

Future power grid development to facilitate RE integration in China

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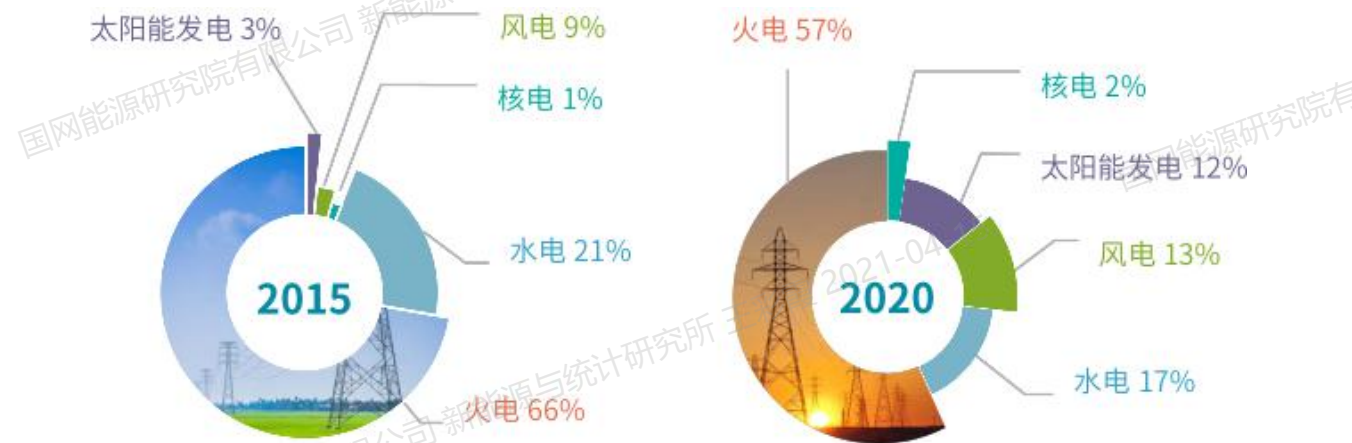
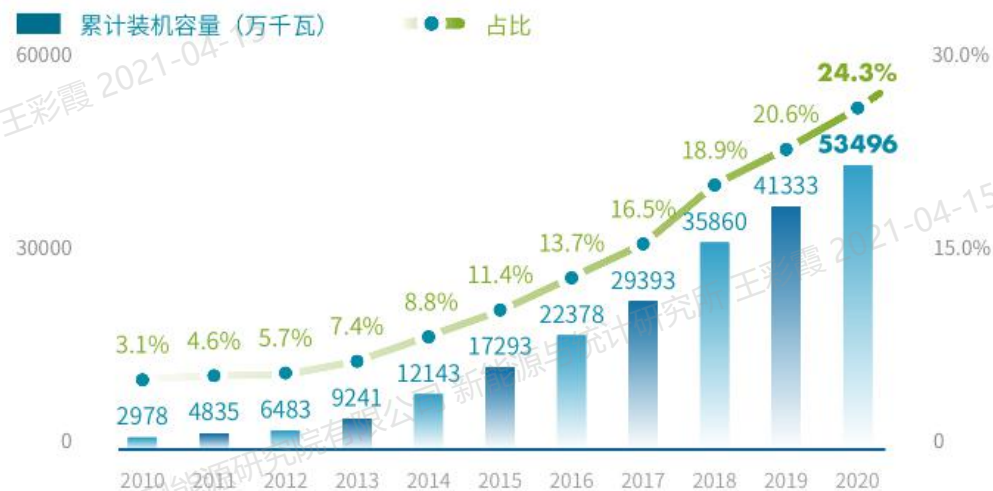
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- 2. Practices of State Grid to Facilitate RE Integration**
- 3. Future Power Grid Development**

(1) Overview

By the end of 2020, the accumulative generation capacity of China's wind and solar has reached 530 GW, which is 24.3% of the nationwide total capacity. In the year of 2020, China has newly installed 120 GW of wind and solar.

