



多元化能源保障方案 推动非道路领域电动化发展

Diversified energy supply solutions
Promote the development of non-road machinery electrification

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01

工程机械电动现状

“双碳”目标，终端拉动，电动化进程稳步推进

Electrification Development Status of Construction Machinery



为积极响应国家“双碳”政策，同时终端巨大的油电经济性推动，现阶段工程机械各板块均在发展电动化，但受限于市场需求、技术难度、设备功能等不同，各板块电动化发展程度有很大差异。目前市场需求最大，电动化程度最高的主要是**电动装载机**、**电动挖掘机**以及**电动矿卡**。启源芯动力作为综合能源服务商，根据行业需求，主要为这三类产品提供能源保障服务。

In order to actively respond to national “carbon peaking and carbon neutrality” policy and promote huge fuel-battery economy of the terminal, all sectors of engineering machinery are currently developing electrification. However, due to differences in market demand, technical difficulties, equipment functions, etc., the development degree of electrification in each sector varies greatly. At present, the engineering machinery with the highest demand and degree of electrification are dominated by **electric loader**, **electric excavator** and **electric mining truck**. Shanghai Qiyuan Green Power Tech Co., Ltd., an integrated energy service provider, provides energy supply services for the three types of engineering machinery according to sector demands.



电动装载机
Electric Loader



电动挖掘机
Electric Excavator



电动矿卡
Electric Mining Truck

挖掘机电动化发展历程

Electrification Development Process of Excavator

- ◆ **微/小挖：采用低电压平台，部分电动化。由于成本原因，国内需求较少，以出口为主。**

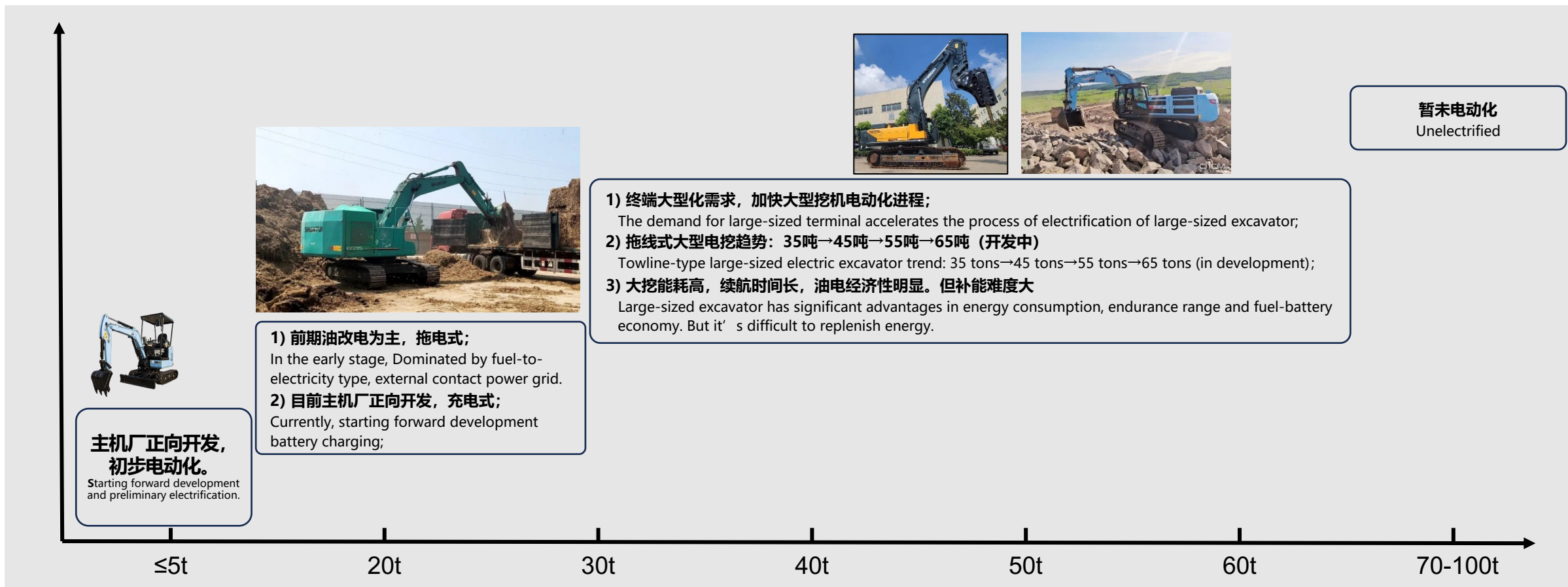
Mini/small-sized excavator: Low-voltage platform, Partially electrified. Cost restricts its domestic demand. Therefore, Export-oriented.

