



电力规划设计总院

China Electric Power Planning & Engineering Institute

中国电力系统转型概况

Performance of China's Power System Transition

电力规划设计总院 国际部主任 方晓松

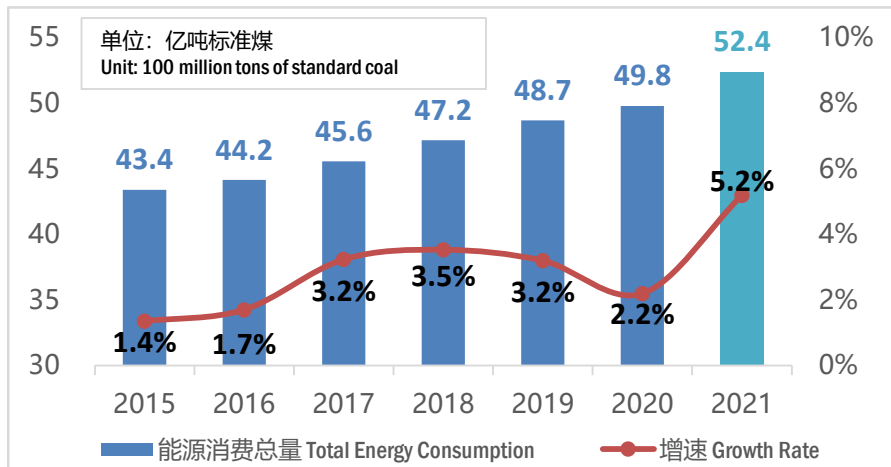
FANG Xiaosong, Director of International Department, EPPEI

2022/09/21

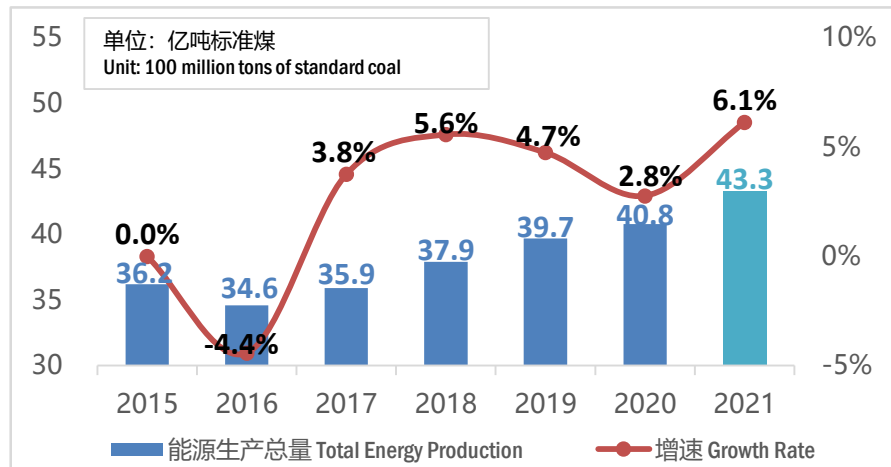
01 能源领域转型

Energy Sector Transition

能源生产保障能力稳步提升。2021年，中国一次能源消费总量为52.4亿吨标煤，同比增长5.2%。带动一次能源生产量达到43.3亿吨标煤，同比增长6.3%，增速均创10年新高。2015-2021年以较低的能源消费增速保障了国民经济的较快发展。**China's energy production capacity has been steadily improved.** The growth rate of primary energy production hit a 10-year high in 2021. The rapid development of the national economy is guaranteed by relatively low energy consumption growth rate from 2015 to 2021.



