CATL

Together for the Energy Freedom

New battery technologies and their capabilities

Balázs Szilágyi

Contemporary Amperex Technology Co., Limited

CATL
Abbreviation

2011
Establishment

Ningde, Fujian
Headquarters

300750
Stock Code

Main Business

Provide EV battery systems & services for green transportation

Cell → Module → Pack

Provide solutions and services for clean energy storage

Rack → Container → Power Station

Global Locations

Headquarters
Ningde, Fujian

5 R&D Centers
China: Ningde, Fujian / Liyang, Jiangsu / Shanghai/ Xiamen, Fujian
Germany: Munich

13 Production Bases
China: Ningde, Fujian / Xining, Qinghai / Liyang, Jiangsu / Yibin, Sichuan / Zhaoqing, Guangdong / Shanghai / Xiamen, Fujian / Yichun, Jiangxi/ Guiyang, Guizhou / Jining, Shandong / Luoyang, Henan
Germany: Erfurt
Hungary: Debrecen







Erfurt Production Base
Erfurt

Xining Production Base
Xining

Luoyang, Henan
Luoyang

Jining Production Base
Jining

Liyang Prodution Base
Liyang, Changzhou

Contemporary Amperex Technology (USA), Inc.
Detroit

Debrecen Production Base
Debrecen

United Auto Battery Co., Ltd.
Liyang, Changzhou

Contemporary Amperex Technology GmbH
Munich

Contemporary Amperex Technology Japan KK
Yokohama

Contemporary Amperex Technology France
Paris

Shanghai R&D Center
Lingang Production Base
Shanghai

Dongfeng Amperex (Wuhan) Battery System Co., Ltd.
Wuhan

CATL-FAW Auto Battery Co., Ltd.
Xiapu, Ningde

Yibin Production Base
Yibin

CATL Headquarters
Ningde Production Base
21C Lab
Ningde

CATL-GEELY EV Battery Co., Ltd.
Yibin

Guiyang Production Base
Guiyang

Yichun Production Base
Yichun

Zhaoqing Production Base
Zhaoqing

Guangdong Brunp Recycling Technology Co., Ltd.
Foshan

CATL-GAC EV Battery Co., Ltd.
Guangzhou

Xiamen R&D Center
Xiamen Production Base
Xiamen

Headquarters
R&D Center
Production Base
Subsidiary

Map source: GS(2016)1663
Supervised by the Ministry of Natural Resources of the PRC

Promote Renewable Energy Transition & Electrification Globally

EV Market

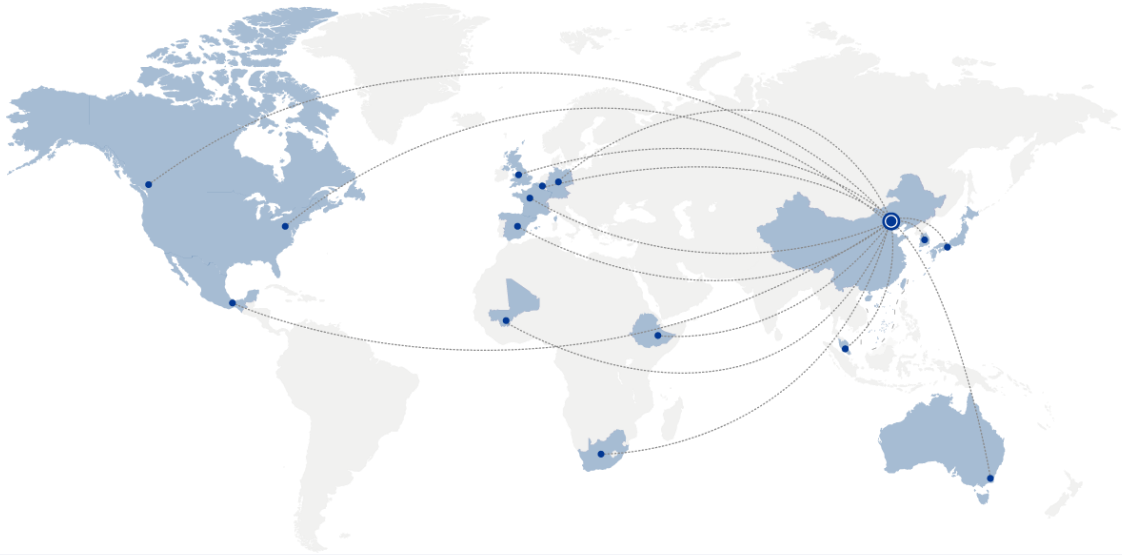
SNE Research:

- CATL ranked No.1 globally in EV battery consumption volume for six consecutive years
- In 2023H1，CATL ranked No.1 globally in EV battery consumption volume and held 36.8% of the market share.

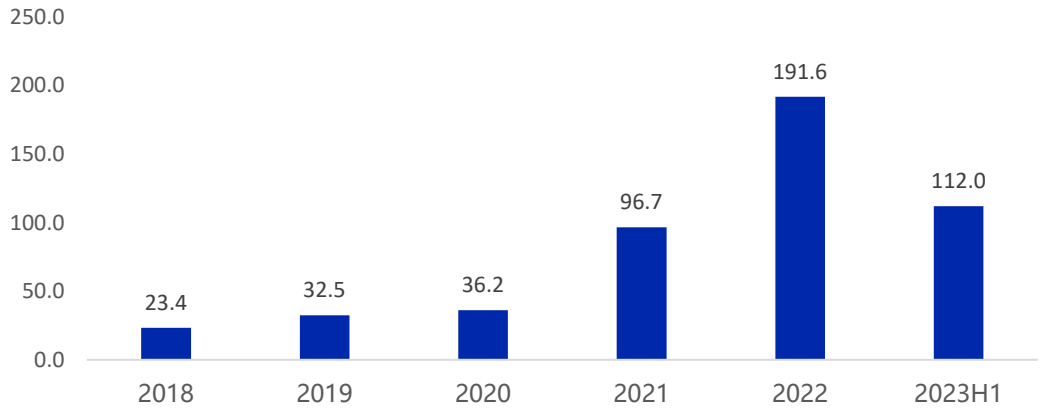
Global: 9.3 million EVs powered by CATL batteries

63 countries and regions

*Data source: SNE Research, data as of June 30, 2023



CATL's Global EV Battery Consumption Volume (GWh)



*Data source: SNE Research

ESS Market

CATL **ranked first** in the world in terms of ESS battery shipment in 2021 and 2022

In 2023H1，CATL ranked first in the world in terms of ESS battery shipment

CATL's energy storage solutions have been recognized by customers in ESS major markets including the United States, China, Germany, Britain, Australia, and other countries & regions. CATL BESS helps to integrate renewable energy and provide auxiliary services to strengthen the grid.