2010-2020 年 我国新能源发电装机容量及占比



(1) Overview

Installed capacity of wind and solar is steadily growing.

- By the end of 2020, the accumulative installed capacity of wind is 280 GW, which is 13% of the nationwide total installed capacity. In the year of 2020, China has newly installed wind generation 71.67 GW.
- By the end of 2020, the accumulative installed capacity of solar is 250 GW, which is 12% of the nationwide total installed capacity. In the year of 2020, China has newly installed solar generation 48.2 GW.

2010-2020 年 我国风电新增装机容量、累计装机容量及占比



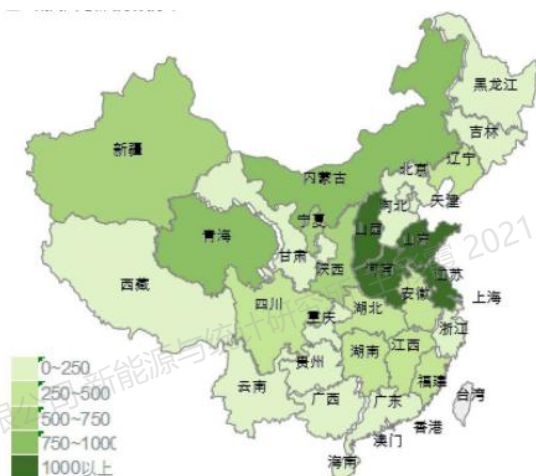
2010-2020 年 我国太阳能发电新增装机容量、累计装机容量及占比



(2) Installed Capacity of Renewable Energy by Regions

In China, the development of wind generation continue to move towards the regions with better resource and better grid integration conditions. Solar development continues to balance between western, northern and eastern, southern regions.

- By the end of 2020, 51% of the wind generation are located in North China, East China and Central China, increasing by 14% since 2015.
- By the end of 2020, 64% of the solar generation are located in North China, East China and Central China, increasing by 26% since 2015.



Wind Generation Accumulative Installed Capacity Distribution in 2020



Solar Generation Accumulative Installed Capacity Distribution in 2020

(3) The Operation and Accommodation of Renewable Energy

Wind and solar generation and its share in total generation continue to grow. In 2020, the nationwide wind and solar generation is 727.6 TWh, which is 9.5% of the total generation.

- In 2020, the wind generation is 466.5 TWh, which is 6.1% of the total generation.
- In 2020, the solar generation is 261.1 TWh, which is 3.4% of the total generation.

2010-2020 年 国家电网经营区风电发电量及占比



2010-2020 年 国家电网经营区太阳能发电量及占比



(3) The Operation and Accommodation of Renewable Energy

In 2020, 23 of the provinces in the SGCC operation area have very few wind curtailment, 25 provinces in the SGCC operation area have very few solar curtailment. The utilization rate of new energy has reached 97.1%.

For the first time, the wind and solar utilization rates in Xinjiang and Gansu have exceeded 90% and 95%, respectively (up to 91.1% and 95.1%).

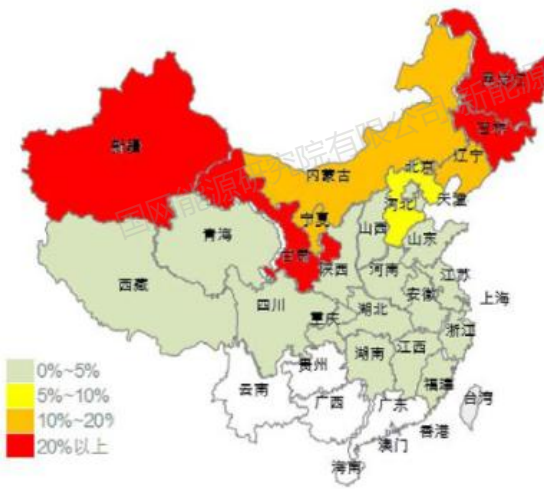
2016-2020年 国家电网经营区新能源弃电量和利用率



(3) The Operation and Accommodation of Renewable Energy

In 2020, the nationwide utilization rate of wind generation is 97%. During 2016-2020, 12 provinces have improved their wind generation utilization rates to be above 95%.

