HANGCHA

Introduction of

HANGCHA

Lithium technology

LI-ION TECHNOLOGY

INNOVATIVE LITHIUM-ION

Design philosophy

The future is now:
Superior performance, Innovative technology, Economical solution

Offering

- Long service life
- Energy saving
- High safety and reliability
- Maintenance free
- Fast charging
- High energy density
- Compact body



HANGCHA

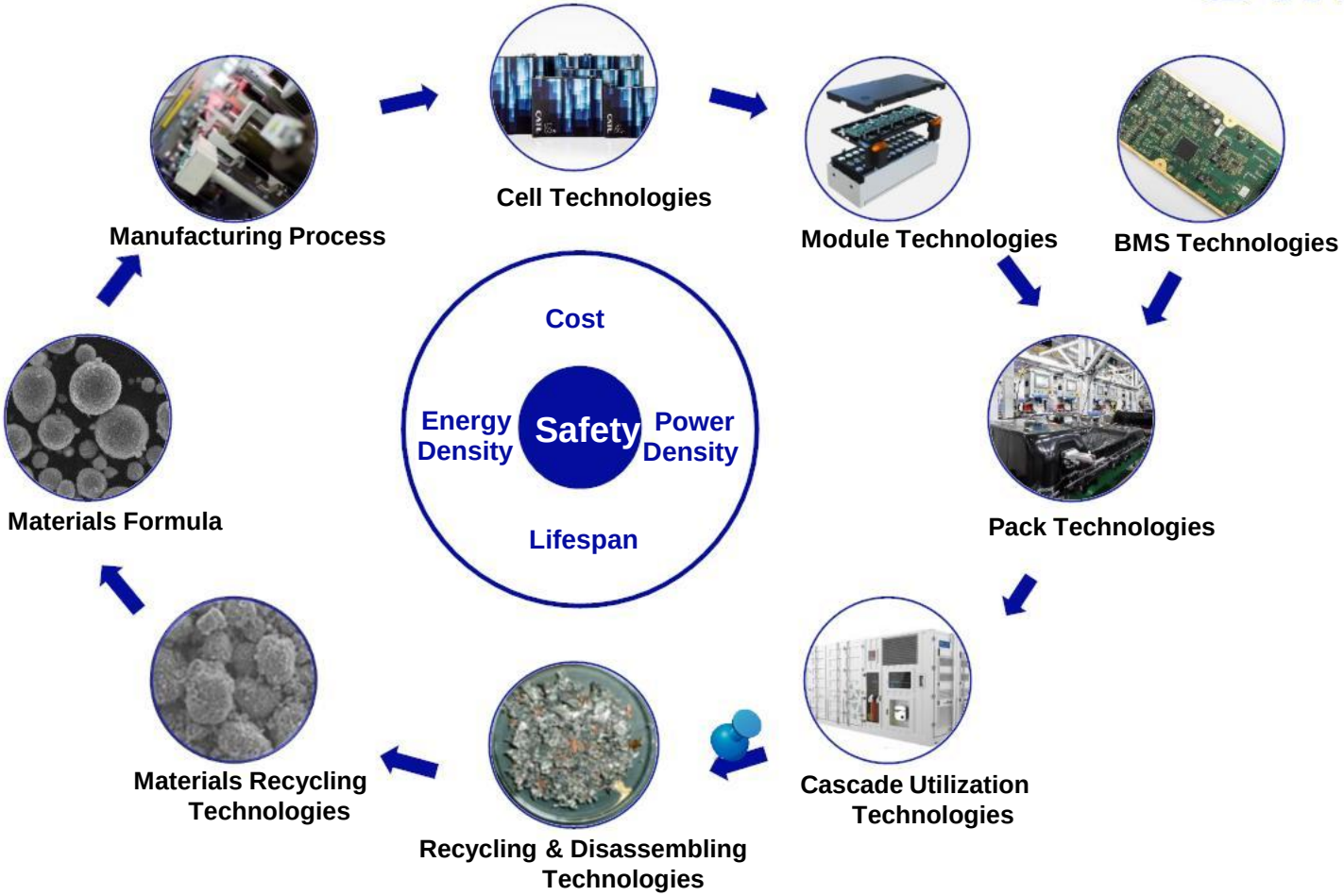
Content

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2	Features & benefits
3	Compare with lead acid battery
4	Product family

1 - HANGCHA Li-Ion technology

HAHGCHA Lithium with CATL Technology

CATL

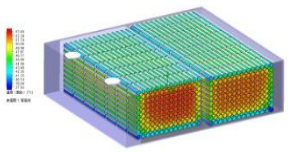


CATL Battery Pack System

Battery Pack System

- Battery Cell
- Module
- Heat Management
- BMS
- Electric System
- Case Structure