*Data source：SNE Research, data as of June 30, 2023

Core Technologies Enable Superior Performance

Authentic Safety Technology

Safety and reliability of aviation level

CATL ensures battery safety in operation through raw materials selection and design, multi-protection structure, automatic manufacturing, comprehensive test and validation, monitoring and warning system.

High Energy Density Technology

Maximum mileage 1,000 km

Owing to the high energy density NCM 811, silicon-lithium combination and groundbreaking CTP (cell to pack) technologies, the system energy density of CATL battery has reached 255Wh/kg, helping to eliminate range anxiety.

Automatic Temperature Control Technology

Free to drive in cold and heat

Thanks to the intelligent thermal management system, CATL's batteries enable electric vehicles to drive in a wide temperature range from -30℃ to 60℃. By using a unique battery self-heating technology, the battery is able to warm up to 6°C per minute without additional cost.

Super-fast Charging Technology

Charging to 80% capacity in five minutes

Because of the revolutionary material and electrode management technologies, CATL has built an efficient lithium-ion high way to promote charging speed dramatically; together with a smart thermal detective system, super-fast charging safety is ensured.

Long-life Technology

Maximum service life 16 years or 2 million kilometers

By developing innovative technologies in key parts of battery such as anode, cathode, electrolyte and electrode, etc., the company is able to slow down cell capacity fading and extend its service life, thus maintaining greater value of a used EV.

Smart Management Technology

24-hour comprehensive monitoring

CATL's leading battery management system is able to control battery parameters precisely and diagnose the unhealthy cell; predict SOC accurately. The cutting-edge V2X function enables EV owners to participate in green power trading, maximizing its benefit.

Advanced Technology

Sodium-ion Battery

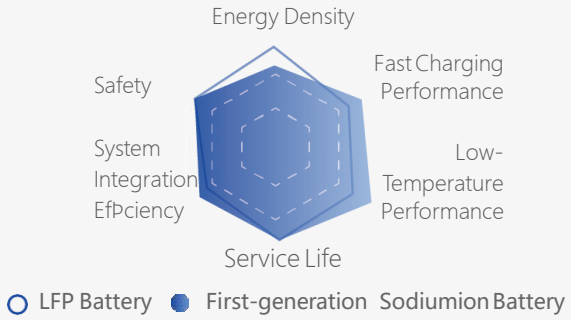
New Material System to Meet the Needs of Multiple Application Scenarios

Supported by breakthroughs in the innovation of material system, CATL's first-generation sodium-ion battery boasts high energy density, high-rate charging, excellent thermal .

≤ 30min
Charging from 10% to 80% SOC at -10°C

≥ 80%
Energy retention rate at -20°C

≥ 160Wh/kg
An energy density nearing that of LFP



M3P

Innovative Balance Among Multiple Performance Indicators

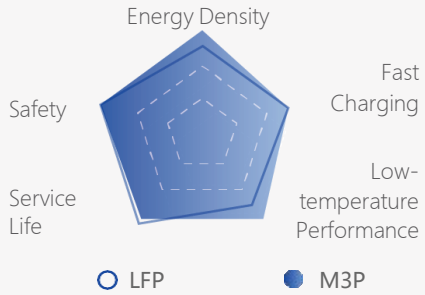
Through the first-principle high-throughput calculation and screening, CATL has developed M3P, a brand new chemical system, which greatly increases the material voltage and improves low-temperature performance, thus achieving a higher energy density than LPF battery and a lower cost than NCM battery.

Up 10%-15%
Cell energy density*

Up 20%-30%
Low-temperature performance*

Up to 900km
Range

* is performance improvement over LFP battery



Condensed Battery

High energy density +High level of safety

Open up moreelectrification scenarios

Condensed battery for electric aircrafts
With an energy density of up to 500 Wh/kg

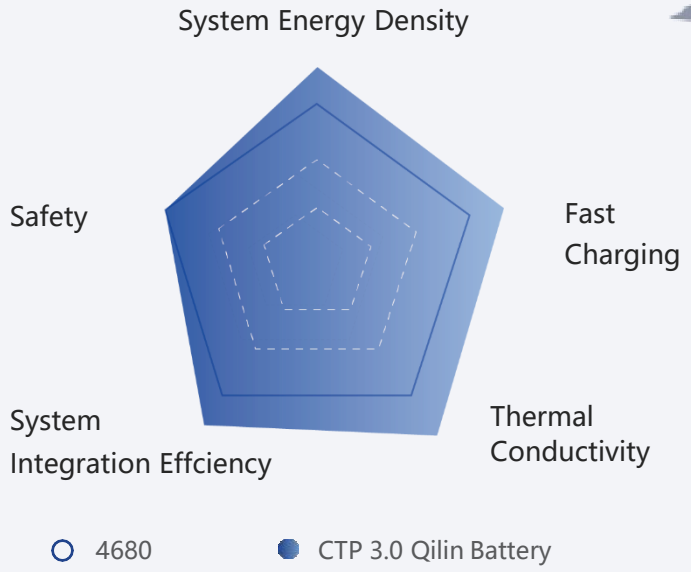
Condensed battery for electric cars
Can be mass produced within 2023

