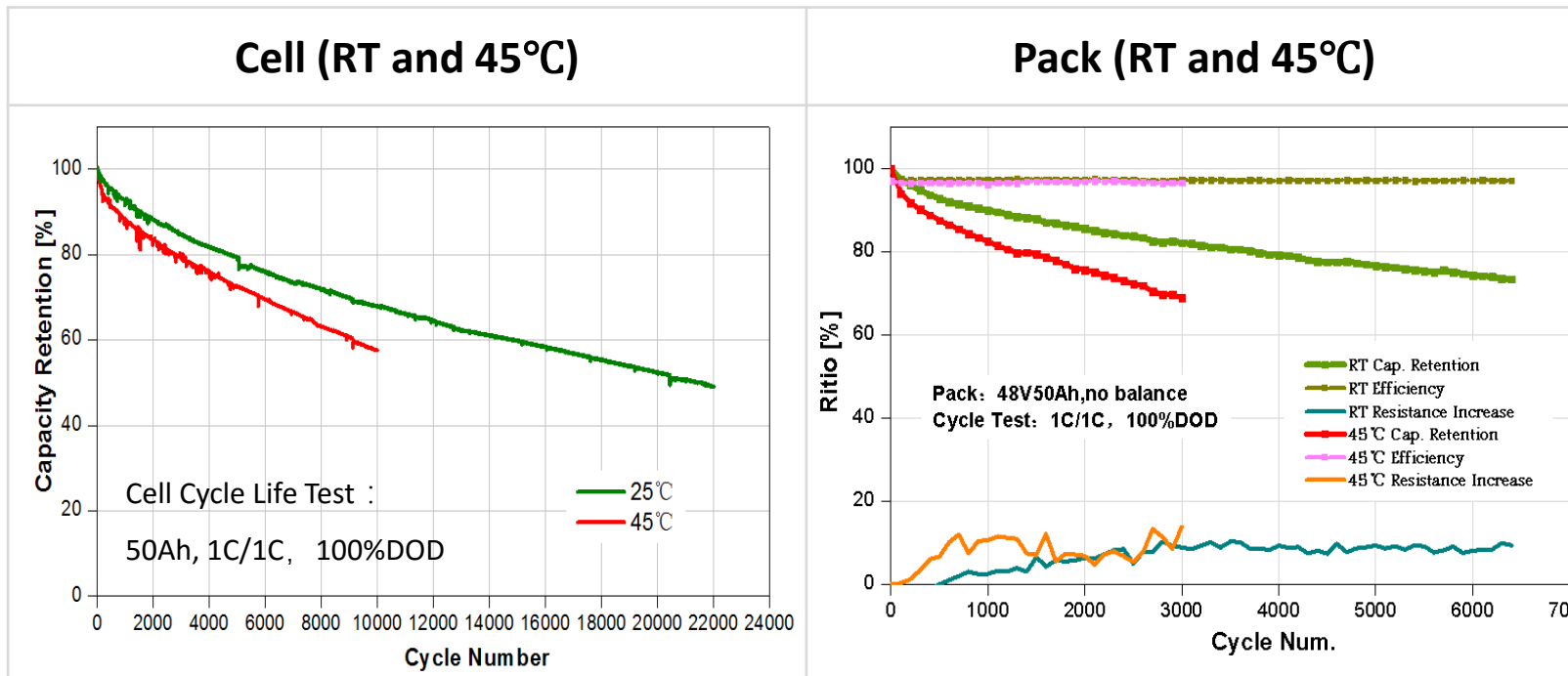
Source: Manufacturer datasheets 2016, Note: Samsung is not in the list as their datasheet doesn't show separate battery parameters

Cycle life as a key driver for investment

Longevity of Batteries

BYD has supplied e-taxis and e-buses to Shenzhen, since 2010. To date, **no batteries have been replaced**.

Up until the end of 2015 they have travelled: Bus distance = **300.000 km** & Taxi distance = **800.000 km**.