Safety Design

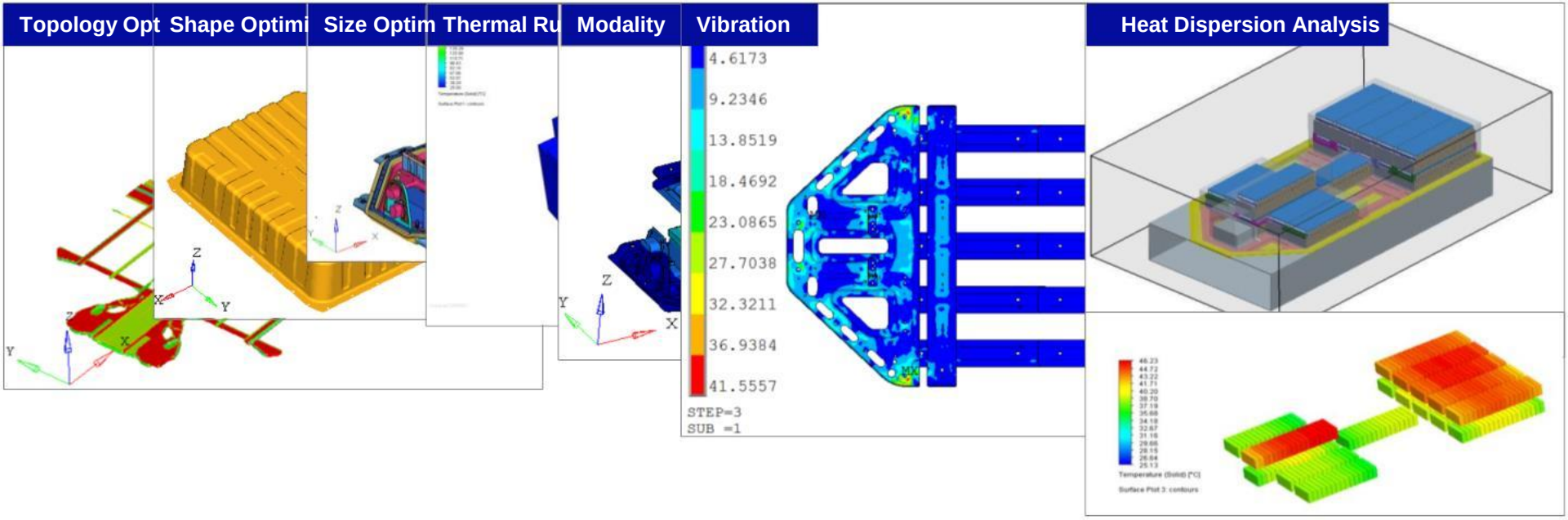
CATL

Concept
- Topology optimization
- Shape optimization

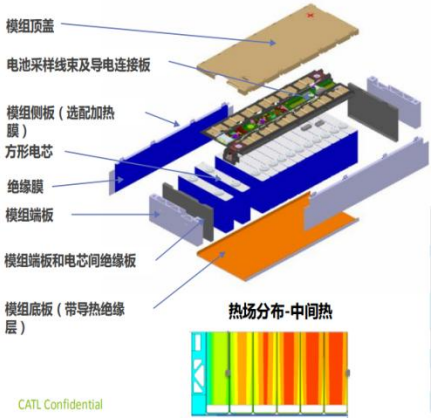
Pre-design
- Size optimization
- Heat dispersion analysis
- Thermal runaway

Design
- Random vibration & mechanical shock
- Stone impact, crush

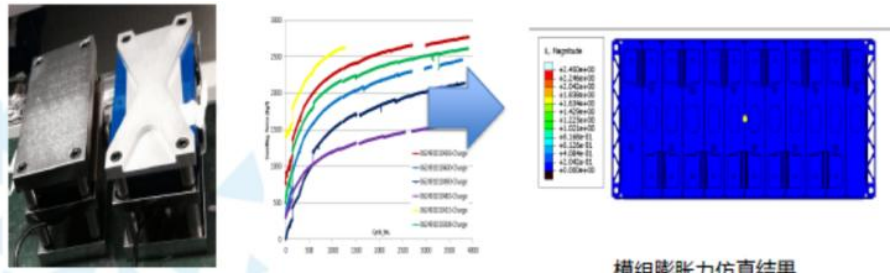
Validation
- Mechanical shock



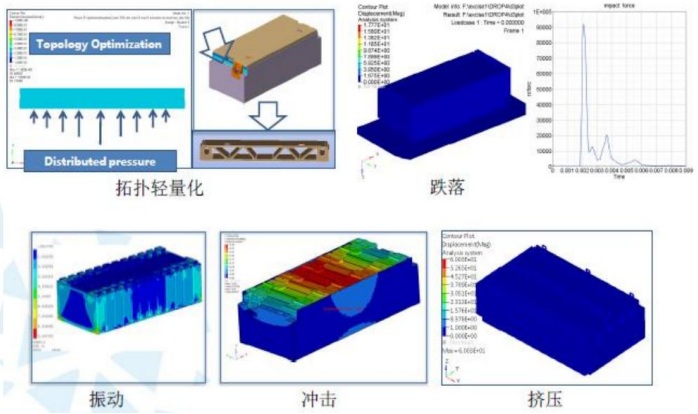
Battery pack design



Safety design



Expansion force assessment

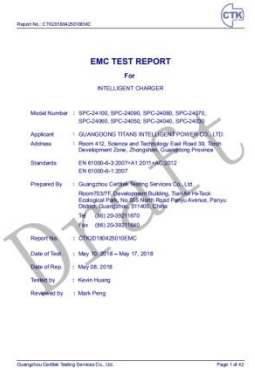


security assessment
(Structural simulation)

Charger test report







BMS security strategy

BMS Security Strategy

HANGCHA battery management system (BMS) monitors the li-ion cells at all time. As a result, our li-ion solution is the most reliable power option.

Battery Safety Management

Overcharge/over dischearge protection
Overcurrent/over-temperature/low- temperature protection
Multi-level fault diagnosis protection
Double fault monitoring

SOC/SOH Detection

Residual capacity estimates
Battery health estimates
High precision capacity integration

High Pressure Safety Management

High voltage interlock(HVIL)
High voltage insulation monitoring
High voltage switch diagnostics

Battery Parameter Detection

Battery voltage detection and analysis
Battery current detection and analysis
Battery temperature detection and analysis

Equilibrium Management

Equalization based on voltage mode
Equalization based on time mode
Equalization based on battery cell SOC
Active/passive equalization optional

Other Features

Low cost,low power consumption
Historcal data record
Flexible cascade expansion
CRC data validation