- ◆ **中挖：20-30吨级部分电动化，采用高电压平台，部分电动化。由于续航时间短、履带行走充电不便，市场推广效果一般。**

Medium-sized excavator: 20-30 tons, High-voltage platform, Partially electrified. Short battery life, crawler travel and inconvenient charging.

- ◆ **大挖：30吨以上多以拖电为主，市电380V直接接入。无法脱离电网，工况和场景受限。**

Large-sized excavator: ≥ 30 ton, Directly powered by 380V mains supply. Its inability to work without power grid restricts its work conditions and scenarios.



装载机电动化发展历程

Electrification Development Process of Wheel Loader



◆ 第一阶段：初期多以代理商或终端用户改装为主，后期主机厂介入，基于燃油车平台进行改造；

Stage 1: In the early stage, Dominated by modification of agents or terminal users. Later, the main producer intervened and transformed based on the fuel vehicle platform;

◆ 第二阶段：基于“油改电”发现的问题，主机厂开始逐步正向开发，电池模块化，提供装配效率，降低故障率；

Stage 2: Based on the problems discovered during the “fuel-to-electricity”, the main producer are gradually starting forward development and battery modularization to improve assembly efficiency and reduce fault rate;

◆ 第三阶段：电装技术基本成熟，但受限于电池能量密度，能量补给成为难题，行业开始尝试装载机换电(电池完全模块化)；

Stage 3: The electric loader technology is basically mature. However, due to the energy density of the battery, the energy supply has become a challenge. The battery swapping of loader is in trial (the battery is completely-modularized);

“油改电” “Fuel-to-electricity”

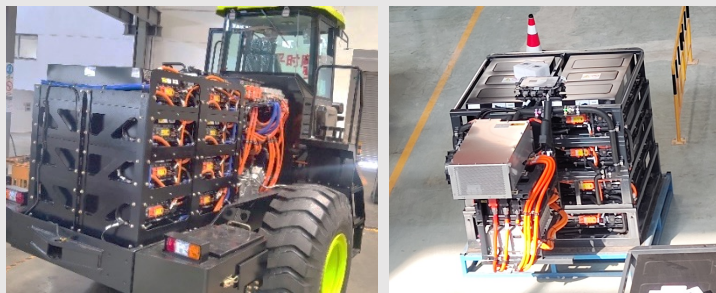
- 基于油车设计，电池电机替换发动机和燃油箱；
Based on fuel vehicle design, it replaces engine and fuel tank with the battery motor;
- 电池Pack简单堆叠，线束和管路外露；
Battery Packs are simply stacked, and wiring harnesses and pipelines are exposed;
- 容量需求，Pack分散布置，线束和管路长，故障风险高；
Capacity requirements, distributed Packs, long wiring harnesses and pipelines, and high fault risk;



第一阶段
Stage 1

“部分模块化” “Partial Modularization”

- 后车架正向开发，预计电池布置空间；
A space for batteries is reserved on the forward-developed rear frame;
- 电池Pack用框架整体集成，作为单独模块；
The battery Packs are integrated by a framework as a separate module;
- 高压盒和水冷机组车端布置，车端连接线束和管路长，无电池维修空间。
High-voltage box and water-cooled unit are arranged at the vehicle terminal connected with long wiring harnesses and pipelines, which lead to no space for battery maintenance.



第二阶段
Stage 2

“完全模块化”（发展阶段） “Complete Modularization”

(Development Stage)

- 电池Pack、高压盒和水冷机组整体集成，作为独立能量模块；
Battery Packs, high-voltage box and water-cooled unit are integrated as a separate energy module;
- 可直接换电，解决电装能源补给问题；
The direct battery swapping solves energy supply problem of electric fitting;
- 电池模块可作为整机动力单元，同时也可以对外放电；
The battery module can serve as the power unit of the entire machinery, and can also discharge externally;
- 难点：电池模块体积大，可能改变整机外观，影响驾驶员后视野；
Disadvantage: The large volume of the battery module may alter appearance of the machinery and affect the driver's rear view;



第三阶段
Stage 3

矿卡电动化

Electrification of Mining Truck

根据矿山场景的运距、重载上下、载重量需求，启源联合国内主流矿卡主机厂共同打造矿山电动自卸车的产品序列，为露天采矿企业矿山提供完整的运输解决方案，包括电动矿卡、换电站等产品。

According to load distance, heavy load travel and load capacity requirements of mine scenarios, Qiyuan Green Power cooperates with domestic mainstream mining truck manufacturers to produce a product series of mining electric dump trucks, providing complete transportation solutions for mines of open-pit mining enterprises, including electric mining truck, battery swapping station, etc.