中国2015-2021年能源消费情况
China's Energy Consumption in 2015-2021

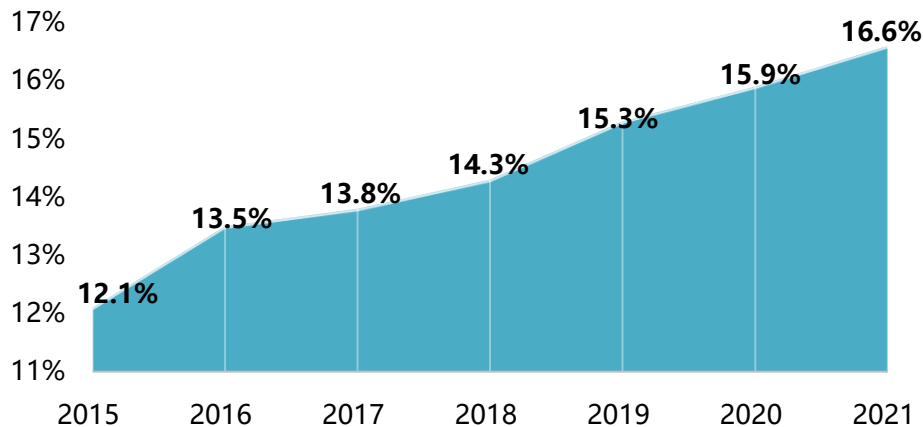


中国2015-2021年能源生产情况
China's Energy Production in 2015-2021

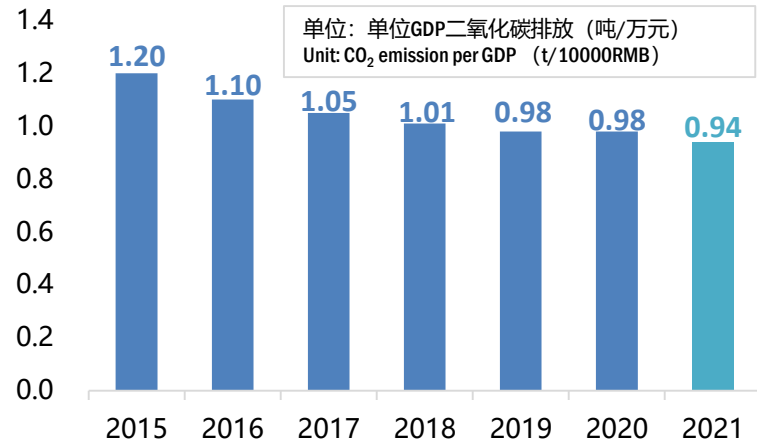
01 能源领域转型

Energy Sector Transition

能源绿色转型加快推进。2021年，中国非化石能源生产和消费比重分别达到20.3%和16.6%，较上年均提高了0.7个百分点。单位GDP能耗强度下降了2.7个百分点，碳排放强度下降了3.8个百分点。**China's green energy transition has been accelerated.** In 2021, the proportion of non-fossil energy production and consumption reached 20.3% and 16.6%, respectively, both up 0.7 percentage points from 2020. Energy intensity (total energy consumption per unit of GDP) dropped by 2.7 percentage points, and carbon emission intensity decreased by 3.8 percentage points.



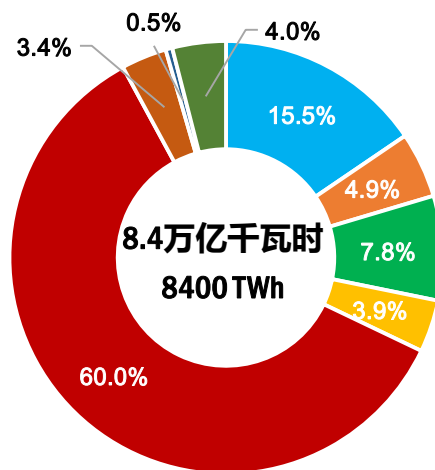
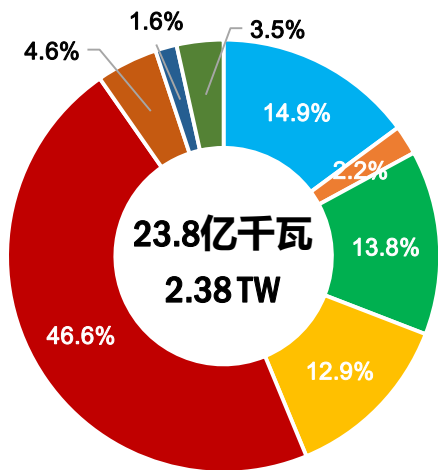
中国2015-2021非化石能源消费量占比
Proportion of China's Non-Fossil Energy Consumption in 2015-2021



