Battery-Swap Electric Heavy-Duty Truck:

A Low-Carbon Transportation Like No Other

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State Power Investment Corporation Limited (SPIC)

Shanghai Qiyuan Green Power Technology Co., LTD.

SPIC at a glance

- ***One of China's Five Major Power Generation Groups with a Total Capacity of 197GW, 62.52% is Clean Energy***
- ***The Global Largest Solar Power Generator***
- ***Ranked 293rd among the Fortune 500 in 2021***

Hydroelectricity installed capacity 25GW

Wind power installed capacity 40GW

Battery-Swap Truck service

Solar power installed capacity 43GW

Hydrogen generation and transportation research and application

Heat storage, electric storage technology research and energy storage power station

An international integrated energy group

Till April 2022, SPIC oversea business covers 46 counties & regions (37counties along the "Belt and Road").

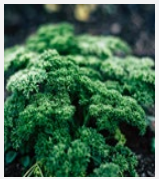
6.8GW
Oversea installed capacity

73.6%
Clean energy portion

2.468GW
Oversea installing capacity

Low-Carbon Transportation revolution in China

01 *Environmental protection requirement*



- CO2 emissions from transportation sector account for about 10% in China, and 80% of emission inside is from road transportation.

02 *Energy security demand*

- High degree of crude oil and natural gas importation.

- China has topped the global list of countries for both the production and sale of new energy vehicles (NEV) for seven consecutive years, and till April 2022, the number of NEV has exceeded 10 million in China .

Emissions from a diesel heavy-duty truck

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Emissions from 1600 passenger car

Advantages of Battery-Swap Mode

Challenges of Charging Mode

Investment Cost

- Large initial investment
- High operating costs

Time Cost

- Charging time up to 2-3 H
- Low vehicle operation efficiency

Security Risk

- Frequent fast charging brings potential safety risks to the battery

Advantage of Battery-Swap Mode

Large Cost Reduction

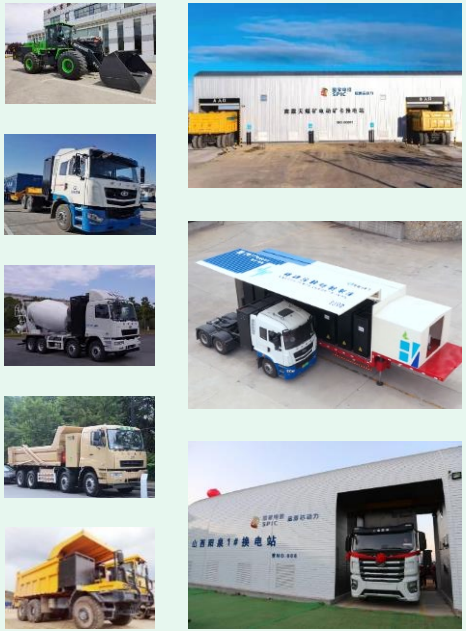
- Reduce 50% purchasing cost
- 15%-30% cost saving compared to fuel track
- Battery life extension

Replenish Energy Efficiently

- 5 mins battery swap

Battery-Charging Safety

- Battery centralized control mode is more safe
- Digital monitoring, avoid hidden dangers



The ‘Three-in-One’ Combination of Truck-Battery Separation mode

Heavy truck body without battery ---- Import, Assembly and Services

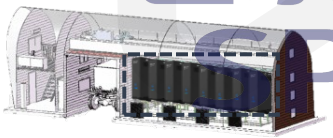
- Heavy truck import certification;
- Local assembly of heavy-duty trucks to reduce high import tariffs on complete trucks;
- Fully functional electric vehicles and power battery after-sales Service Network.

Power Battery ----Sharing Services

- Sharing lease mode;
- Battery charging or swapping, at customer’s convenience;
- Rent billed by time and consumption of electricity;
- Centralized recycling and disposal of retired batteries.

Battery-Swap Stations ----Energy Replenishment

- stationary and mobilized battery-swap stations adapt to local conditions;
- Battery-swap stations can form a network to provide services together;
- Interact with the power grid to provide electric ancillary services.