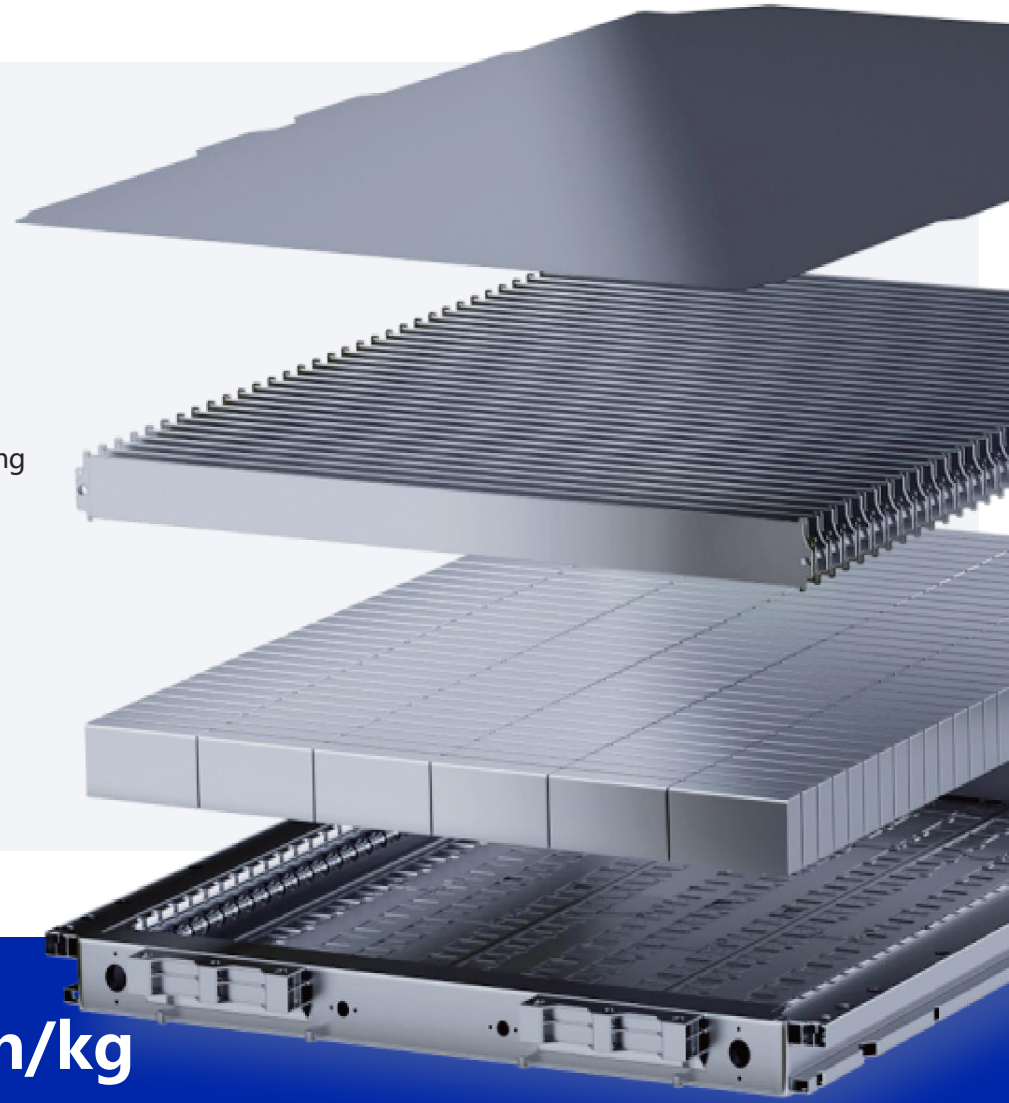
Advanced Technology

Qilin Battery

Qilin, the Premium Solution

Qilin battery, CATL's third-generation CTP technology, has achieved the highest system integration level worldwide so far, capable of delivering a range of over 1,000 km in a breeze and 4C fast charging. It has been widely recognized by the market and launched on car models soon after its release. Mass production of Qilin batteries has started.





Up to 72%
Volume utilization efficiency

Within 10min
Fast charging 10-80% SOC

Up to 255Wh/kg
System energy density for NCM

Shenxing Superfast Charging Battery

The World's First 4C Superfast Charging LFP Battery

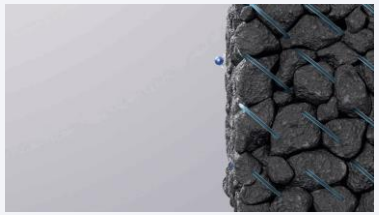
700km+
Long Range Comparable to Conventional Fuel-powered Vehicle

Charge to **80%** within **30 min**
-10℃

uncompromised **0-100 kph** acceleration **performance**
at low temperatures

10-minute Charging, 400-km Cruising

Super Electronic Network Cathode Technology

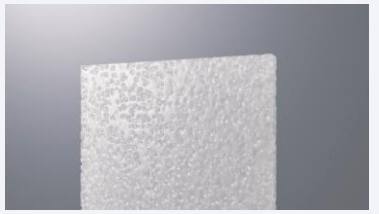


Fast Ion Ring Graphite Technology

Ultra-Thin SEI Film

Superconducting Electrolyte

High Porosity Separator

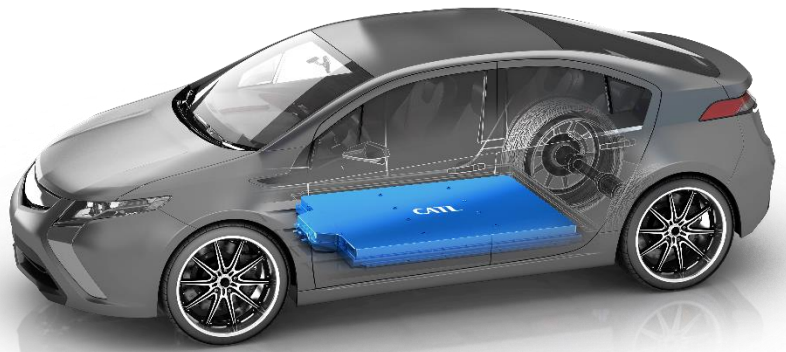


Intelligent Electrification

Passenger Vehicle Solutions

Strong, calm and in control

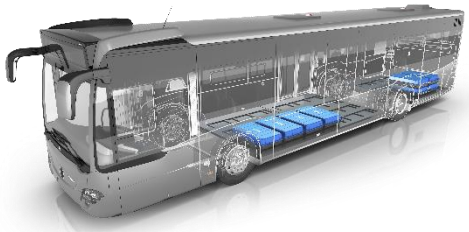
CATL's passenger vehicle products cover the needs of different segmented markets including BEV, PHEV, HEV, 48V, and 12V, and developed the widest range of OEM partners worldwide.



Electric Solutions for Personal Application	Maximum endurance mileage **1,000 km** Free EV driver from mileage anxiety	Make a significant breakthrough in battery system energy density to achieve longer endurance mileage and more EV driving pleasure.
Hybrid Vehicle Solutions	Mileage in electric mode **310 km** Comprehensive cruising range **1,160 km**	CATL's hybrid battery cell which is small and light, offers surging power instantly and makes your travel green and efficient.
Solutions for Operating Electric Vehicles	Optimal warranty of **8 years or 800,000 km** Fulfill operation requirement in full life cycle	CATL's ultra-long service life battery system solution enables operating vehicles to operate uninterrupted, 24-7-365.

Commercial Application Solutions

Earn more with each mile



Road Passenger Transport Solutions

CATL provides safe, reliable, durable road passenger transport solutions customized for various working conditions and transport scenarios, to build an environmentally friendly transport system.

Urban Delivery Solutions

Start with safe, reliable and economical principle, CATL provides comprehensive battery system solutions suitable for light trucks, mini-buses and minivans used in express, supermarket and food delivery as well as other applications, accelerating urban logistics' electrification.