Comprehensive Test & Validation

CATL













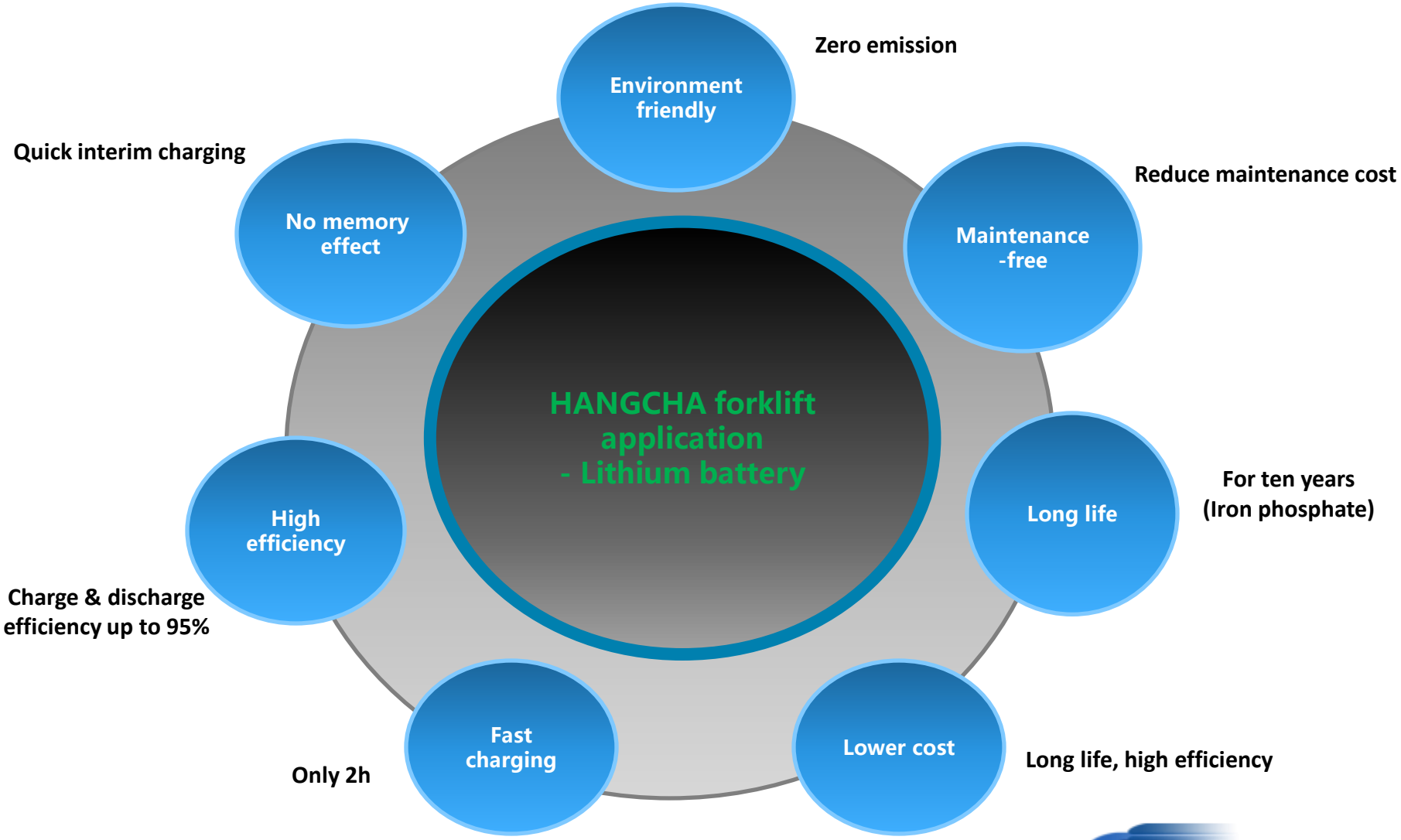
With the biggest testing lab by area, largest number of charging & discharging equipment, most complete standards, CATL's testing is among the best domestically. By December 2018, CATL is able to carry out 273 kinds of tests* including safety, reliability and performance tests.

***The 273 kinds of tests included 100 performance tests, 48 safety tests and 125 reliability tests.**

HANGCHA

2 - Features & benefits

HAHGCHA with CATL Lithium technology



Features & benefits

COMPACTNESS

- Higher energy density for **compact battery dimensions**

SAFETY

- **Intelligent battery management** monitoring every important function
- **Higher user safety,** thanks to acid-free use
- **User friendly** due to avoided battery change
- **No emission of battery gasses**

ECOLOGIC RESPONSIBILITY

- Eco-friendly thanks to **twice the service life**
- **Eco-friendly** due to absence of acid
- **Substantially higher efficiency** of the Li-Ion battery when charging and discharging reduces energy costs

POWER

- **High energy density** with an identical volume as a lead-acid battery, the Li-Ion battery contains twice as much energy
- **High availability** by quick opportunity charging without the need to change the battery
- **Longer truck performance** thanks to stable voltage supply throughout the discharging process
- Li-Ion batteries maintain their performance level also at temperatures below freezing making them **ideal for use in cold areas**

PRECISION

- **The communication between truck and battery controller** allows to efficiently use and deploy the Li-Ion battery