-> **5-year accelerated cell testing**

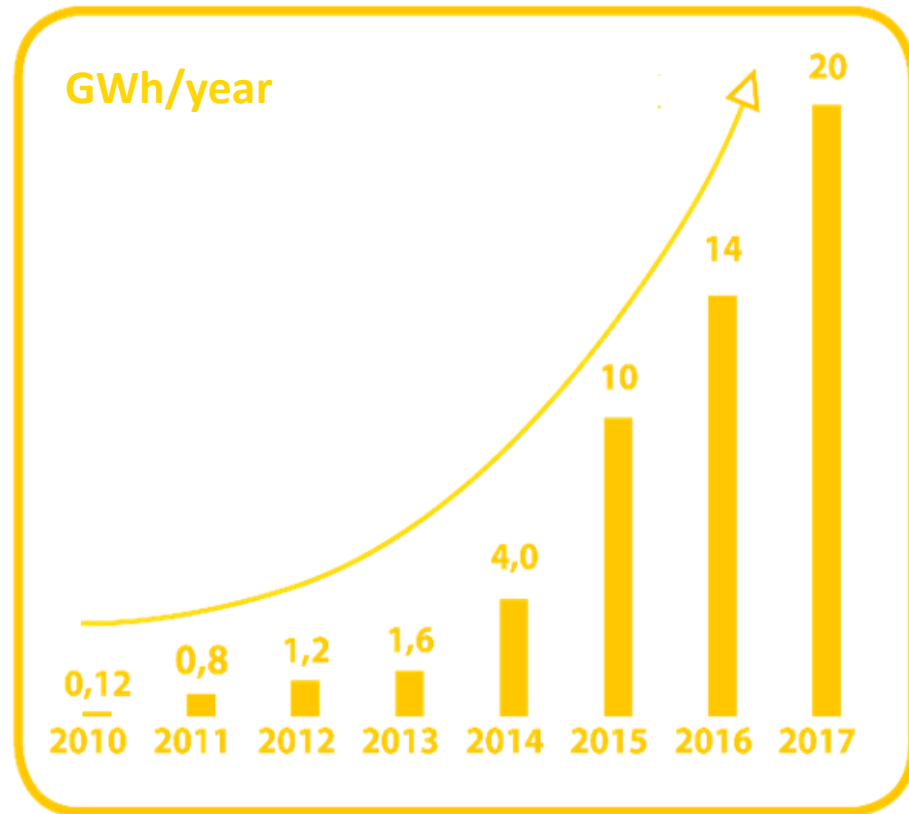
-> **After 22.000 cycles, the cell keeps 50% capacity**