2014-2020 年 国家电网经营区弃风电量与利用率



Main Regions with Wind Generation
Curtailment in 2015

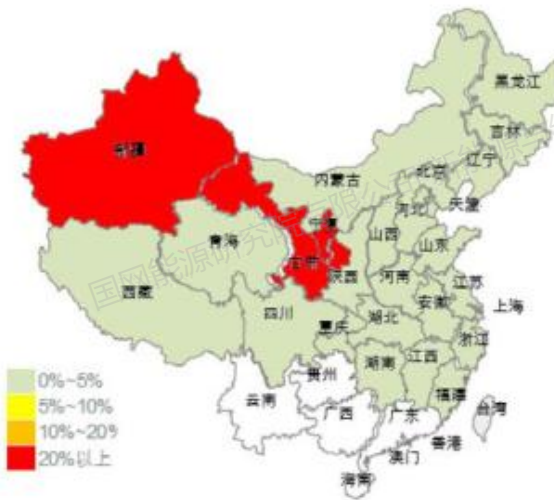


Main Regions with Wind Generation
Curtailment in 2020

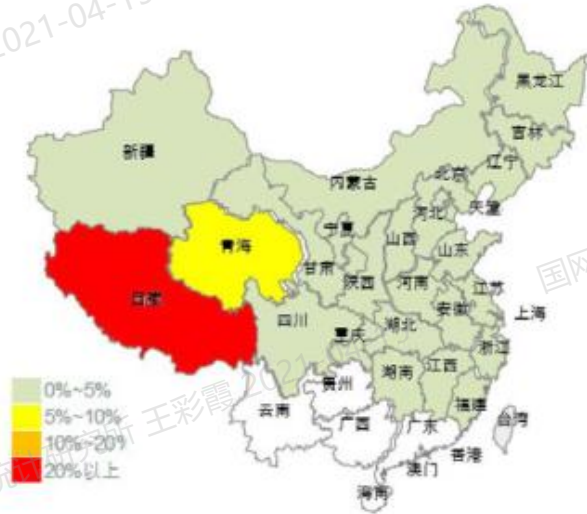
(3) The Operation and Accommodation of Renewable Energy

In 2020, the nationwide utilization rate of solar generation is 98%. During 2016-2020, 4 provinces have improved their solar generation utilization rates to be above 95%.

2014-2020 年 国家电网经营区弃光量和利用率



Main Regions with Solar Generation
Curtailment in 2015



Main Regions with Solar Generation
Curtailment in 2020

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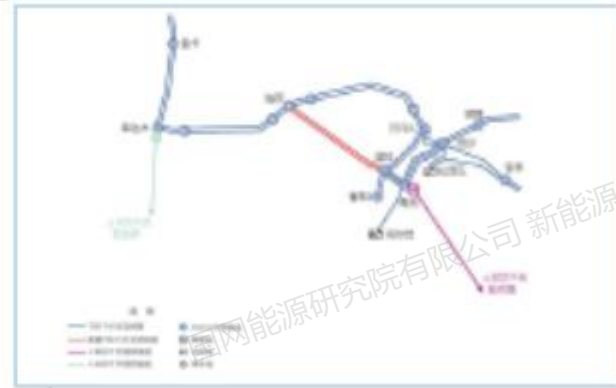
(1) UHV transmission and inner-province transmission lines were constructed to enhance transmission capability of renewable energy.

- **UHV transmission line:** During 2016-2020, China has built 11 AC and 8 DC UHV transmission projects.
- **Inner-province transmission:** During 2016-2020, more than 100 key inner-province transmission projects were built to enhance the accommodation capability of wind and solar.
- Following the requirement of National Energy Administration, timely and efficiently interconnection of wind and solar power plants to the power grids were ensured.