Cloud Platform Cluster ----Digital Empowerment

- Realize fine lifecycle management of power battery and BS station assets;
- Online payment, clearing and settlement services.

Star Models: BS Truck and Machinery

4×2 B-S Heavy-Duty Port Specialized Tractor

4×2 B-S Heavy-Duty Tractor

8×4 B-S Heavy-Duty Dumper

B-S Electric Mining Truck （70 tons）

B-S Electric Mining Truck （120 tons）

Electric Empty Container Handler

Electric Container reach Stacker

Electric Heavy-Duty Forklift

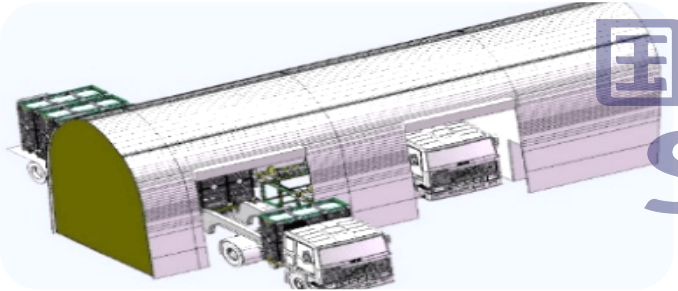
Electric bulldoze

Electric Loader （5.5 tons）

Star Models: BS station

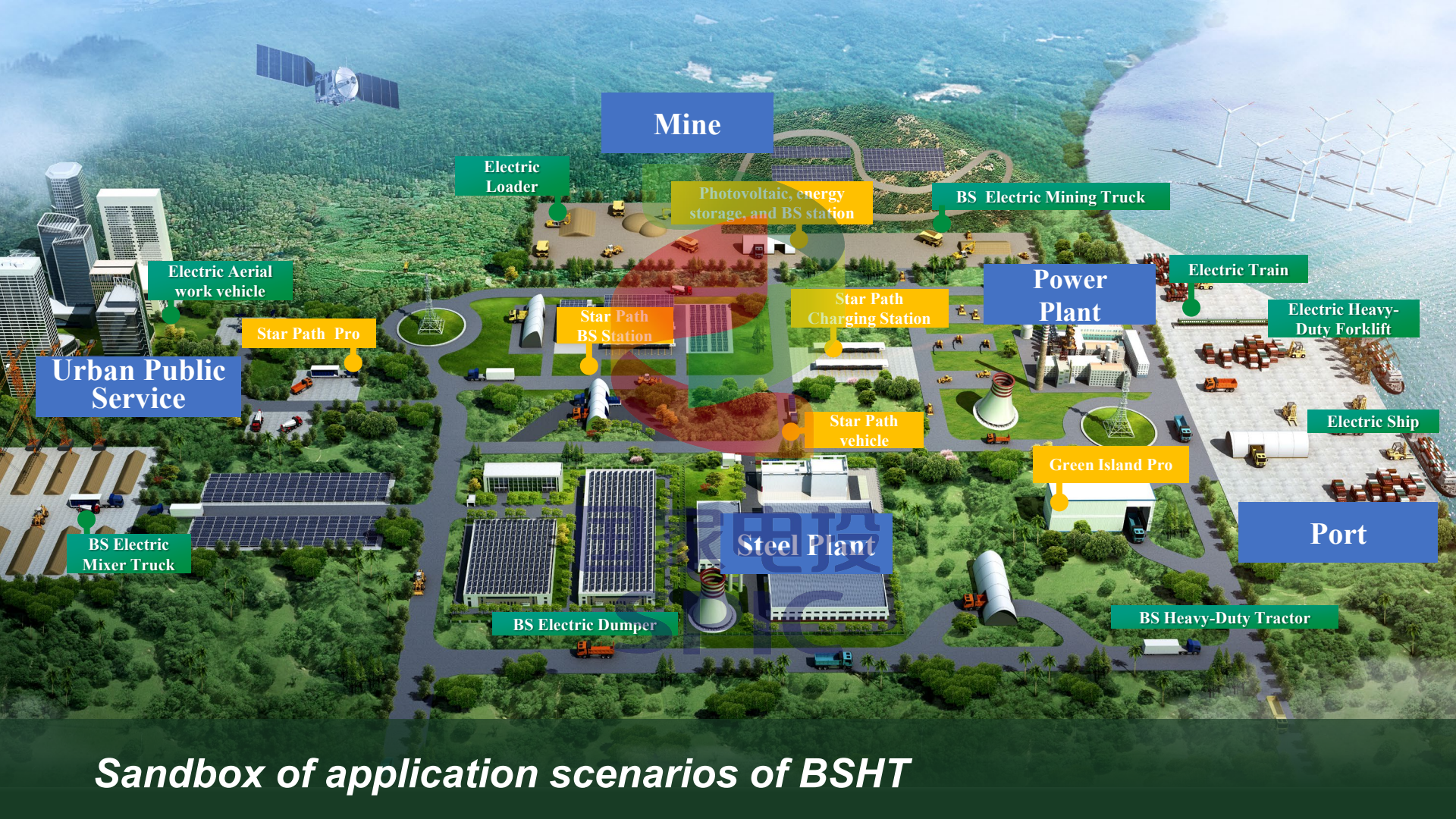
Green Island
stationary B-S station

Green Island Pro
Skid-Mounted B-S Station



Star Path
Battery distribution Vehicle and stationary B-S station

Star Path Pro
Battery distribution and Swap Vehicle



Sandbox of application scenarios of BSHT

Deployment and Development Progress of BSHT Project in China

Since 2016, SPIC has started the BSHT project, as well as the green power transportation industry, becoming a pioneer in this field.

BS Heavy-Duty Trucks

- In operation : **10,000+**
- Accumulate mileage : **over 100 million kilometers**

Batteries

- Capacity of battery assets at service : **934MWh**
- Nominal rated charging and consumption capacity : **872GWh** per year

Battery-Swap Stations

- BS station constructed and under construction :
- **150 stations in 31 provinces and municipalities**

Project case : Low-Carbon Port with BSHT

Based on the common concept of low-carbon upgrading of ports, the SPIC Green Power Transportation has reached strategic cooperation with large state-owned ports such as **Liaoning Port Group, Shandong Port, Lianyungang port, Shanghai international port Group, Ningbo port, China China Merchants Port Holdings Company, Shenzhen Yantian port and Hainan Yangpu Port.**

BS Heavy-Duty Truck Delivered to Meishan port

In Ningbo Meishan port, the first batch of **40 BS Semi-trailers** has replaced fuel trucks and carried out container transportation. The first **Green Island station** in the port has been officially put into use to supply energy to Electric Semi-trailers and further improve the efficiency of truck operation.

SPIC launched **30 BS Semi-trailers** in the Rizhao port area of Shandong Group to carry out container short reverse transportation. In October 2021, a Green Island station has been put into operation, accelerating the pace of low-carbon and intelligent operation in the port area.