中国2015-2021年能源消费情况
China's Energy Consumption in 2015-2021

◆ 电源侧 Power Side

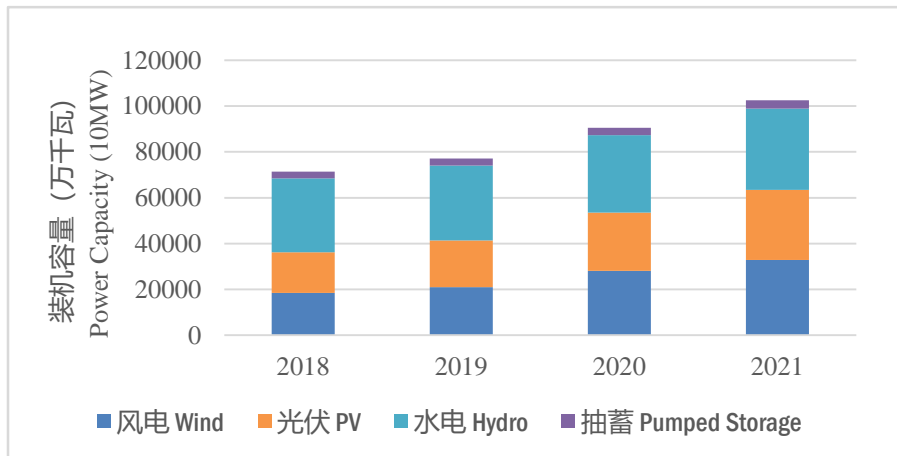
电力供应保障能力逐步夯实。2021年，中国发电装机达到23.8亿千瓦，同比增长9.5%；发电量8.4万亿千瓦时，同比增长4.0%。China's power supply capacity has been gradually strengthened. In 2021, China's installed power capacity reached 2.38TW, with a year-on-year growth of 9.5%; power generation reached 8400TWh, up 4.0% year on year.



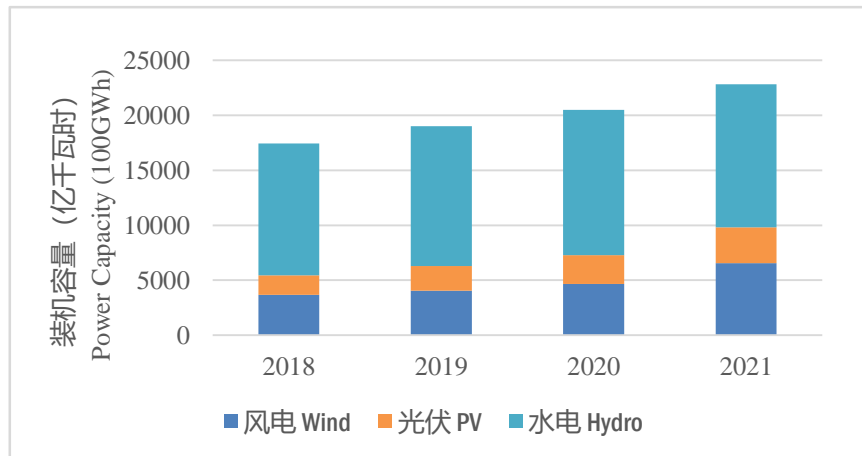
2021年中国电源发电装机和发电量 China's Power Supply & Power Capacity by Source in 2021

◆ 电源侧 Power Side

绿色电源占比大幅提升。2021年，中国可再生能源发电装机历史性突破11亿千瓦，占总装机的比重达到45.8%，风电、光伏均居世界第一。可再生能源发电量达到2.49万亿千瓦时，占全社会用电量的29.9%。**The proportion of renewable power supply has significantly increased in China.** In 2021, China's installed renewable power capacity exceeded 1.1TW, generating 2490TWh, with wind and solar power ranking first in the world.