海西—塔拉 750 千伏线路工程

线路长度 460 千米，工程
投资 19 亿元，提升新能
源外送能力 200 万千瓦。



(2) Flexibility of the power systems was promoted with multiple measures.

- **Acceleration of ancillary service markets establishment.** By the end of 2020, 5 regional and 13 provincial grids under SGCC officially have the downward regulation ancillary service market in operation. In 2020, 44.8TWh of wind and solar that would otherwise be curtailed was generated in the “three north regions” due to the peak-regulation ancillary service market.
- **Continuous efforts on the retrofit of thermal generators.** During 2016-2020, a total of 162 GW of thermal generators in the SGCC area were retrofit to be more flexible , 82GW of which are from the “three north regions”, increasing balancing capability of 15GW.

国家电网“十三五”期间火电机组灵活性改造统计表

区域	数量 (台)	容量 (万千瓦)	供热能力提升调节 能力(万千瓦)	非供热能力提升调节 能力(万千瓦)
华北	34	1185	305	272
东北	81	3378	606	366
西北	74	3678	590	559
华中	9	447	78	3
华东	116	7521	865	862
总计	314	16209	2444	2062

(2) Flexibility of the power systems was promoted with multiple measures.

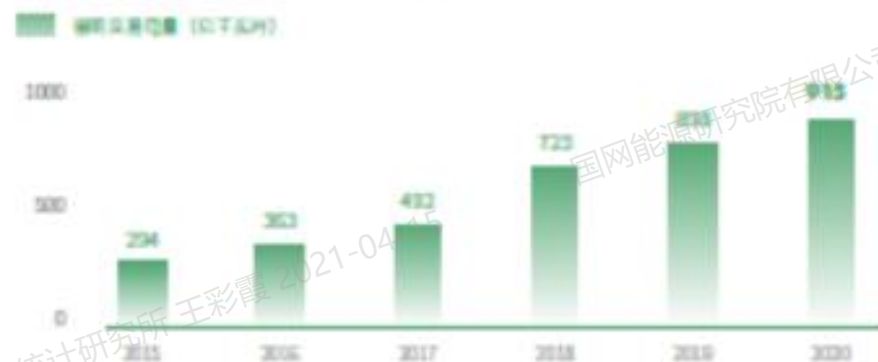
- **Initiating coordinated dispatch of generation, power grid, electric load, and energy storage.** Technologies such as big data, cloud computing, IoT, AI, and block chain are applied in power system operation. Multi-timescale coordinated dispatch of generation, power grid and load are initiated. Flexible load participation is integrated in power grid emergency dispatch. The capacities of distributed energy storage, EV, thermal storage, and other regulation resources are increased.



(3) The amount of renewable energy traded in the electricity markets were increased to incentivize more customers to use renewable energy.

- **Inter-provincial electricity market trading.** In the SGCC area, the total amount of wind and solar traded in the inter-provincial electricity market in 2020 was 91.5TWh, in which 87.8TWh was traded in the long term market and 3.7TWh was traded in the inter-regional spot market. During 2016-2020, the total amount of wind and solar traded in the inter-provincial electricity market was 337.2TWh.

2015—2020 年新能源省间交易电量



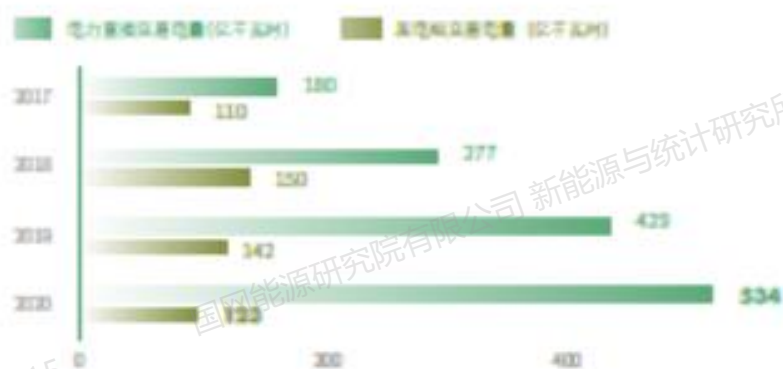
2020 年
各受省间交易电量及占比图



(3) The amount of renewable energy traded in the electricity markets were increased to incentivize more customers to use renewable energy.