-> **Long lifecycle and slight increase in the internal resistance**

Economies of scale as a core competitive advantage

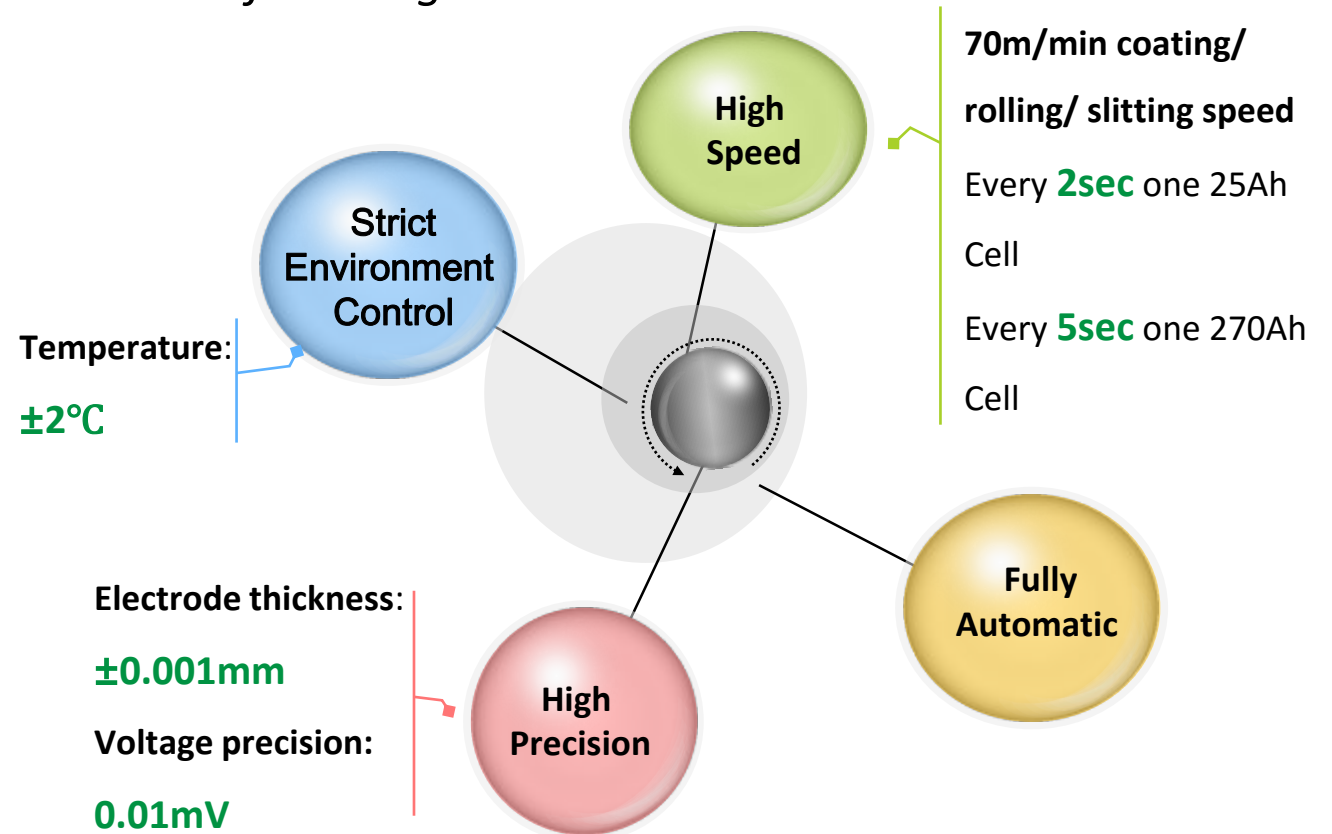
Production Capacity

Worldwide capacity in 2015 was 50GWh, in 2016 BYD will produce the equivalent to **5.6M B-plus**