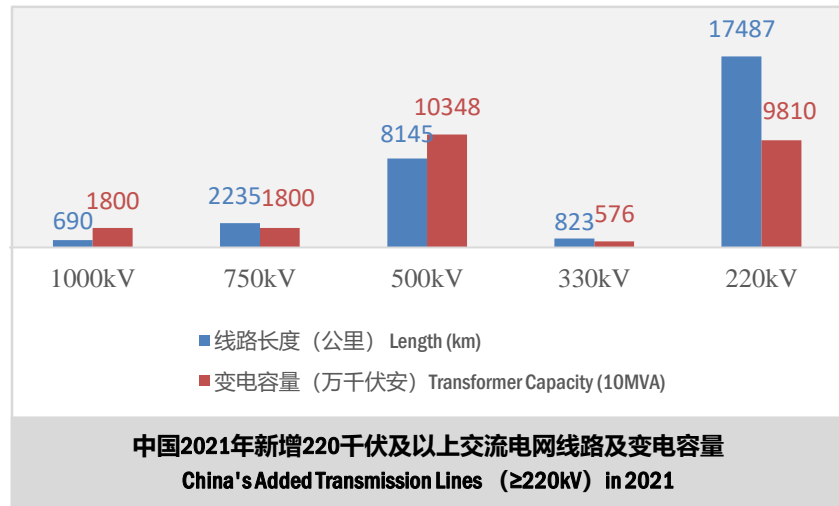
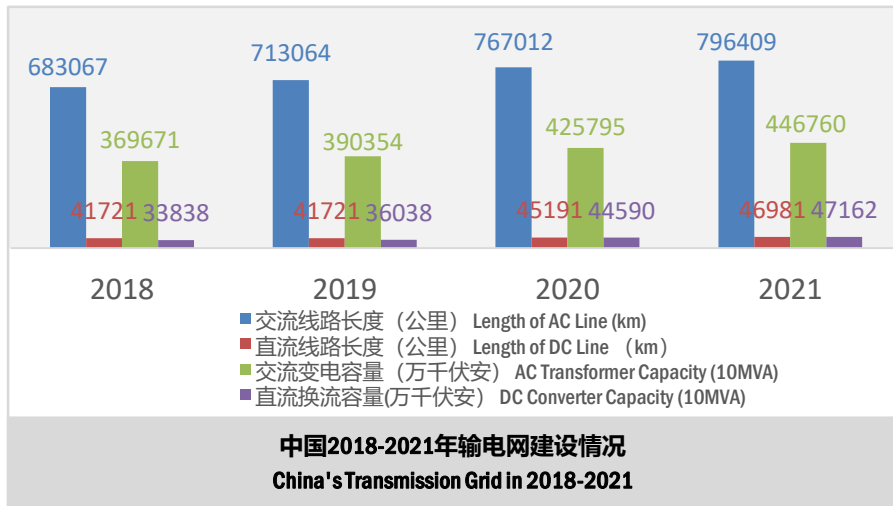
中国2018-2021年可再生能源装机
China's Renewable Power Capacity in 2018-2021