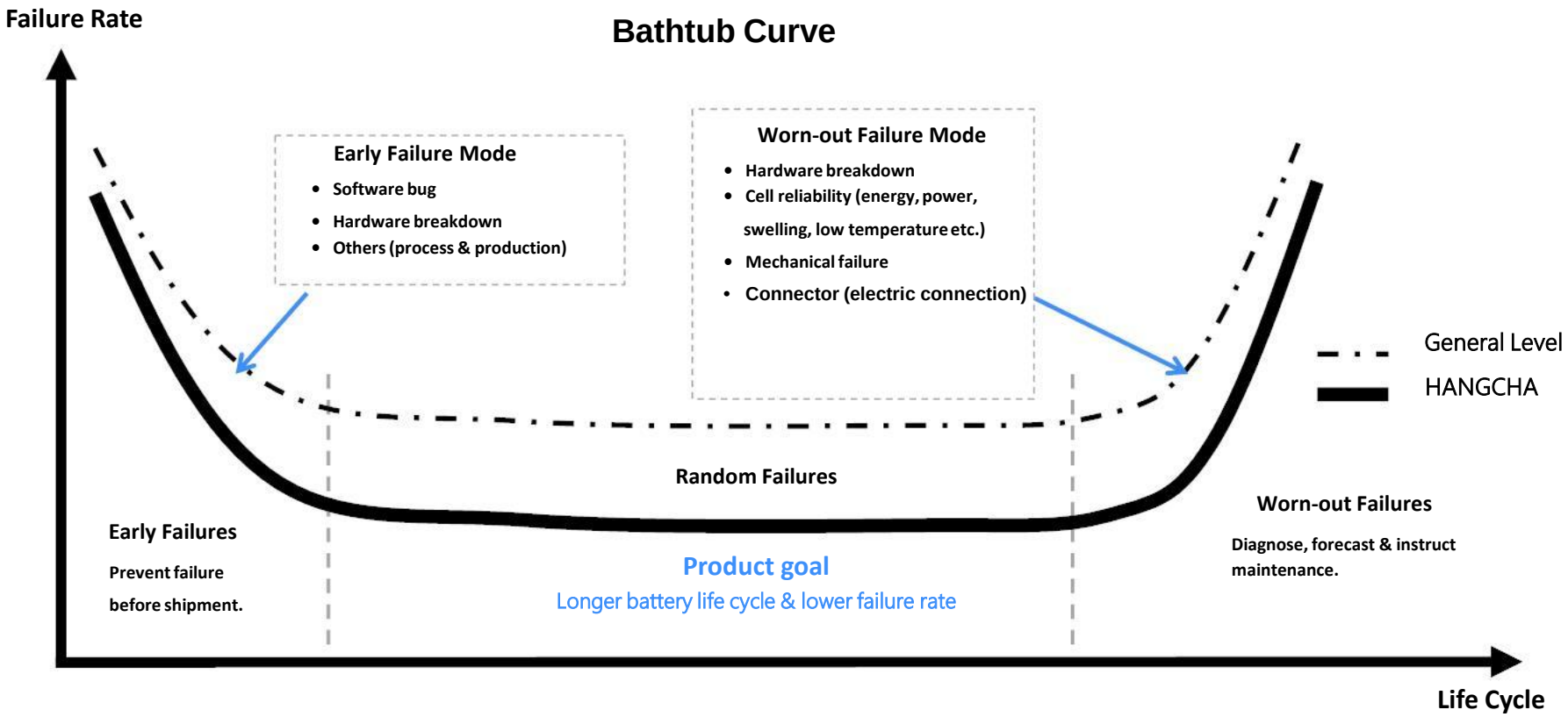
ERGONOMICS

- **Virtually no physical strain**, because battery changes are not needed
- **Maintenance free operation** - no topping up of water or checking acid levels
- **No organizational effort** - pre-work checks and providing water are not needed

Reliable gene from CATL

CATL has the largest volume, *0* safety accidents: In 2014-2017, the number of passenger cars supporting CATL batteries exceeded 95,000, and *0* safety accidents.

High reliability throughout the entire battery life



Long cycle life

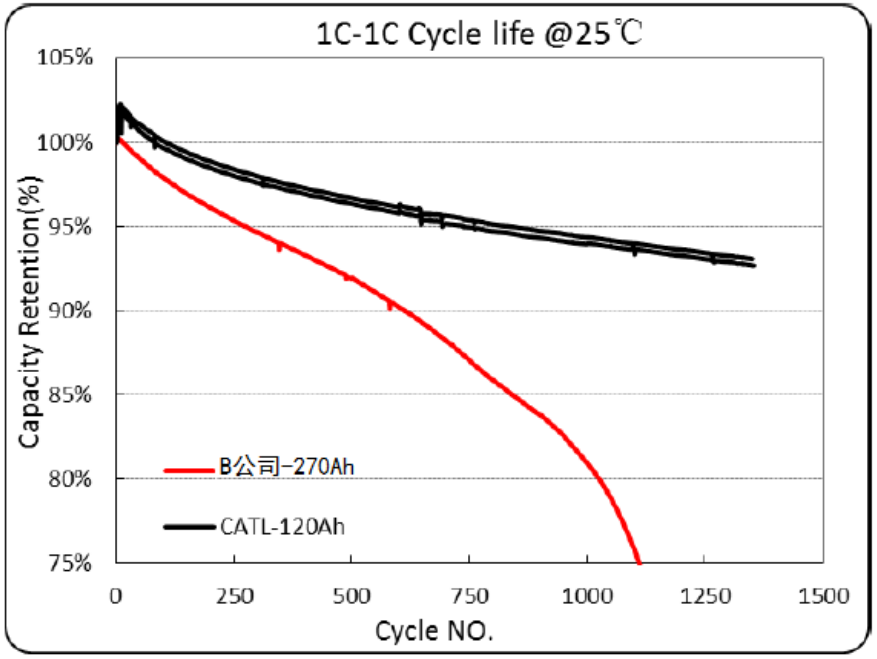
Battery cell cycle life test

- Capacity retention at -25 ℃

500 charge and discharge cycles: General level 92%, HANGCHA 97%

1000 charge and discharge cycles: General level 80%, HANGCHA 94%

1100 charge and discharge cycles: General level 75%, HANGCHA 93%



Long cycle life

Battery pack cycle life test

5 YEARS GUARANTEE

- Attenuation rate comparison

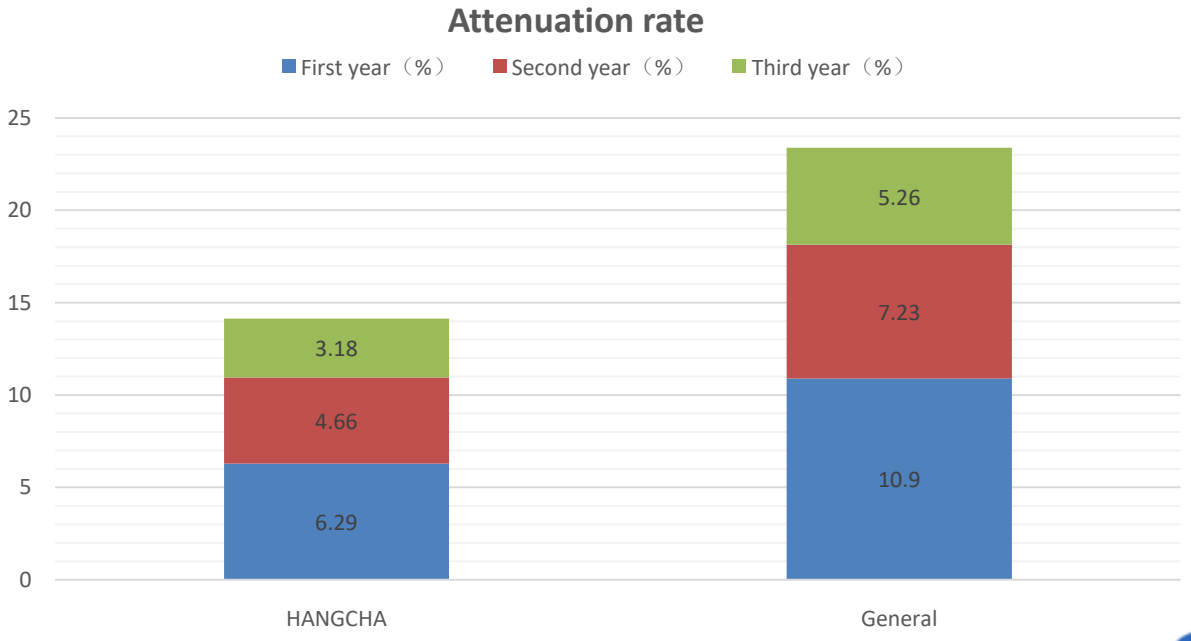
HANGCHA: First year 6.29%, Second year 4.66%, third year 3.18%