目前已经完成载货量在**60-80吨级**、载货量**80-90吨级**和载货量在**120-140吨级刚性电驱轮**矿卡的产品开发，目前三个载货量级的矿卡销售数量占到矿卡总销量的90%。

The mining trucks with rigid electrically-driven wheels (cargo capacity:60-80 tons, 80-90 tons and 120-140 tons) have been developed. Currently, the sales of the mining trucks at the three cargo capacity levels account for 90% of the total sales of mining trucks.



载货30-40吨，总重60吨
Cargo capacity 30-40 tons,
weight 60 tons



载货60-80吨，总重90-110吨
Cargo capacity 60-80 tons, weight
90-110 tons



载货80-90吨，总重120-130吨
Cargo capacity 80-90 tons,
weight 120-130 tons



载货100-110吨级，总重150-160吨
Cargo capacity 100-110
tons, weight 150-160 tons



载货120-140吨级，总重220-240吨
Cargo capacity 120-140
tons, weight 220-240 tons

其它工程机械电动化情况

Electrification of Other construction Machinery

在“双碳”背景，除了以上3类产品外，其它工程机械产品也都在进行电动化尝试。例如推土机、压路机、伸缩臂叉车、堆高机和高空作业平台等，但由于工程机械功能和结构多样，电池跨产品通用难度大，整体规模化不足，因此电动化进程缓慢，基本都停留在尝试或样车阶段。

In the context of “carbon peaking and carbon neutrality”, in addition to the above three types of products, other engineering machinery are attempting electrification, for example, bulldozer, road roller, telescopic forklift, stacker and aerial work platform, etc. However, due to diverse functions and structures of engineering machinery, it is difficult for batteries to be widely used across products, and the overall scale is insufficient. Therefore, the electrification progress is slow, and most of them are still in the trial or prototype stage.

未来发展趋势:

- ① 根据设备所需功率，统一不同产品电压平台：低/中/高。
- ② 同电压平台电池通用，通过电池并联满足不同产品布置和电量需求。
- ③ 不同产品间电池共享，降低电池闲置率。

Future development trend:

- ① According to the required power of the equipment, the voltage platform is unified for different products: low/medium/high.
- ② Batteries on the same voltage platform are universal, and are connected in parallel to meet requirements for different product layouts and capacities.
- ③ Batteries can be shared by different products to reduce idle rate.



打桩机/Pile Driver



推土机/Bulldozer



伸缩臂堆高机
Telescopic Stacker



压路机
Road Roller



登高机/Elevating Truck



叉车/Forklift



升降平台
Elevating Platform

- ◆ 设备无人化：探索阶段，目前行业普遍实现“车端无人”（远程遥控），“真无人驾驶”还处于实验室验证阶段；

Unmanned equipment: In the exploration stage, the industry is generally implementing “unmanned vehicle terminal” (remote control); however, “real unmanned driving” is still in the laboratory verification stage;

- ◆ 场景端无人：矿卡已经实现真无人驾驶，但产业化落地商业化，还需要国家政策/产业链上下游/终端用户共同推动；

Unmanned scenario terminal: the mining truck has achieved real unmanned operation. However, industrialization and commercialization still require the joint promotion of national policies/upstream and downstream of the industrial chain/terminal users;

电动装载机/电动挖掘机 Electric Loader/Electric Excavator

- ① 主机厂与科技公司联合开发，目前已经实现车端无人（远程遥控），并在部分场景进行了应用；
 - ② 无人智能驾驶，目前一线主机厂以及行业新势力还在加紧研发中，目前基本可以实现自动作业，但安全性和可靠性还需要进一步有验证；
- ① companies have jointly developed. TMain engine plants and technology he unmanned vehicle terminal (remote control) has been achieved, and applied in some scenarios;
- ② The unmanned intelligent driving is currently being developed by the front-line main engine plants and industrial new forces. The automated work has been basically achieved. However, safety and reliability still need further verification;