Container Handling in Rizhao Port

Project case ： Huolingol South Open-pit Mine Project

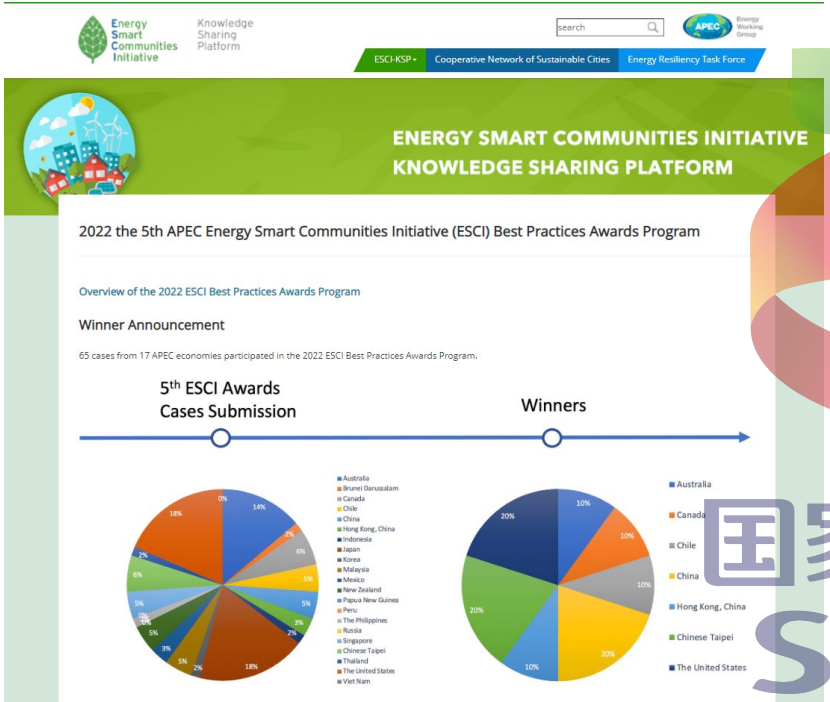
2023: Within 2 years, plan to build another 15 BS stations , and put another 300 mining trucks into use. In addition, the world's first mining truck with maximum nominal rated payload 220 tons will be put into use.

2021： Built two BS stations Providing energy replenishment service for 21 B-S mining trucks with maximum nominal rated payload 120 tons .

Economic Performance： Heavy load downhill energy feedback **reduces 15%-30% of operation costs** caused by energy saving.

Behavior Efficiency： **Excellent powertrain performance,** have power advantage under heavy load uphill condition.

Gold Award winner of the 5th APEC ESCI Best Practice Program



Our project has recently won the gold award for Smart Transportation in the 5th APEC ESCI Best Practice Award.

Winner Announcement

Pillar	Rank	Project	Economy
Smart Transport	Gold	Battery-Swap Electric Heavy-Duty Truck: A Low Carbon Transportation Like No Other	China
	Silver	MaaS(Mobility as a Service) MeN Go Program –New Opportunities for the Digital Transformation of Transportation Services	Chinese Taipei
Smart Buildings	Gold	80 Atlantic	Canada
	Silver	The Affiliated Hospital of Qingdao University (West Coast District Hospital) Smart and Low-carbon Hospital Renovation	China
Smart Grids	Gold	Project EDGE	Australia
	Silver	Microgrid Systems Laboratory	The United States
Smart Jobs and Consumers	Gold	Retro-commissioning (RCx) Training and Registration Scheme – From Active Training to In-class Training	Hong Kong, China
	Silver	Professional Training Program for Energy Managers in Industry and Mining	Chile
Low Carbon Model Towns	Gold	Kaohsiung's Green Transformation: from Heavy Industry to Semiconductor Clusters, a Roadmap to Low Carbon Nirvana	Chinese Taipei
	Silver	City of Austin- Efforts to Reduce Carbon Emissions	The United States

In 2010, APEC leaders launched the Energy Smart Communities Initiative (ESCI).
As the only project award under the APEC energy working group, ESCI Best Practice Award includes five categories: Smart Transportation, Smart Building, Smart Grid, Smart Work and Low-Carbon Demonstration Towns. The award is based on reducing the energy intensity of APEC by at least 45% by 2035 compared with 2005. It is selected every two years, and one gold award and one silver award are chosen for each category.

BS Mode Replication and Promotion Experience

1	Significant operating cost reduction compared to diesel heavy-duty truck	2	Practical environmental protected plan by the government
3	Accessible electric grid with sufficient capacity and lower electricity price	4	High-Speed mobile Internet to realize real-time operation monitoring
5	Fully functional electric vehicles and power battery after-sales Service Network	6	Financing support

Suggestion:

- In the early stage, priority should be given to **centralized vehicle operation & long-term and stable transportation business,** such as transportation **inside ports and mines**, which is convenient for after-sales service station construction and guaranteeing asset operation efficiency.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Every Change that Makes the Environment Better
is a Great Moment Worth Recording