Total attenuation 14%

General: First year 10.9%, Second year 7.23%, third year 5.26%

Total attenuation 23.4%

HANGCHA provides Li-Ion (LiFePO4) battery with 5 years or 10000 hours warranty



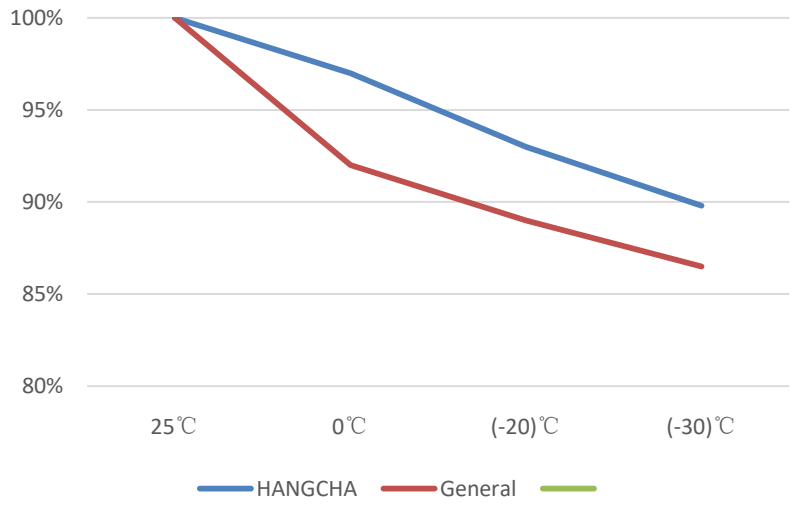
Perfect performance in cold area

Battery cell test

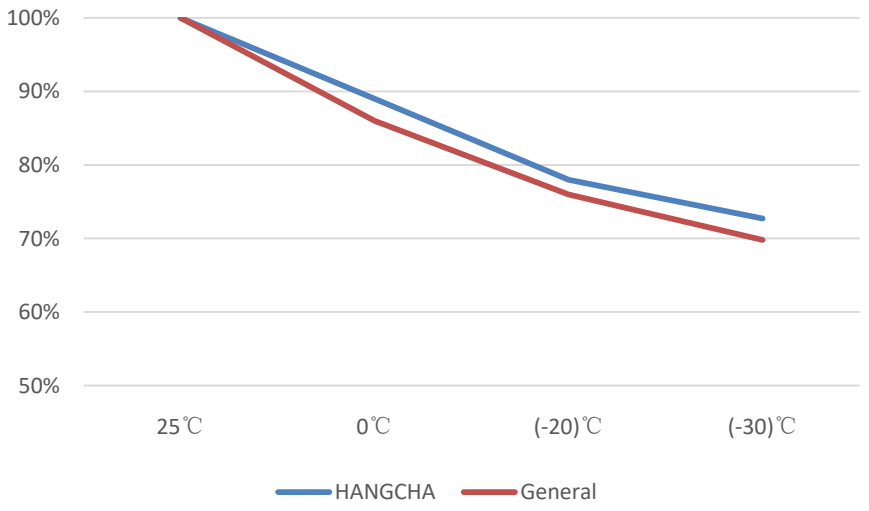
Capacity at 0℃: HANGCHA 97%, General 93%
Energy at 0℃: HANGCHA 89%, General 86%
Capacity at -30℃: HANGCHA 89.8%, General 86.5%
Energy at -30℃: HANGCHA 72.7%, General 69.8%