无人驾驶换电矿卡 Unmanned Battery Swapping Mining Truck

23年3月，由启源芯动力、伯镭科技、特百佳等联合开发无人驾驶换电矿卡“电牛”下线，搭载伯镭科技自研自动驾驶系统。目前在南方水泥矿山进行场景端应用测试。

根据现场测试情况，一台“电牛”每年至少能够为运营方减排二氧化碳260吨，节省至少20万元人力成本。

In March 23, “Electric Cattle”, an unmanned battery swapping mining truck jointly developed by Qiyuan Green Power, Shanghai Boonray Intelligent Technology Co., Ltd., Top Gear, etc., and equipped with automated driving system developed by Shanghai Boonray Intelligent Technology Co., Ltd., rolled off the production line. Currently, it has been carried out scenario terminal application test in the mines of South Cement.

According to the site test, an “Electric Cattle” can reduce carbon dioxide emissions by at least 260 tons per year for the operators, saving at least RMB200,000 in labor cost.



02

多元化能源保障方案

“充换送”为一体的定制化解决方案

Diversified Energy Supply Solutions



“充-换-送” 相结合的综合补能方式

Integrated energy recharging method combining “charging-swapping-transmission”



构建完善的能源补给产品矩阵，组合输出**光、储、充、换、送**一体**综合能源补给方案**，实现更多场景覆盖，**直充则充、直换则换，充换送结合**，突破电动化应用场景限制！

Build a perfect energy supply product matrix, and output **Integrated Energy Supply Solutions** combining **Light, Storage, Charging, Swapping and Transmission** to achieve coverage of more scenarios. “**Charging if appropriate, swapping if appropriate, combination of charging and swapping**”, breaking through restriction of electrification application scenarios!

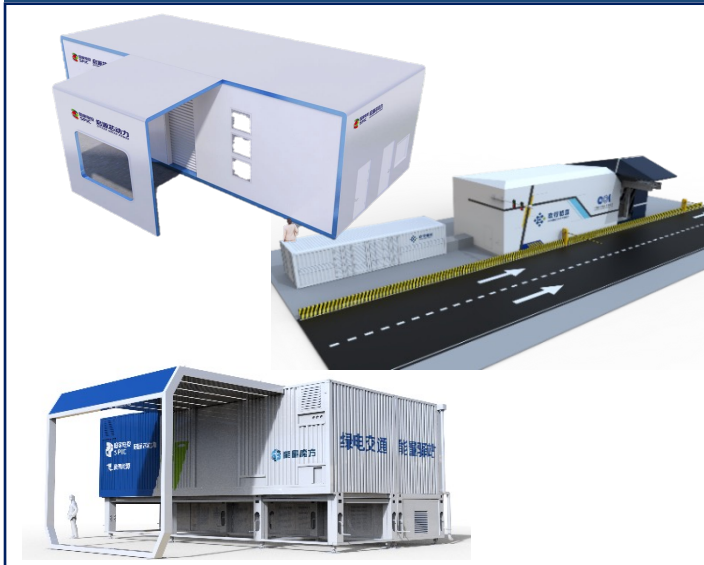
综合能源补给方案

Integrated Energy Supply Solutions

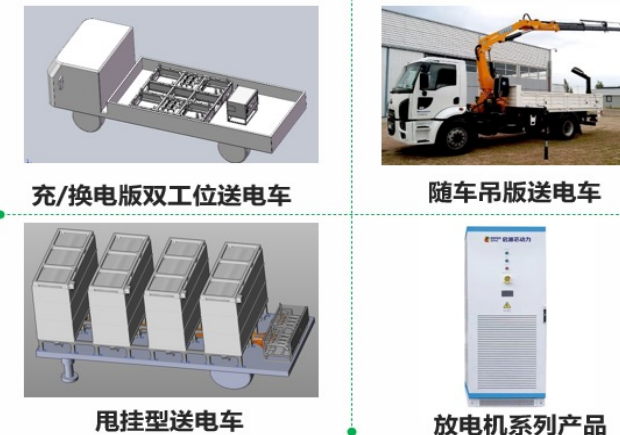
充电系列产品 Charging Series Products



换电站系列产品 Battery Swapping Station Series Products



送电系列产品 Power Transmission Series Products



储充一体、站网互动型充电机 (科技部课题项目)