中国2018-2021年可再生能源发电量
China's Renewable Power Generation in 2018-2021

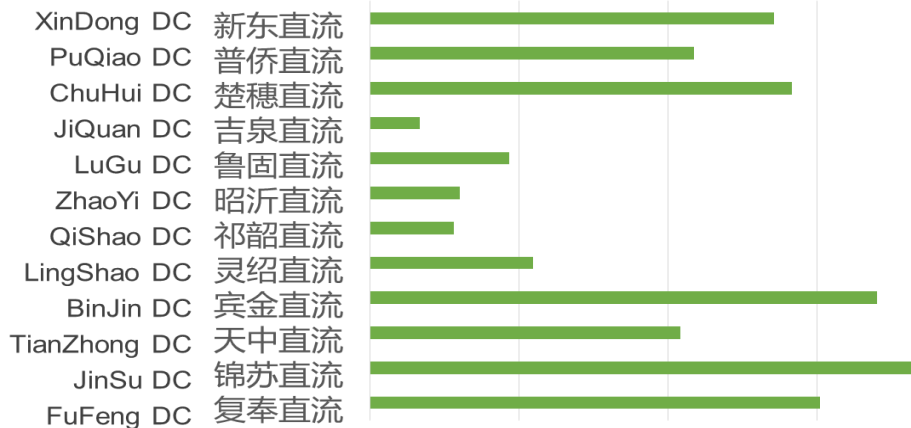
◆ 电网侧 Grid Side

电网建设规模稳步扩大。截至2021年底，中国220千伏及以上输电线路长度达到84.3万公里，同比增长3.8%；220千伏及以上变电容量44.7亿千伏安，直流换流容量4.7亿千瓦；主要高压配电线变电容量24.3亿千伏安，高压配电线路长度达到115万公里。**China's power grid scale has been steadily expanded.** By the end of 2021, the length of China's transmission lines ($\geq 220\text{kV}$) reached 843,000 km, with a substation capacity of 4.47 billion kVA and a DC converter capacity of 4700GW; the length of high-voltage distribution lines reached 1,150,000 km.



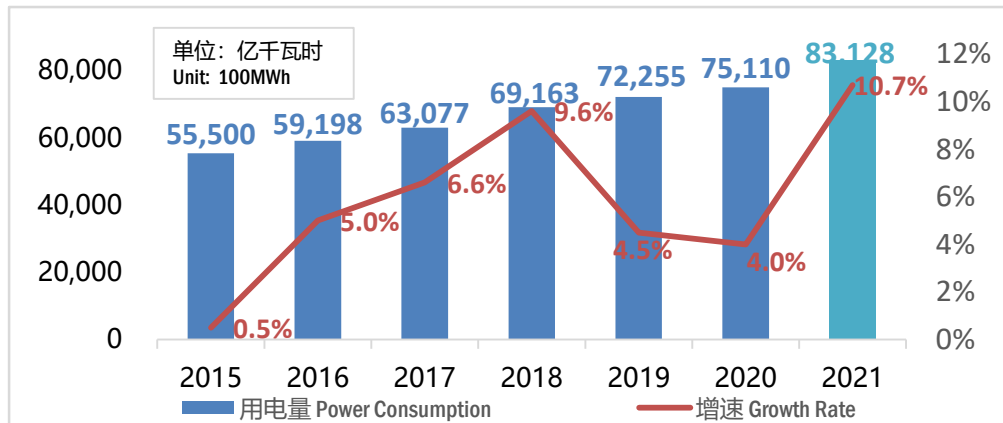
◆ 电网侧 Grid Side

绿色资源配置能力不断加强。 中国资源禀赋与能源需求呈现逆向分布，为了实现绿色能源在全国范围内的优化配置，中国建成了世界上规模最大、远距离输送能力最强的电力系统，每年将约3000亿千瓦时的绿色电力由西部地区送至东部负荷中心。**China's capacity to allocate green resources has been enhanced.** To realize the optimal allocation of green energy nationwide, China has built the world's largest power system, transforming about 300TWh of green power yearly from the west to the east.