Capacity performance in cold area@1/3C



Energy performance in cold area@1/3C

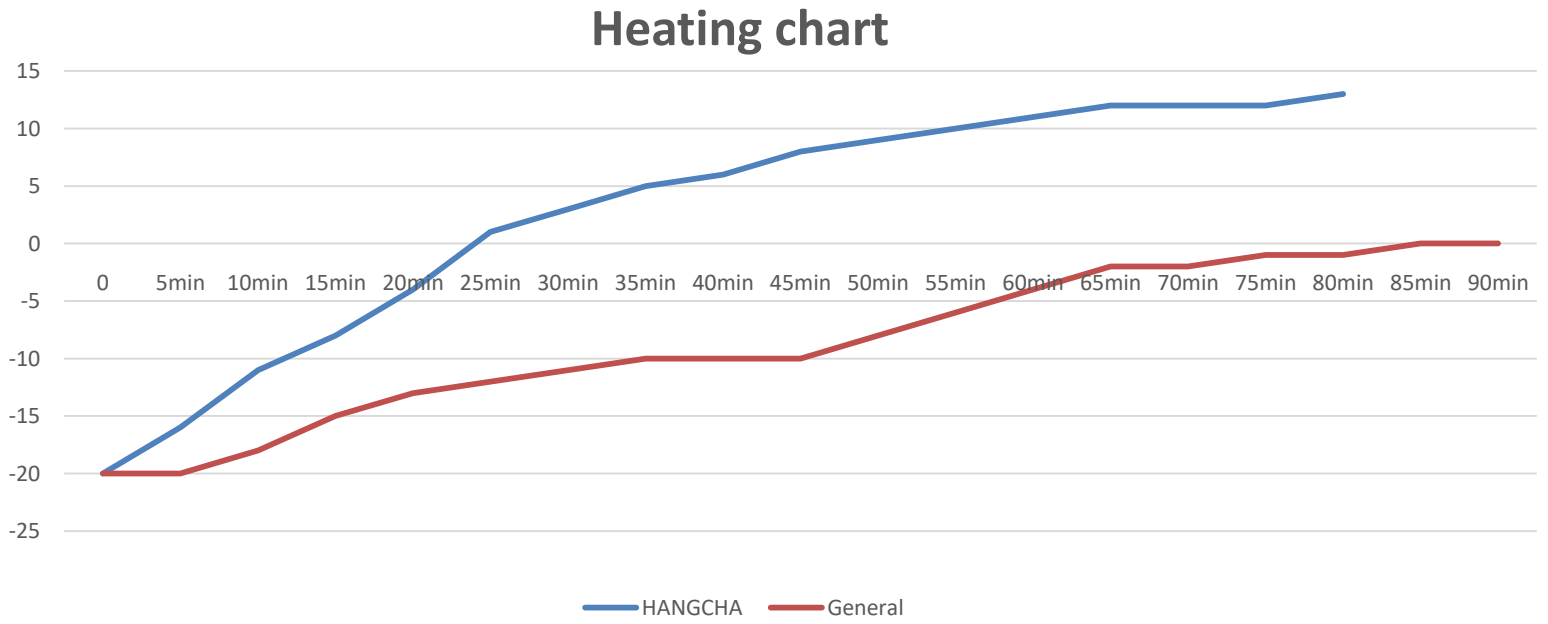


Perfect performance in cold area

Battery pack heating management

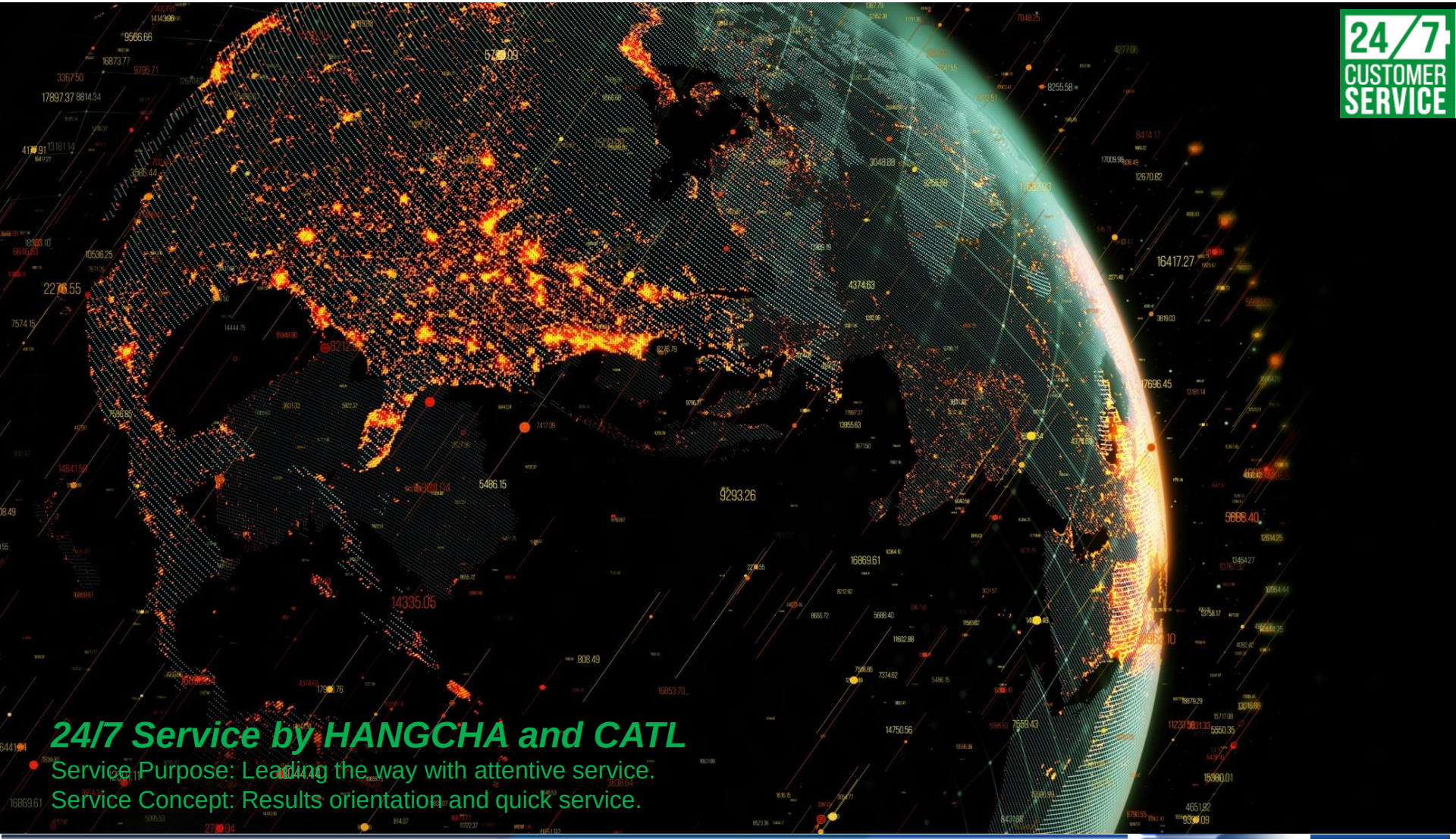
HANGCHA battery pack with heating management during the discharge process, the temperature rises from - 20℃ to 0℃ only takes 25-30 minutes

General battery pack during the discharge process, the temperature rises from - 20℃ to 0℃ will take 85-90 minutes