Charger with integrated storage and charging and interactive station network (a research project of the Ministry of Science and Technology)

光伏直供换电站技术方案 PV Direct supply battery swapping station technology solutions

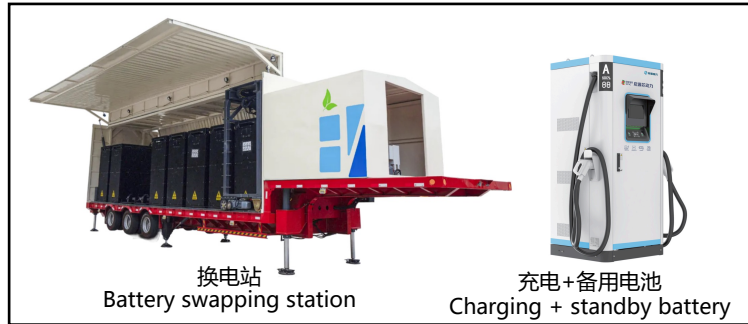
电动挖掘机能源保障方案

Electric Excavator Energy Supply Solutions



针对30吨以上电动挖掘机，续航时间短，充电难等问题，将电池从车端分离，提高电池灵活度。启源提出专门针对30-70吨级电动挖掘机能源补给方案：**电池从车端分离，通过快速充电/换电完成电动挖掘机补能。**

To address the difficulties of the electric excavators weighing over 30 tons, such as short endurance range, difficult charging, etc., the batteries are separated from the vehicle terminal to improve flexibility of the batteries. Qiyuan Green Power proposes special energy supply solutions for 30-60-ton electric excavators: **the batteries are separated from the vehicle terminal, and can be recharged for the electric excavators through fast charging/swapping.**



电池/Battery: 2×282kwh
尺寸/Dimensions: 4700x2300x2968
重量/weight: 9 ton
电缆收放/Max. cable length: 50 m
最大车速/Max. speed: 5.0km/h
Other battery optional: 2×350kwh
2×344kwh, 2×400kwh等



为了做好能源服务，更好的“送电到车”，启源开发了一系列能源补给辅助设备：

In order to provide good energy services for the better “Power Transmission to Vehicle”, Qiyuan Green Power has developed a series of energy supply auxiliary equipment:



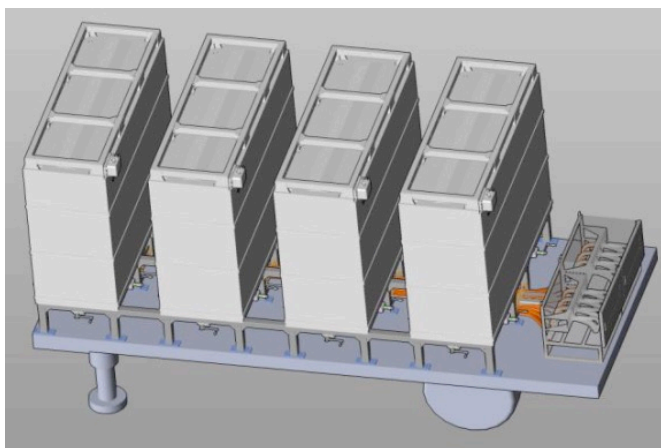
移动送电车/Mobile Power Transmission Truck



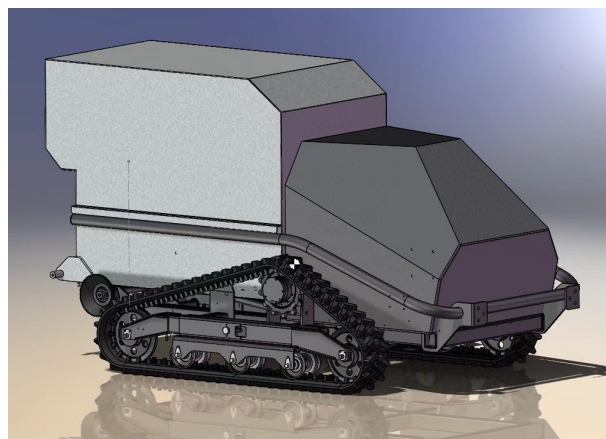
移动充电舱/Mobile Charging Cabinet



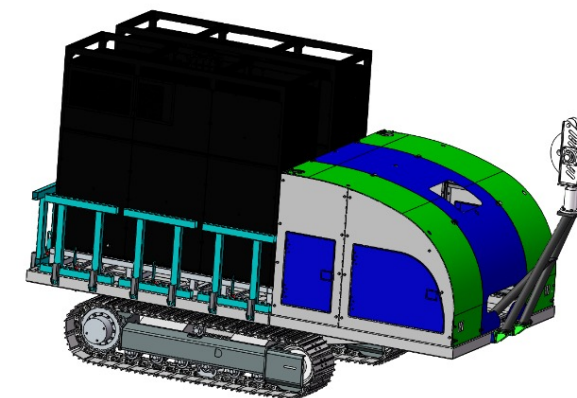
移动换电车/Mobile Battery Swapping Truck



甩挂供电车
Trailed Power Supply Truck



M200移动补电车
M200 Mobile Power Recharging Truck



M500 移动供电车
M500 Mobile Power Supply Truck

电动装载机车电分离方案

Electric Loader Truck-Battery Separation Solutions



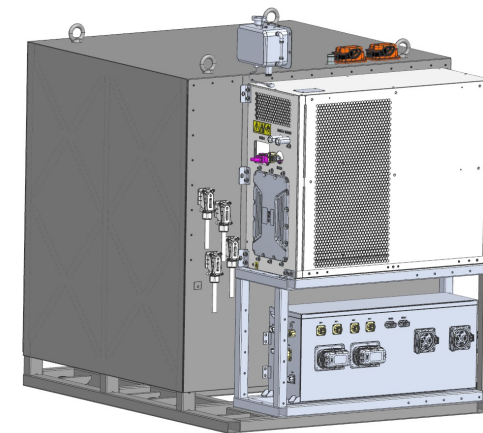
◆ 启源车电分离方案

Qiyuan Green Power Truck-Battery Separation Solutions

- ① 电池完全模块化，可充可换。
 - ② 车电分离，灵活配置金融方案。
 - ③ 电池作为独立能量单元，配置放电机电可为其它设备供电。
 - ④ 车储共用，二次利用，充分挖掘电池剩余价值。
- ① Completely-modularized batteries can be charged and swapped.
 - ② The truck-battery separation provides flexibly-configured finance solutions.
 - ③ As a separate energy unit, the batteries are equipped with a discharger to supply power for other equipment.
 - ④ The remaining value of the batteries can be fully excavated through truck storage sharing and secondary utilization.



NO	电量/Capacity	适配机型/Adaptable Models
1	141kwh	3吨以下电装 ≤3 tons electric loader
2	200kwh	3吨以下电装 ≤3 tons electric loader
3	284kwh	5吨普通型, 6吨经济型 5 tons standard type, 6 tons economical type
4	370kwh	5吨长续航, 6吨普通型 5 tons long endurance range, 6 tons standard type
5	400kwh	6吨长续航, 7吨电装 6 tons long endurance range, 7 tons standard
6	600kwh	8-10吨电装 8-10 tons electric loader

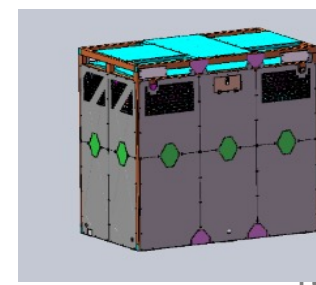
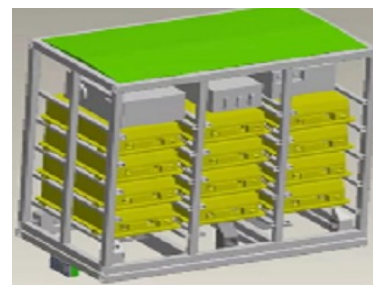
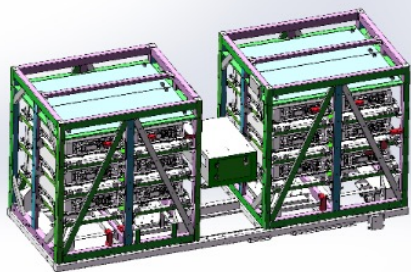


换电矿卡

Battery Swapping Mining Truck

根据矿卡特点，启源联合开发不同的电池方案，主要有分体后背式，整体后背式，甲板式，并且适配换电站，换电站也多次设计优化，从以换电为中心到以保运营为中心转变，从多维度提升产品的适应性，目前已在多个矿山项目落地

Qiyuan Green Power proposes different battery swapping battery solutions for different types of mining trucks: split back type, integrated back type, deck type, etc. Three battery swapping solutions support the mining truck battery swapping station. Currently, the solutions have been applied in multiple projects. Users can flexibly choose according to their needs.