Urban Cleaning Solutions

To promote the Blue Sky Protection Campaign, CATL has developed customized solutions for all kinds of sanitation vehicles. The batteries are safe and feature a strong environmental adaptability

Heavy-duty Transport Solutions

CATL provides strong and clean power for heavy-duty vehicles in mining areas, ports, and construction sites in complex conditions, to significantly improve operational efficiency and get to the root of the mobile pollution problem.

Commercial Application Solutions

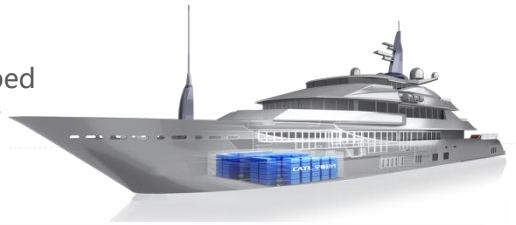
Earn more with each mile

Construction Machinery Solutions

Customized battery solutions provided by CATL are cleaner and more efficient for special vehicles, such as forklifts, airport boarding vehicles, loader, excavator, reach stacker etc. So far, they have been successfully applied in logistics parks, ports, mining areas to drive the electrification, intelligence and low-carbon development.

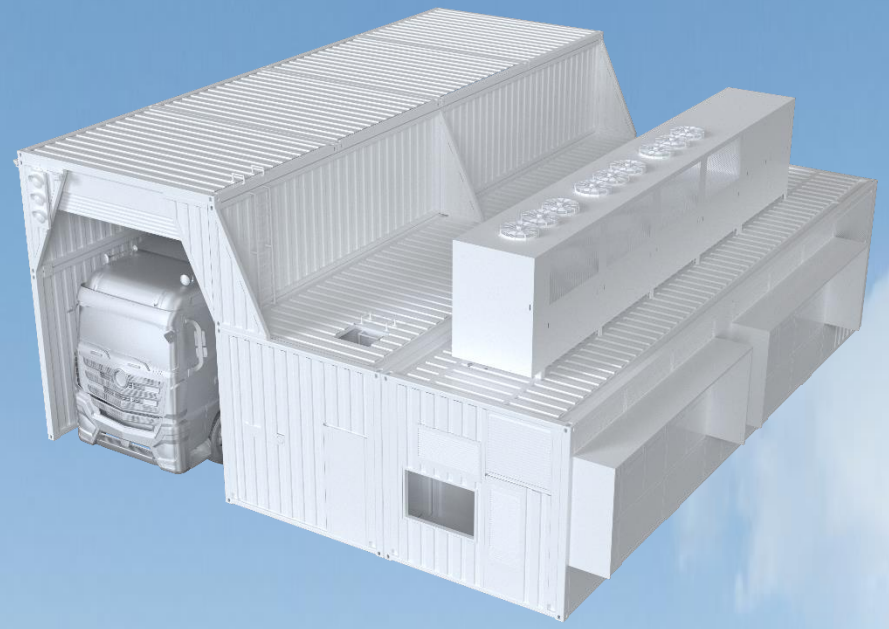
Vessel Solutions

To accelerate vessel electrification, CATL developed safe, reliable, green and environmentally friendly vessel battery products, which have successfully passed the testing guidelines of the China Classification Society (CCS).



Two-wheeled Vehicle Solutions

CATL offers green, intelligent and safe battery solutions for two-wheeled vehicles. It makes the cycling trip more comfortable, efficient and convenient for commuting, food and express delivery.



QIJI Battery Swap Solutions for Heavy-duty Trucks

CATL provides innovative battery swap solutions and services for heavy-duty trucks, which consist of heavy-duty truck QIJI battery swap station, QIJI swapping electric and QIJI cloud platform, facilitating high-efficiency operation in complex application scenarios including mining areas, ports, short-distance transportation in urban areas and construction sites.

Battery Swapping Solution EVOGO

Go With EVOGO

Based on the mode of vehicle-battery separation, Contemporary Amperex Energy Service Technology Limited ("CAES"), a wholly-owned subsidiary of CATL, has released the battery swap solution EVOGO that features modular battery swapping, making batteries shared assets and solving the three pain points of electric vehicle users, namely, range anxiety, inconvenience of refueling and high total cost of ownership.

Small Floor Space

A standard station takes up a floor space of about three parking spots.

High Capacity

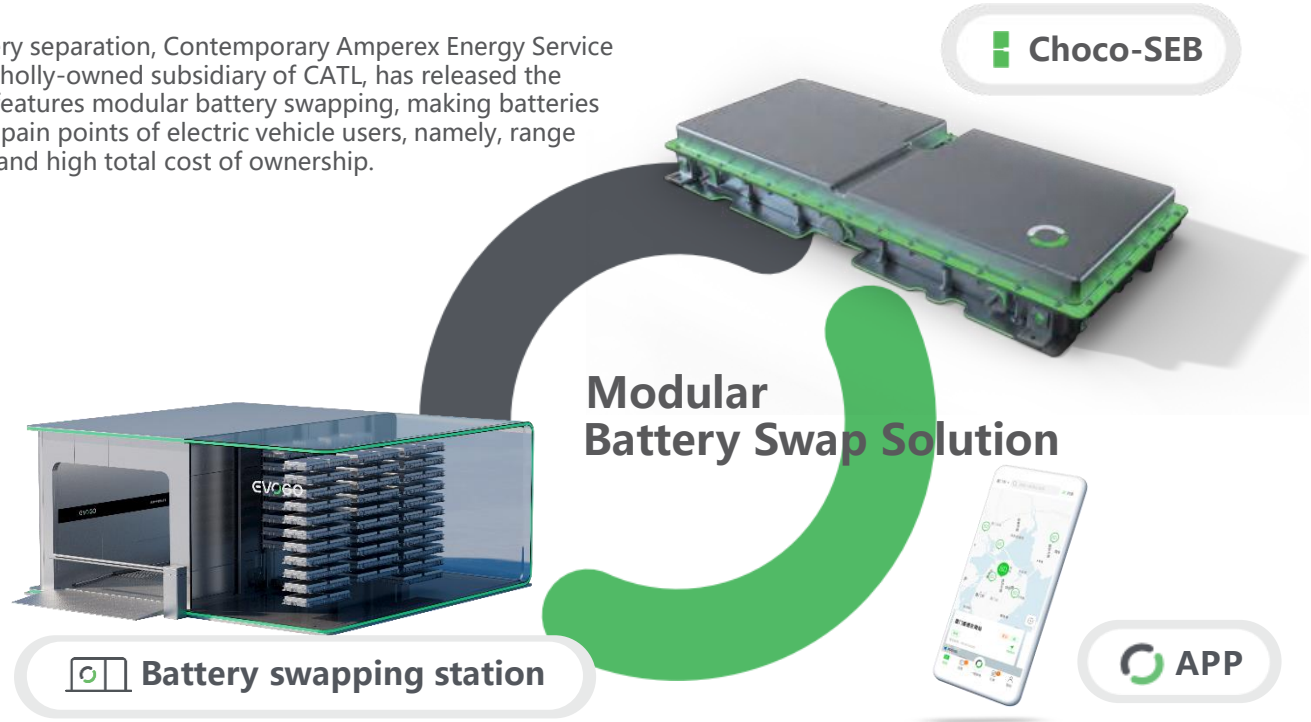
A standard EVOGO battery swap station can house up to 48 Choco-SEBs.