★ Note: Battery pack with LiFePO4 features heating management

Global Service



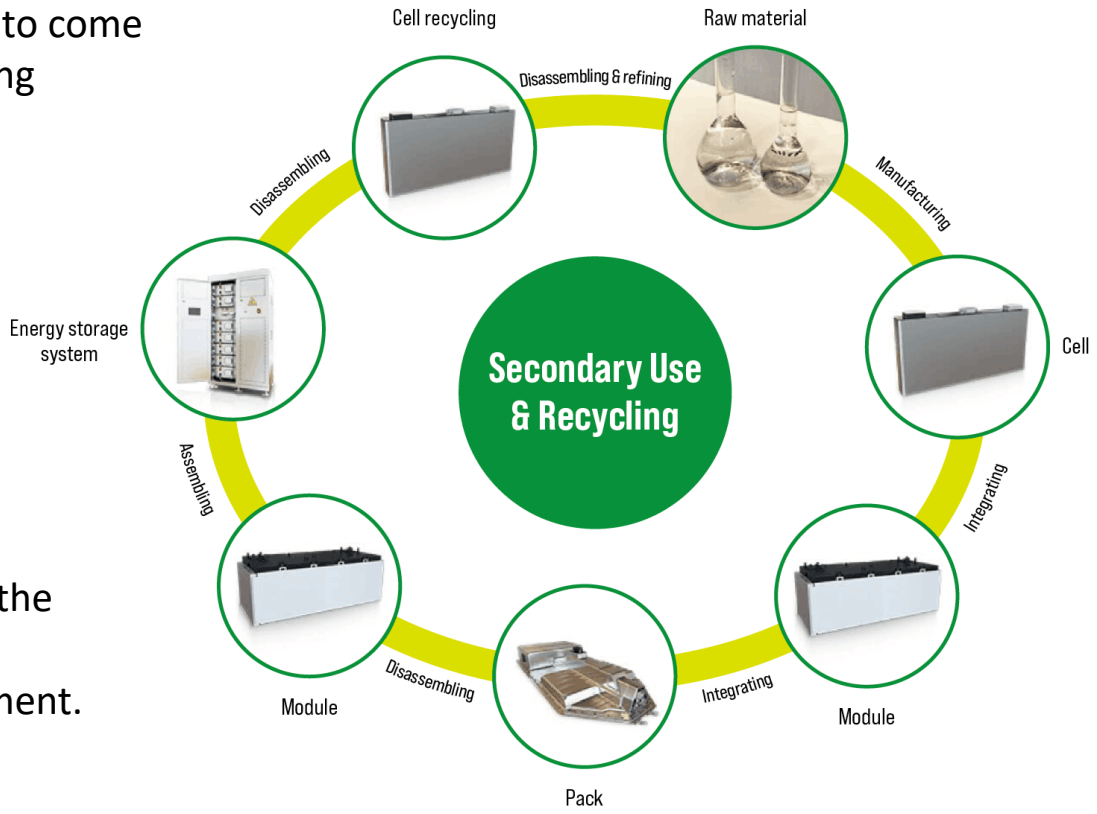
24/7 Service by HANGCHA and CATL

Service Purpose: Leading the way with attentive service.

Service Concept: Results orientation and quick service.

Lithium battery recycling solution

In the future, battery components will not be sourced solely from mining; They will have to come from recycling and from applications utilising industrial side streams.



HANGCHA is working with CATL to improve the secondary use technology now.
In doing so, we help to protect our environment.

3 - Compare with lead acid battery

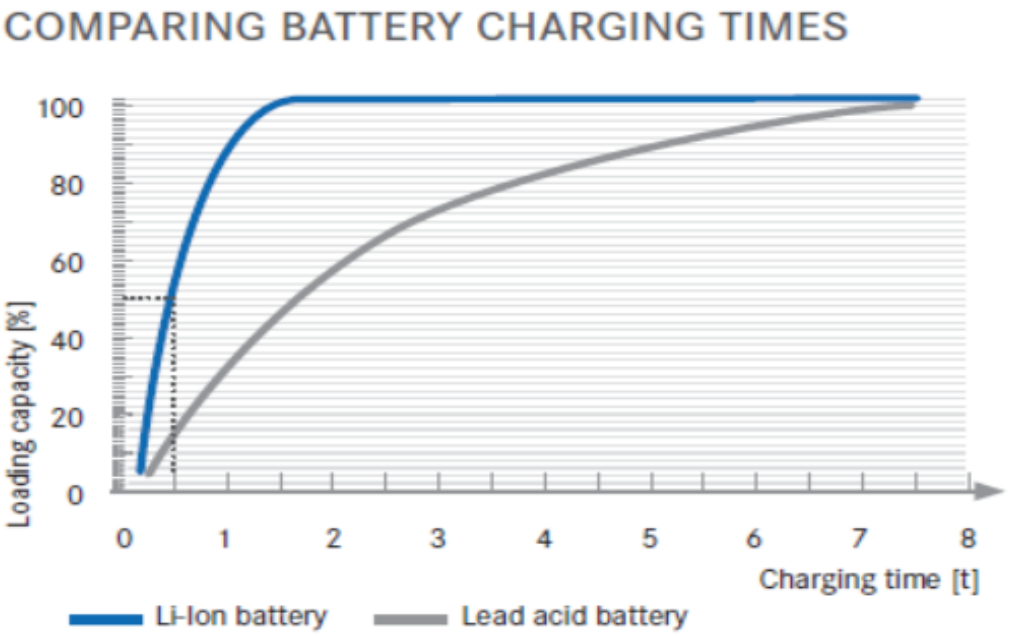
Comparison- Performance

Item	Lithium battery LiFePO4	Lead acid battery
Long cycle life	> 4000 times (80% remaining capacity), the service life more than 10 years	800-1500 times (70% remaining capacity), the service life 2-3 years
Quick charge	2h	8-10h
Charge and discharge efficiency	>95% High charge efficiency	~80% Low charge efficiency
Energy utilization ratio	DOD > 95%	DOD 80%
Operating temperature	-30~60℃	-20~45℃
Maintenance	Maintenance free	Topping up of water or checking acid levels 1-2 times/month
Impact of environment	Zero pollution	Charging acid mist or battery gasses

Li-Ion batteries reduce your costs. With improvement in energy efficiency and a three times longer battery life than lead acid batteries.

Comparison- Charging

- Rapid charging and opportunity charging ensure continuous availability of vehicles

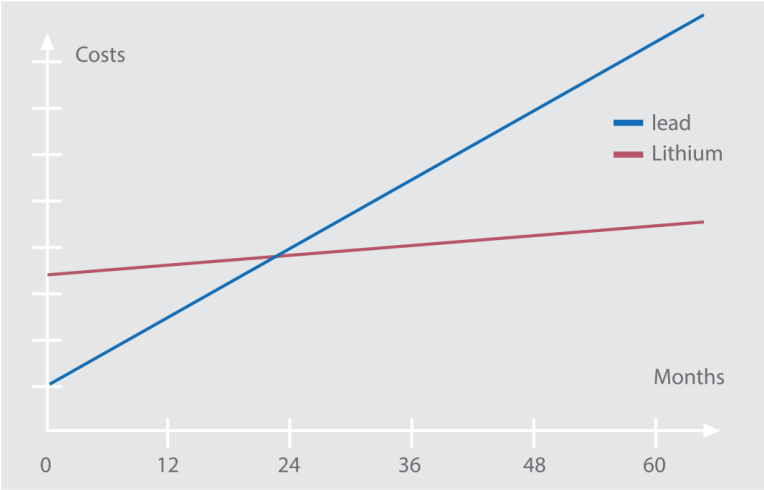


Li-Ion powered forklifts are always available. They allow for fast full charging or boost charging (100 % charge in 2 hours). They are maintenance free and do not require a battery change when used for multi-shift operations.