换电矿卡

Battery Swapping Mining Truck

◆ 启源矿卡换电站 Mining truck swapping station



青海格尔木
Qinghai Golmud



南矿
South Open-pit Coal Mine



鹤岗
Hegang

03

推动工程机械规模化电能替代

为零碳工程机械保驾护航

Promote large-scale Construction Machinery Electrification



01

基础设施共建、共享

Co-construction and sharing of infrastructure



- **投资或加盟共建：**以开放的心态，邀请金融机构、货主企业、能源企业等产业链上下游以资本注入或者加盟的方式共建能源基础设施。

Investment or franchising co-construction: With an open mindset, invite financial institutions, cargo owners, energy enterprises and other upstream and downstream enterprises in the industry chain to co-construct energy infrastructure through capital injection or franchising.

- **共享互换：**呼吁行业采用统一的技术路径，保证能源基础设施的共享流通属性，为行业发展创造良好的营商环境。

Sharing and exchange: Call on the industry to adopt a unified technical roadmap to ensure sharing and circulation attributes of energy infrastructure, thereby creating a good business environment for industry development.

02

挖掘动力电池价值

Excavate value of power battery



- **探索车储共用储能：**打造“车储共用”电池系统模式，兼容储能电站直流侧和矿卡/工程机械等动力场景应用。

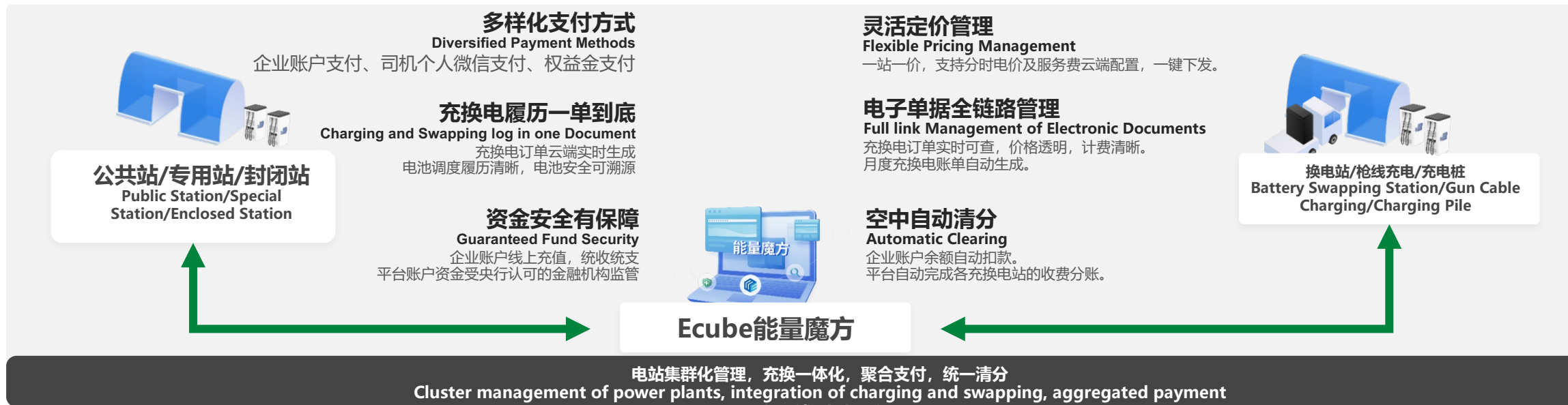
Explore energy storage mode of truck storage sharing: Create “truck storage sharing” battery system mode, that is compatible with the DC side of energy storage power station and mining truck/engineering machinery and other power scenario applications.

- **探索能源基础设施参与V2G：**通过能源大数据、车联网等手段，探索换电站、储能电站等参与需求侧应急响应等功能。

Explore participation of energy infrastructure in V2G: Explore the participation of battery swapping station, energy storage power station, etc. into demand side emergency response and other functions through energy big data, Internet of Vehicles (IoV) and other means.