Rapid Circulation

It takes about 1 minute to swap a single battery.

All-Weather Solutions

A variety of swap stations suit the climates of different regions.



High-Energy Density with Small Size

CTP
(Cell-to-Pack) Technology

≈200km
Range

>160Wh/kg
Weight Energy Density

>325Wh/L
Volume Energy Density

Flexible Combination

Customers are free to take one to three blocks to meet different range requirements at swap stations

It links customers with different modules of EVOGO, allowing the connection among customers, vehicles, stations and batteries, and provides other services as well

EVOGO
Three Characteristics

High Compatibility, Freedom of Choice

Based on the development principle of universal adaptation, Choco-SEB is designed to suit most passenger cars and logistics vehicles developed on BEV platforms, and the swap stations can match all vehicle models by different OEMs that use Choco-SEBs, allowing a free choice of vehicle models for battery swaps.

Need-Based Battery Rental, Freedom of Power Consumption

EVOGO allows customers to choose the number of battery blocks to rent according to their driving scenarios and habits. Only one block is needed for inner city commuting, while for longer trips, customers can rent two to three blocks and swap them with one block after returning to the city.

Charging and Swapping, Dual-Choice Refueling

Vehicles carrying Choco-SEBs supports both charging and battery swapping for refueling. Together with the existing household charging and fast charging, EVOGO helps provide all-scenario refueling solution.

Unite for A Better Future

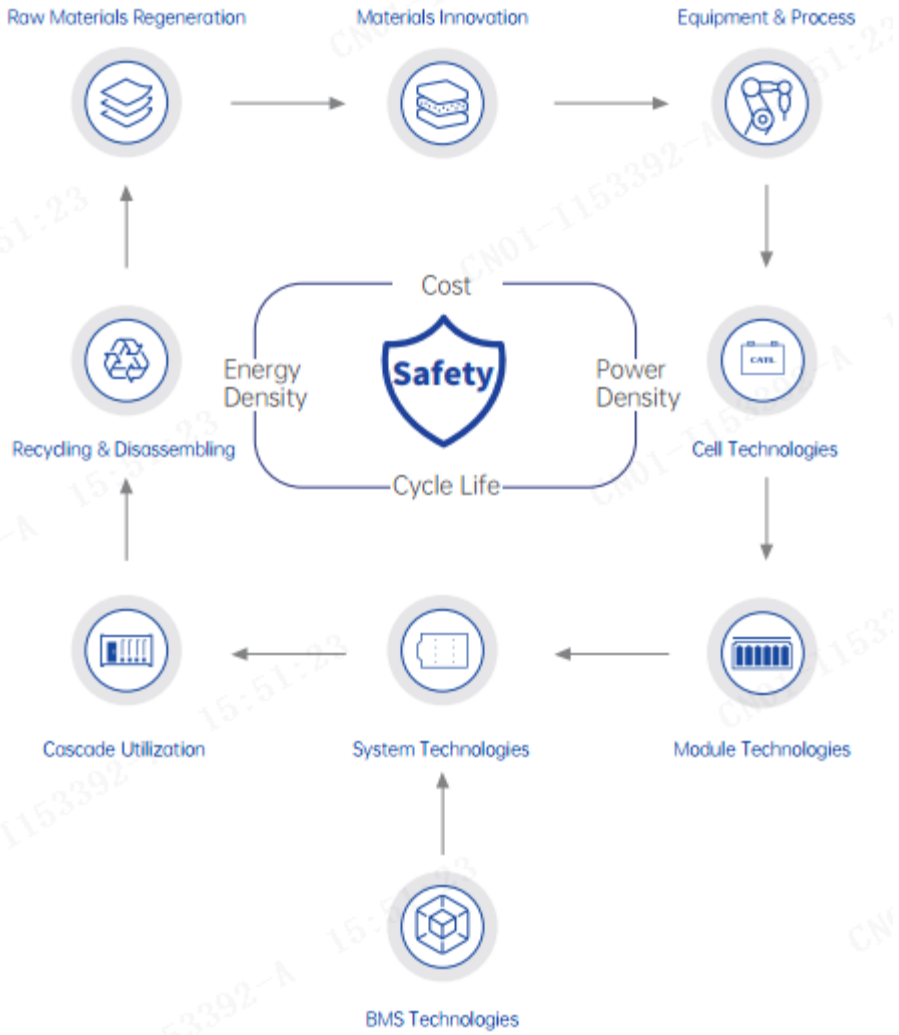
Passenger Vehicle Clients

Commercial Vehicle Clients

BESS Clients

R&D Strength

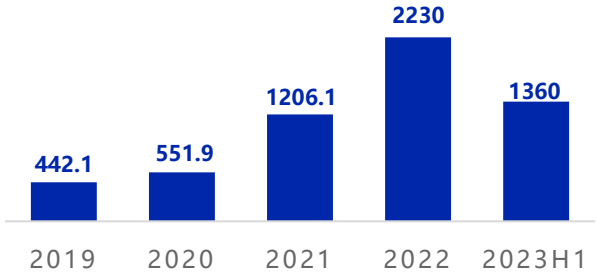
R&D Scope



R&D Investment and Talents

Annual R&D investment (M USD)

*Data: CATL's 2023H1 annual report



17,998 R&D Talent

283 Doctors

2,972 Masters

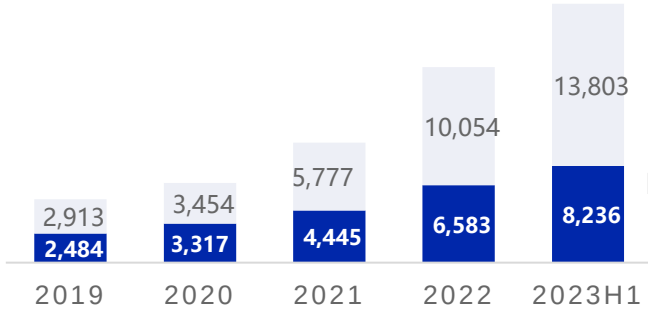
21C LAB
21C Innovation Lab

National Engineering Research Center for Electrochemical Energy Storage Technology