Comparison- TCO



Item	unit	Lithium battery	Lead acid battery
Voltage	V	48	48
Capacity	Ah	400	500
Battery energy	KW·h	19.2	24
Charge efficiency	%	95%	70%
Annual charge times	Time	300	300
Electricity price	CNY/KW·h	1	1
Annual electric charge	CNY	6063	10286
Annual maintenance cost	CNY	0	10000
Maintenance cost of ten years	CNY	60630	202860
Purchase cost of ten years	CNY	110000 (1 unit)	177000 (3~4 units)
Total cost per forklift	CNY	170630	379860

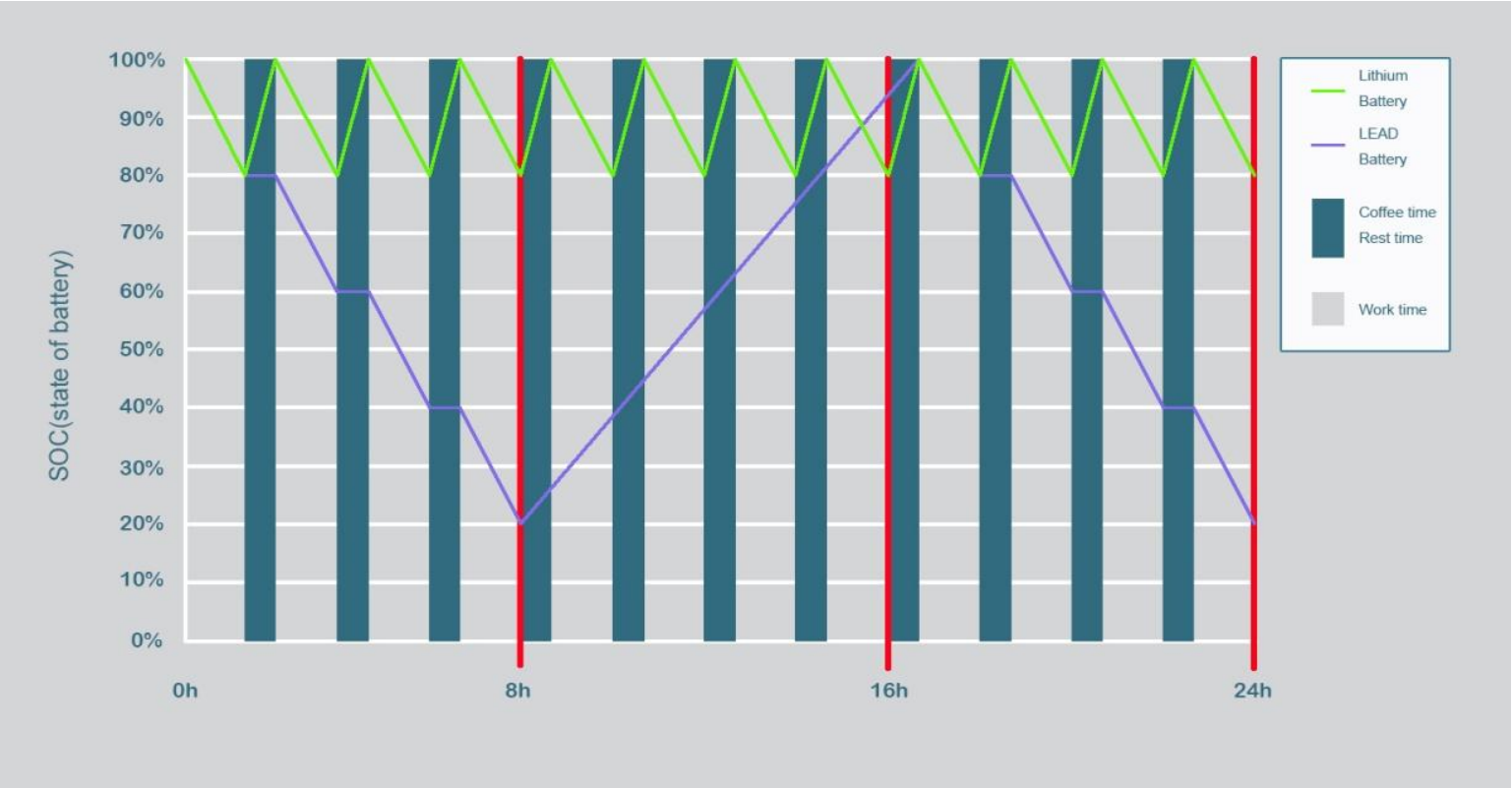


Lithium battery's cost reduction is about 55%

After taking a look at the complete total cost of ownership (TCO), currently high procurement costs are more than compensated for by HANGCHA's longer service times and significantly lower operating expenses.

☆ The above data refer to the case for actual use from lithium forklift

Comparison- Efficiency



The high-performance Li-Ion technology is especially suitable in cases where lead acid batteries are in use and have to be changed in two to three-shift operation. Lithium-ion batteries do not need to be replaced. By quick interim charging any downtime, such as a lunch break, can be efficiently used and the battery is recharged in a very short period of time. Interim charging does not affect the battery service life.

Lithium-ion technology supplies constant voltage throughout the entire application time. Accordingly, you can work under full power through several shifts without having to change a battery or do any kind of maintenance at all.

4 - Product family

Family overview

Model	Lithium Powered Products
Warehouse Equipment	
Counterbalanced Truck	

Product range

Warehouse equipment



Pallet truck

1.5t

24V/35Ah



Pallet truck

1.2t

24V/20Ah



Pallet truck

1.5, 2.0t

24V/40Ah, 48V/20Ah



Rider pallet

2.0/3.0t

24V/120(202)Ah
LiFePO4



Pallet truck

2.0/3.0t

24V/120(202)Ah
LiFePO4



Pallet stacker

1.2~2.0t

24V/120(202)Ah
LiFePO4



Reach truck

1.6~2.0t

80V/271Ah
LiFePO4



Tow tractor

4.0/6.0t

48V/200Ah
LiFePO4

Product range

Counterbalanced truck



XC series 4-W electric forklift

2.5~3.5t

80V/271、404、542Ah
LiFePO4



A series 3-W electric forklift

1.6~2.0t

48V/480Ah
LiFePO4



A series 4-W electric forklift

1.0~3.5t

80V/202、271、404Ah
LiFePO4



A series 4-W electric forklift

4.0~5.0t

80V/542Ah
LiFePO4

HANGCHA



HANGCHA has started to work with Li-Ion batteries early on and being able to develop a large number of trucks with this technology.

Today we are ready to offer you a complete fleet of Li-Ion trucks. Low lift or high lift pallet trucks, counterbalanced trucks - our portfolio is constantly growing. Let’s find out more about the innovative Li-Ion family from HANGCHA.