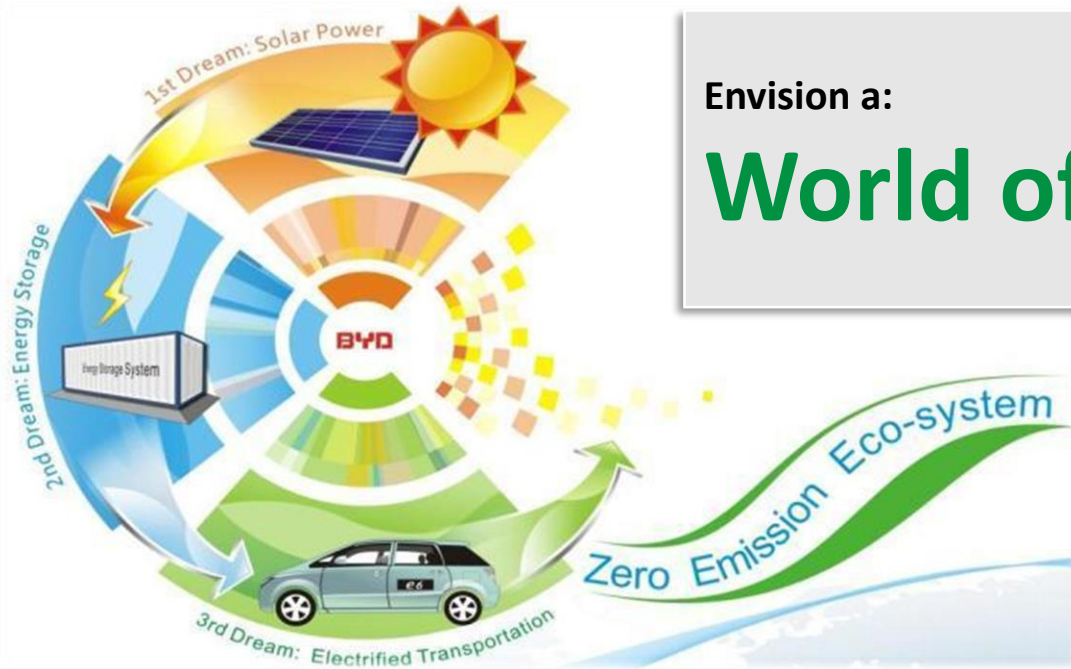


Manufacturing Capacity

BYD has unique techniques and abilities for optimal manufacturing.



Three Green Dreams



Envision a:
World of Zero Emissions

- Through 3 Key Areas of Focus:
- ✓ **Solar Power**
 - ✓ **Energy Storage**
 - ✓ **Electrified Transportation**

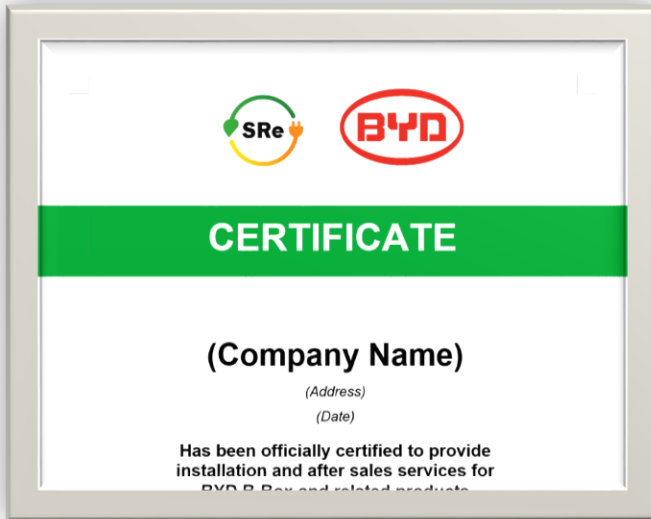
There vision for Energy Storage can be found in all forms of applications:

- ✓ **Residential Energy Storage Systems (ESS)** – B-Box, Mini ESS, MDESS
- ✓ **Electric Vehicles (EV)** – EV, HEV, Tank cars, Forklifts , E-Bus
- ✓ **ES Stations** – Solar Power, Wind Power, Solar Lamp, Container ESS



SREnergy's goal for the UK & Europe markets

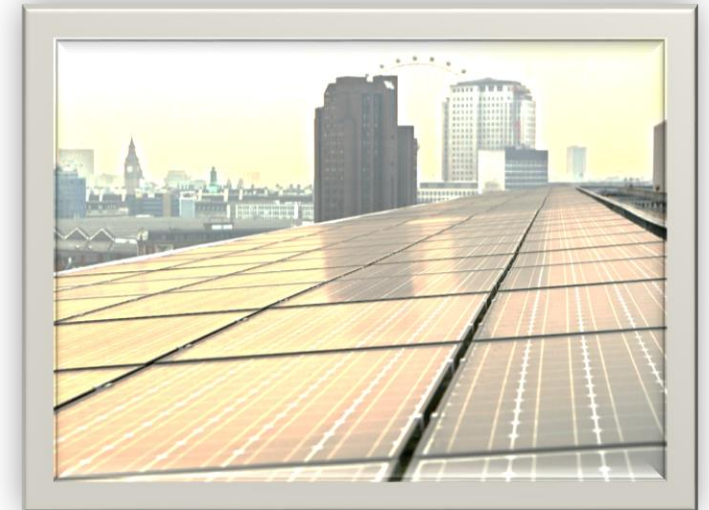
To Build
A Network of Certified Installers
across UK & Ireland



To Support
Residential Developments in
Creating Energy Positive Homes



To Increase
Energy Self-Consumption in
Commercial Industries



THANK YOU FOR YOUR ATTENTION.

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