Key Laboratory of Lithium-ion Battery Enterprise of Fujian Province

Test and Validation Center certified by CNAS

Rapidly Increasing Number of Patents



Led or participated in the formulation or revision of

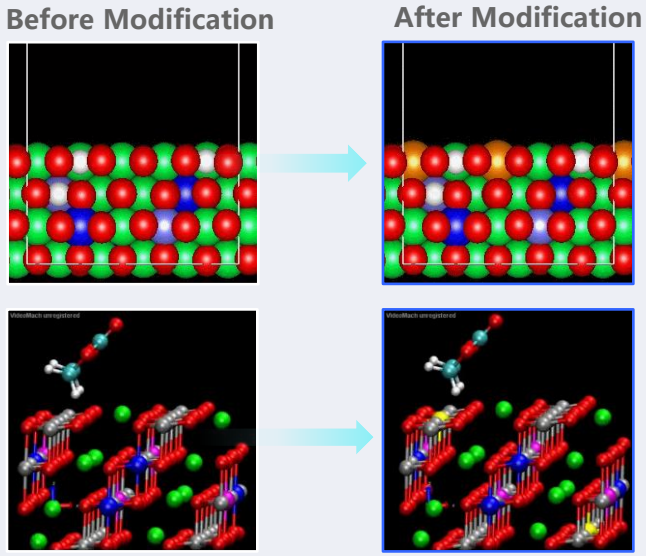
110+ national and international standards

Material R&D

Research on the microscopic mechanism of materials, develop high-performance materials

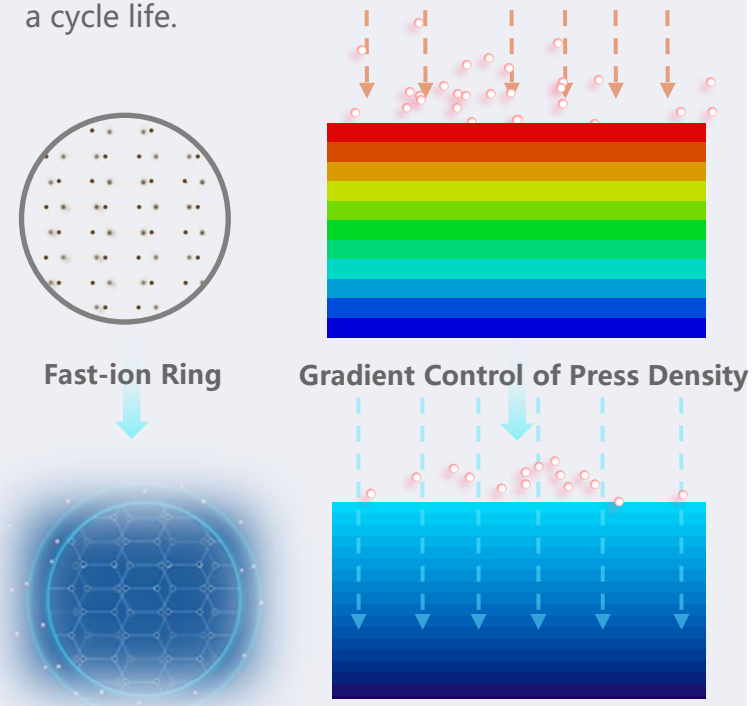
Cathode Materials: Intelligent Selection & Modification

- Structural stability enhancement.
- Create technique that intensifies the chemical strength of particles, improve cyclic stability and increase the operational life for products.
- Cathode surface coating to improve batteries' gassing and safety performance under elevated temperature.



Anode of Outstanding Performance

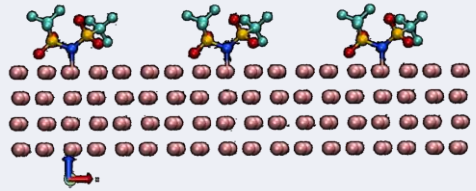
- Super Graphite: enhance kinetic property and life performance.
- Long-life Silicon Anode: CATL's SiOx with artificial SEI shows a better performance during a cycle life.



Innovative Electrolyte Technology

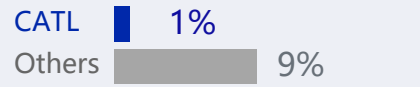
- CATL's EL is characterized by long life and low gas generation.
- Safer EL improves lithium-ion's thermal stability.
- CATL built a solid state battery platform containing material design, synthesis, characterization.

Electrolyte Simulation



Low Gas Generation ↓

45℃ | 90 days storage (volume swelling)



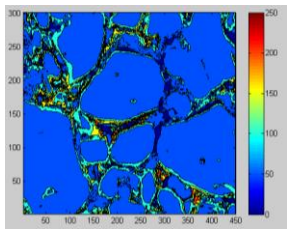
Long-life ↑

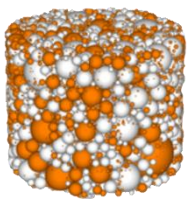
25℃ | cycle life (cycle number)

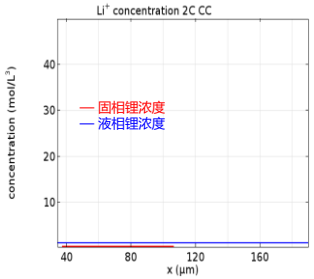
Simulation Helps to Develop Digital Battery

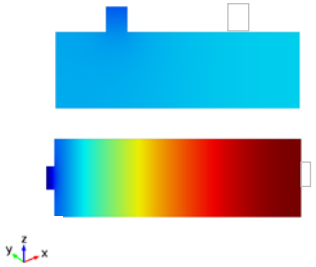
Multi-directional & multi-angled simulations, thereby creating a Digital Battery of outstanding performance

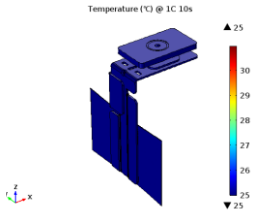
Material Selection	Material Optimization	Chemical Design	Electrode Design	Cell Parts Design	Cell Performance Simulation	Module Integration	System Integration	Operation
10^{-10}	10^{-8}	10^{-6}～10^{-4}	10^{-3}～10^{-1}	10^{-3}～10^{-1}	10^{-2}～10^{-1}	10^{-1}～10^{0}	10^{0}～10^{1}	Unit:m