推动能源基础设施网络共建、共享、共赢

Promote co-construction, sharing and win-win cooperation of energy infrastructure network



为助力实现双碳目标，保障国家能源安全，加快推动能源基础设施建设与绿电交通协同发展，恳请相关部委出台相应指导政策，加强产业扶持力度。

To help achieve carbon peaking and carbon neutrality target, ensure national energy security, and accelerate the coordinated development of energy infrastructure construction and Green Power Transportation, we earnestly request relevant ministries and commissions to introduce corresponding guiding policies and strengthen industrial support.

强化能源基础设施建设统筹规划

Strengthen overall planning of energy infrastructure construction

- 完善充换电基础设施建设配套政策。如将充换电配套设施(含电力配套)建设列入专项规划;
Improve supporting policies for construction of charging and swapping infrastructure. For example, the construction of charging and swapping supporting facilities (including power supporting facilities) is included into special planning;
- 明确牵头主管部门，统筹协调换电站建设所需的土地、电网建设等保障措施。
Define the authority in charge, and coordinate land, power grid construction and other security measures required for the construction of battery swapping station.

强化电动工程机械市场引导

Strengthen market guidance of electric engineering machinery

- 加强重点行业的工程机械电动化率指标监管。如将工程机械的电能替代比率作为施工单位、矿山、搅拌站、等的企业评级指标等。
Strengthen the supervision of the electrification rate indicators of engineering machinery in key industries. For example, the electric energy substitution ratio of engineering machinery is used as an enterprise rating indicator for construction units, mines, mixing plants, etc.

完善财政支持政策

Improve financial support policies

- 对充换电站投资运营企业提供适当的建设及运营财政补贴;
Provide appropriate financial subsidies for construction and operation of charging and swapping station investment and operation enterprises;
- 对主动更换纯电动新能源工程机械的用户予以适当的购买补贴政策;
Provide appropriate purchase subsidy policies to the users who actively replace pure electric new energy engineering machinery;
- 鼓励电网企业为充换电基础设施提供低成本的电力保障。
Encourage power grid enterprises to provide low-cost electricity security for charging and swapping infrastructure.

加快行业技术标准统一

Accelerate unification of industrial technical standards

- 加快电动工程机械相关产品及补能基础设施标准体系的立项、制定及审批流程，引导行业有序、健康发展;
Accelerate establishment, formulation and approval process of the standard system for electric engineering machinery and its related energy recharge infrastructure, and guide orderly and sound development of the industry;

电池银行及充换电网络已实现核心场景规模化覆盖

Battery banking and charging and swapping networks have achieved large-scale coverage of core scenarios



启源芯动力在全国31个省市区已投运换电站380+座，建设中150+座，配套在运营电池8000+套，累积交付重卡及工程机械20000+，主要覆盖六大场景：矿山、钢厂、港口、电厂、干线网络和城市渣土。

Qiyuan Green Power has 380+ battery swapping station in operation and 150+ Battery swapping station under construction all over China, mainly Cover 6 core conditions.



投建充换电站 (座)

380+



在运营电池 (套)

8,000+



累计交付重卡及工程机械 (辆)

20,000+



矿山

Mines



钢厂

Steel refinery



港口

Port



电厂

Power plant



干线组网

Trunk network



城市渣土

Urban dregs

换电重卡交付市占率/Market share of delivered battery swapping heavy trucks

62%

充换电站投建市占率/ Market share of built charging and swapping station

67%

*截至2023年8月底

扩大绿电交通生态圈，助力工程机械行业规模化电能替代

Expand ecosystem of Green Power Transportation and promote large-scale electric energy substitution of construction machinery



主机厂 Main producer



核心零部件 Core parts and components supplier



新能源交通运营商 New energy transportation operators



绿色电力 Green power



能源管理 Energy management



智能交通解决方案 Intelligent transportation solutions





绿电交通与能源基础设施协同发展

Coordinated Development of Green Power Transportation and Energy Infrastructure

绿色交通与综合智慧能源耦合，依托电动化、智能化、网联化和共享化带来的技术变革，显著提升交通设备能效水平，并通过智慧能源网、交通网、信息网“三网融合”，实现电动交通和智慧能源的智能互动与深度融合。



让交通更绿色 让生活更美好
Greener Transportation, Better Life



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