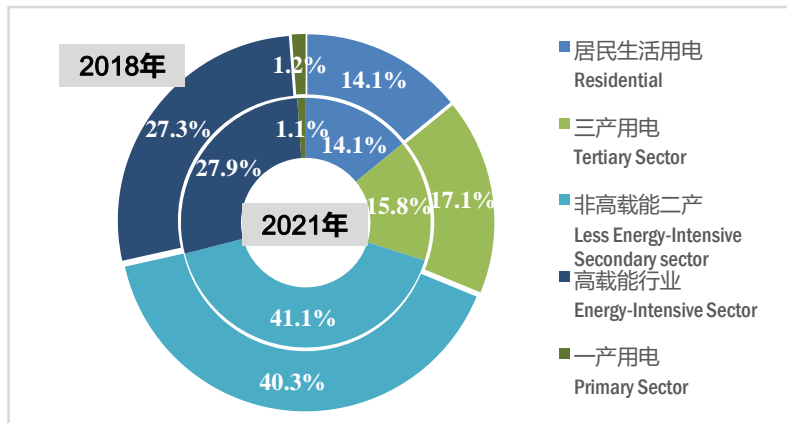
◆ 负荷侧 Load Side

用电量保持增长，用电结构持续优化。 2021年，中国全社会用电量达到8.3万亿千瓦时，同比增长10.7%，增速较2020年提高6.7个百分点。用电结构保持由二产用电向三产、居民生活用电转移趋势。**China's power consumption has kept growing and the power consumption structure has been continuously optimized.** The power consumption growth rate in 2021 is 6.7 percentage points higher than that in 2020. Power consumption structure continues shifting from the secondary sector to the tertiary sector and residential electricity.



中国2015-2021年用电情况

China's Power Consumption in 2015-2021

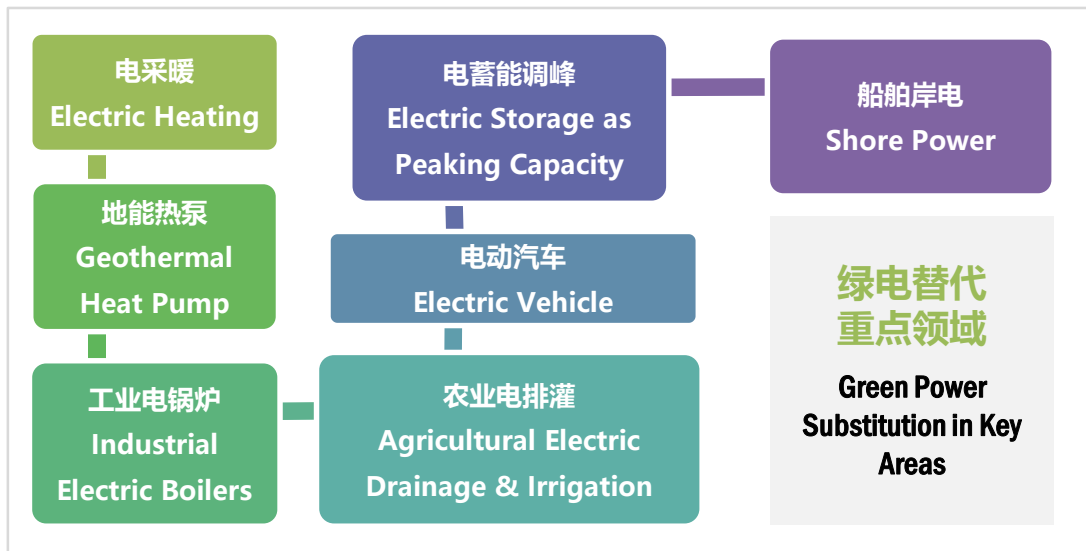
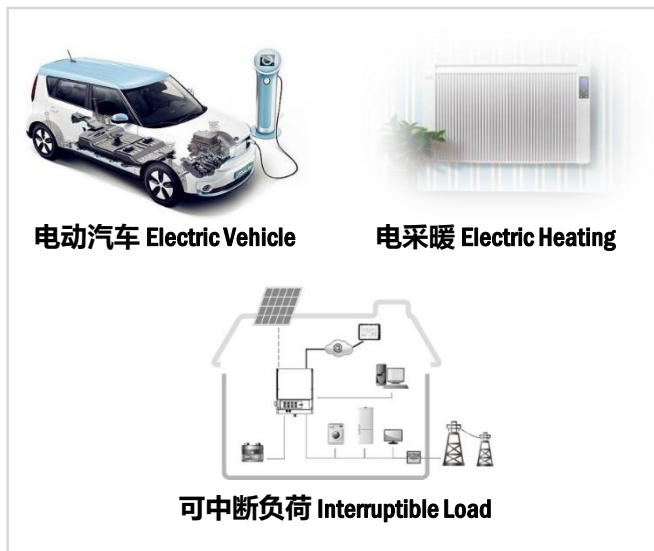