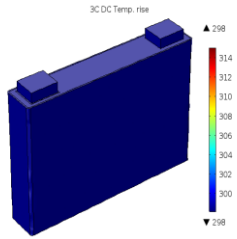


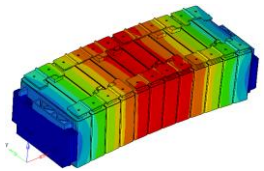


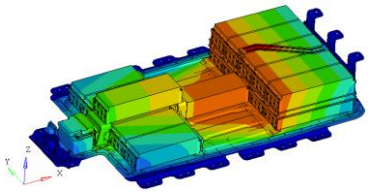








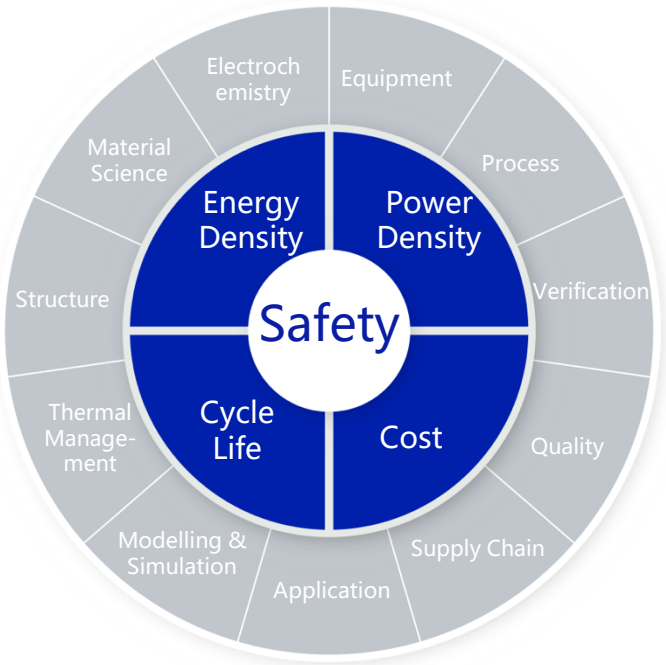




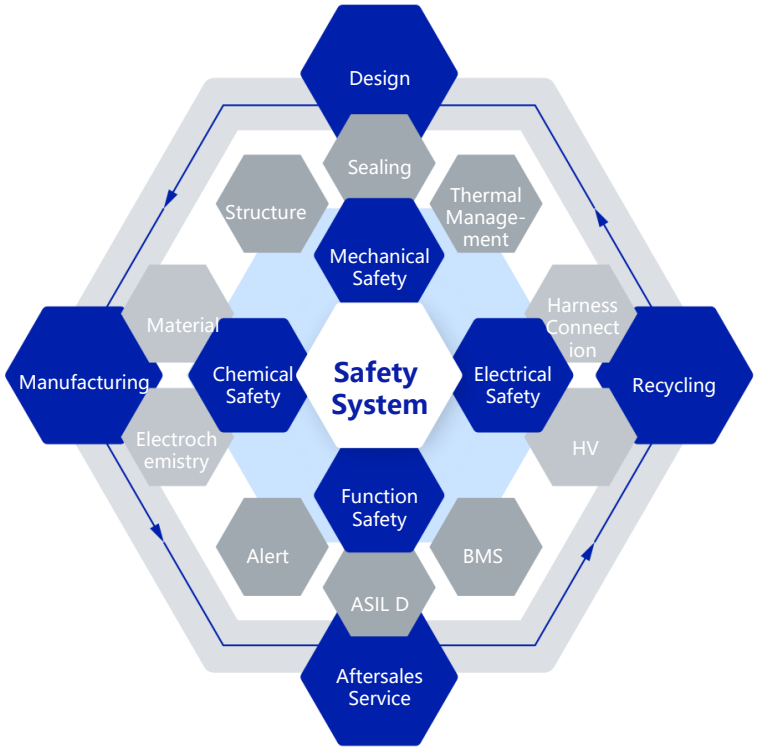
Product Design

Safety is at the core of battery design, integration as well as operation

Cell Development



System Design



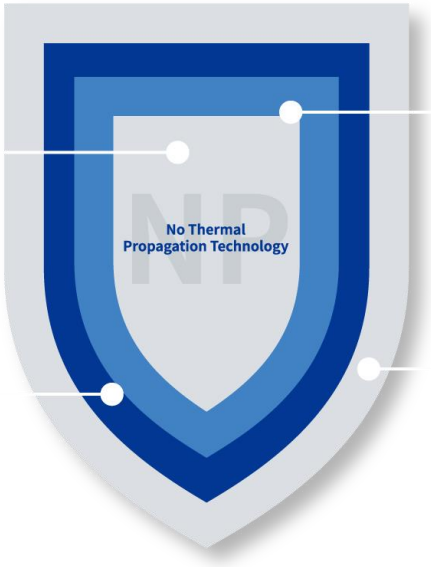
Multi-level Safety Design

Improve Material Thermal Stability

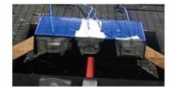
Safe cathode
Safe electrode
Heat-resistant separator

Prevent Module Thermal Diffusion

Thermal insulation design of aviation level

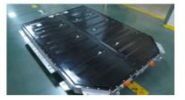


Improve Cell Temperature Resistance



Fire-resistance

Prevent Pack-level Thermal Diffusion



Fireproof & heat insulation precise spray design

Material Character Analysis & Product Test and Validation

100 Material character analyze capabilities

CATL has led and contributed to setting numerous national, industrial and corporate standards.

Leading technique

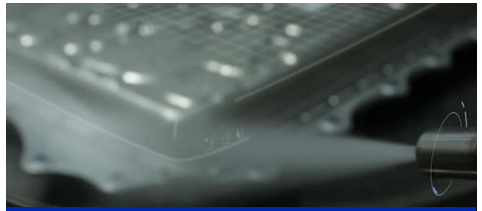
- Single particle micro-electrode analysis
- In-situ swelling analysis
- Ultra-high precision charger analysis
- Electrochemical & material simulation platforms

Testing & analyzing capability

Large-scale and multifunctional characterization capability from atomic/molecular level to device/battery level, including element, chromatography, mass spectrometry, thermal, surface structure and electrochemical analysis. CATL has created a comprehensive standard test manual for material, process and battery design.

400+ Product testing & validation items

Multi-level: material, cell, module, BMS, pack
Multi-dimension: mechanism, safety & reliability, electrical performance, etc.
Standards: cover GB/T, ISO, IEC, UN, ECE, which also enable the establishment of a complete corporate standard in the company.