中国2018年和2021年用电结构

China's Power Consumption Structure in 2018 & 2021

◆ 负荷侧 Load Side

推进用能产业与新能源就近结合。大力引导新增用能产业向新能源富集地区布局，推进传统方案升级改造，加强需求侧响应，持续加快电动汽车、可中断负荷规模化发展，提升终端用能和新能源发电的匹配程度，促进重点领域绿电替代。**China has initiatives for high-energy consumption industry to deploy near the regions with rich renewable energy resources.** China encourage green power substitution in key areas.



电力系统灵活性持续提升。通过煤电灵活性改造、扩大抽水蓄能和电化学储能装机、提升完善需求侧管理和响应能力等方式有效提升了电力系统灵活性。**China's power system flexibility has been effectively enhanced** by coal power flexibility retrofit, expansion of installed pumped storage & electrochemical energy storage, and improvement of demand-side management & response capabilities.



煤电灵活性改造超8000万千瓦

Over 80 GWh coal power has been retrofitted for flexibility.

6000千瓦及以上火电厂供电标准煤耗降至302.5克/千瓦时
Standard coal consumption of coal power unit ($\geq 600\text{MW}$) has been reduced to **302.5 g/kWh**.



电力需求侧管理措施不断完善

Demand-side management has been continuously improved.

需求侧响应能力持续增强

Demand-side response capacity continues to be enhanced.

新能源友好电站、虚拟电厂建设稳步增长

Construction of "system-friendly" renewable power stations and virtual power plants is steadily increased.



抽水蓄能装机3669万千瓦

The installed capacity of pumped storage reached **36.69GWh**.



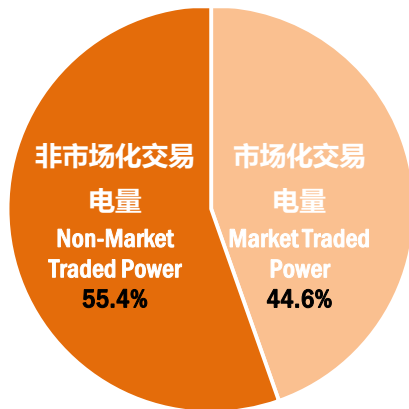
电化学储能装机400万千瓦

The installed capacity of electrochemical energy storage reached **4GWh**.

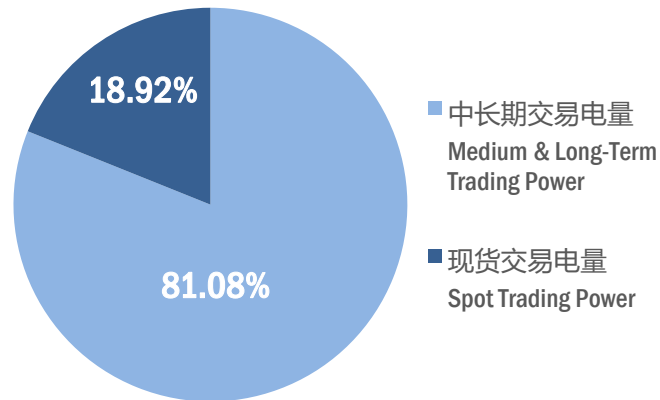
03 电力市场改革

Power Market Reform

电力现货市场建设有序推进、全国统一电力市场体系加快建设。2021年，全国完成市场化交易电量3.7亿千瓦时，占全社会用电量比重达44.6%，年均增长率约40%。中长期交易机制全面建立，现货市场稳定试运行，辅助服务市场稳步推进。China's electricity spot market has been built orderly and the construction of a unified electricity market system has been accelerated. The market traded power in 2021 reached 370GWh, accounting for 44.6% of total power consumption, with a 40% average growth rate. The medium and long-term trading mechanisms have been fully established, the spot market pilot keeps running, and the auxiliary service market is running steadily.