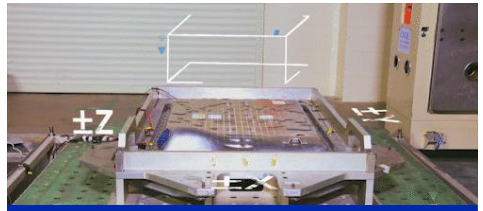

IP Test


Mechanical Shock Test


Crush Test

External Fire Test


Immersion Test



Vibration Test

Extreme Manufacturing

Committed to building a intelligent plant : flexible, efficient, low-cost, self-upgrading and of high quality

Automation

Digitalization

Intelligent

2.2M+

System Productivity (PCS/day)

150+

Max Takt Time (unit/ line/minute)

25,000+

Product Number of System-level

340,000+

Data Exchange Volume (per second)

1,000B+

Cumulative Data Points

20 Years

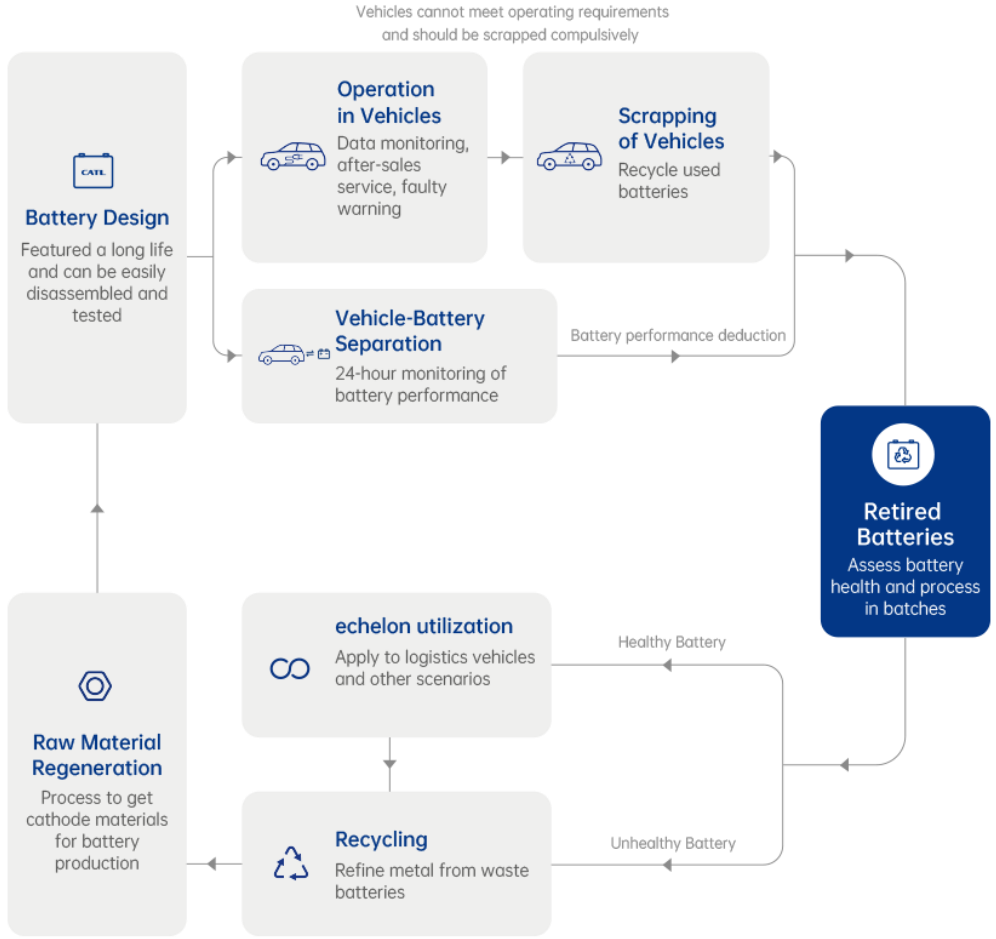
Traceability

Intelligent Plant

Adopt new technologies such as AI, image recognition, machine learning, predictive algorithms and 5G etc.

Battery Recycling and Circular Economy

Supported by its subsidiary Brunp, CATL is working with customers to create a closed loop of battery production – application – echelon utilization – battery recycling. At the same time, CATL is in talk with local partners in Europe for strategic cooperation in areas of cathode active materials and battery recycling, so as to promote CATL's localization in Europe and develop a sustainable battery value chain, thus contributing to achieving global carbon neutrality goals.



Brunp Recycling, Pioneer of Recycling

Overall Network of 7 Bases

Bases located in Guangdong, Hunan, Fujian, East China and Indonesia. Cooperate with top automotive groups, battery and material enterprises as well as academic research institutes.

335 Standards

Participated in setting and revising standards related to waste battery recycling and battery Material regeneration. Among those, 214 standards have been Issued.

2,905 Innovative Patents

Brunp takes the lead to address the issues of waste recycling through the original "reverse product positioning design" and "directional recycling" technologies.

Large-scale Recycling

120,000 Tons
Waste battery disposal ability

99.3%
Metal recovery rate of nickel, cobalt, manganese

90%
Metal recovery rate of lithium

50.4%
Comprehensive recycling rate of used batteries in China

*The data above are as of June 30, 2023

Carbon Neutrality Plan

CATL plans to achieve carbon neutrality in its core operations by 2025 and across the battery value chain by 2035

The World's First Zero-Carbon Battery Factory

In March 2022，SGS awarded Sichuan Contemporary Amperex Technology Limited(CATL-SC),a wholly-owned subsidiary of Contemporary Amperex Technology CO., Limited(CATL),the PAS 2060 certification on carbon neutrality, making the plant the world' s first zero-carbon battery factory.In February 2023, CATL-SC completed the previous year's carbon neutrality certification, demonstrating the sustainability of the zero-carbon factory.

With a total investment of over RMB 50 billion (about USD 7.58 billion), CATL-SC was established in October 2019. It has been planned that the project will be executed in 10 phases and cover a lot area of over 6,000 mu (400 hectares). After the whole project is completed, its annual production capacity will exceed 200GWh and it will become a world leading lithium-ion battery production base.

50 billion yuan
Total investment

10 phases
Project plan

400 hectares
Total land area

200 GWh
Annual production capacity

Yibin

Supervised by the Ministry of Natural Resources of the PRC
Map source：GS(2017)1267

Achieve Carbon Neutrality Through Comprehensive Measures of Carbon Reduction

Electricity

- Energy-saving technology reduces consumption
- Introduce the CFMS intelligent system
- Substitution with hydropower

Natural gas

- Thermal efficiency enhancement of boilers
- Use of the efficient condensed water recovery system
- Energy-saving technology of dehumidifiers
- Energy-saving technology of coating machines
- Net zero-carbon natural gas

Transpotation

- Electrification of logistics vehicles
- Electric mobility of employees

Others

- All-round electrification
- Remaining emissions offset through carbon trading

CATL

Together for the Energy Freedom

Rooted in the Chinese culture while embracing the global culture, strive to be a global premier innovative technology corporation, deliver excellent contribution to green energy resolution for mankind!

www.catl.com

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