2021年中国市场化交易电量占全社会用电量比重
Market Traded Power/Total Power Consumption in 2021



2021年中国中长期和现货市场交易电量占比
Medium and Long-Term vs Spot Trading Power in 2021

电价改革持续优化、体制机制进一步健全、完善。输配电价体系持续优化，上网电价市场化改革进一步深化，分时电价、阶梯电价机制进一步健全，抽水蓄能价格形成机制进一步完善。The electricity price reform has been continuously optimized, and the system & mechanism have been further improved in transmission & distribution pricing system, market reform on feed-in-tariff, time-of-use tariffs & tiered pricing mechanism, etc.

输配电价体系

Transmission & Distribution Pricing System

- ✓ 区域/省级电网第一、二监管周期输配电价
Transmission and distribution price of regional/provincial power grid in the 1st and 2nd supervision periods
- ✓ 跨省跨区专项工程输电价格定价办法
Pricing method for transmission pricing of inter-provincial and inter-regional special projects
- ✓ 事前核定、定期校核机
Approving pricing before operation and regular check mechanism

上网电价市场化改革

Market Reform on Feed-in-Tariff

- ✓ 全面放开燃煤发电上网电价
Full liberalization of coal-fired power generation feed-in tariffs
- ✓ 扩大市场交易电价上下浮动
Expanding the fluctuation range of market transaction electricity price
- ✓ 取消工商业目录销售电价
Cancellation of catalog sales electricity price for industry and commerce
- ✓ 煤价、上网电价、用户电价“三价联动”
“Three-price linkage” of coal price, feed-in tariffs and consumer electricity price

分时电价、阶梯电价机制

Time-of-Use Tariffs & Tiered Pricing Mechanism

- ✓ 引导用户削峰填谷
Guiding consumers to cut peak and fill valley
- ✓ 设定阶梯电价分档标准
Setting tiered electricity tariff standards
- ✓ 加价电费资金管理使用制度
The management and use system of increased electricity tariff

抽水蓄能价格形成机制

Pricing Mechanism for Pumped Storage

- ✓ 竞争方式
Competition mode
- ✓ 成本回收与分摊机制
Cost recovery and sharing mechanism
- ✓ 收益分享机制
Revenue sharing mechanism
- ✓ 独立市场主体地位
Independent market entity status

03 电力市场改革

Power Market Reform

增量配电业务改革稳步推进，售电公司管理更加精细化。截至2021年底，中国共计开展增量配电业务改革试点459个，206个增量配电项目获得电力业务许可证；全国已注册售电公司约5000家，向用户提供购售电业务、合同能源管理和综合节能等多种服务。**The reform of incremental distribution business is steadily promoted, and the management of power sales companies is more refined.** By the end of 2021, China has established 459 pilot projects of incremental distribution business reform, and 206 incremental distribution projects have obtained power business licenses. Around 5000 power sales companies have registered to provide services in power purchase & sales business, contract energy management, and comprehensive energy conservation.



Profile of EPPEI

China Electric Power Planning & Engineering Institute (EPPEI) is a national-level high-end consulting and knowledge-intensive consulting institution with a history of 70 years.



Government
Authorities

Financial
Institutions

Energy
Enterprises

Industrial Policy

Development Strategy

Development Planning

New Technology

Project Evaluation

Consulting & Technical Services

谢谢 Thanks

地址：北京市西城区安德路65号 邮政编码：100120
电话：010-58388230 传真：010-82086966 邮箱：info@eppei.com
No.65 Ande Road,Xicheng District,Beijing,100120
Tel: 010-58388230 Fax: 82086966 E-mail: info@eppei.com
www.eppei.com