- **Provincial electricity market trading.** In the SGCC area, the total amount of wind and solar traded in the provincial electricity markets in 2020 was 65.7TWh, in which 53.4TWh was traded through direct trading between renewable energy and electricity consumers and 12.3TWh was traded through generation rights trading between thermal generation and renewable energy.

2017—2020年新能源省内市场化交易电量



2019、2020年 主要省份新能源省内电力直接交易电量



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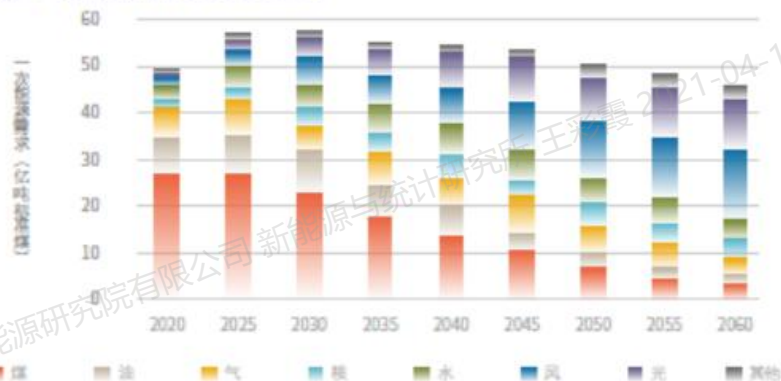
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(1) Trends of Renewable Energy Development

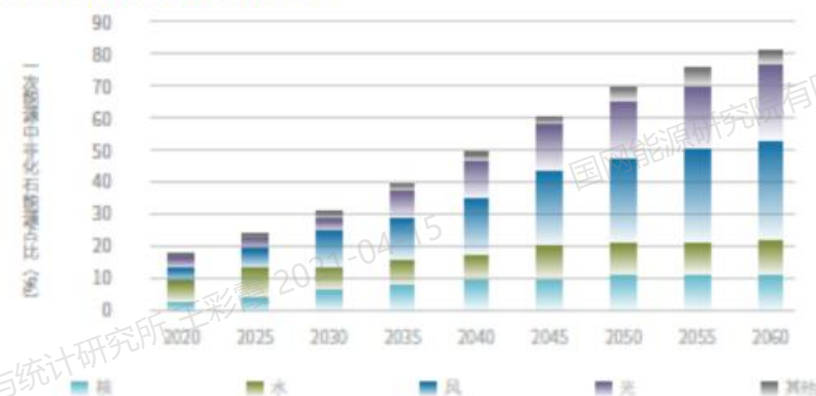
On September 22, 2020, in the statement by President Xi Jinping at the General Debate of the 75th Session of the United Nations General Assembly, **China will adopt more vigorous policies and measures and aim to have CO₂ emissions peak before 2030 and achieve carbon neutrality before 2060.**

On December 12 2020, President Xi addresses at the Climate Ambition Summit: by 2030 China will lower its carbon dioxide emissions per unit of GDP by over 65 percent from the 2005 level, **increase the share of non-fossil fuels in primary energy consumption to be around 25 percent, and bring the total installed capacity of wind and solar power to be over 1200 GW.**

我国一次能源需求结构演化趋势



我国非化石能源占比演化趋势



(2) Challenges faced by power grid

- Ensure the secure supply of energy
- Ensure the security of power system operation
- Ensure efficient utilization of renewable energy

(3) Outlook of the Future Grid Development

❑ **Development of power grids of both transmission and distribution level** to adapt to the local consumption as well as long distance transmission of renewable energy and its long distance transmission.

❑ **Enhancement of the inter-regional transmission capability.** Newly built transmission lines will mainly focus on renewable energy. 7 UHV DC transmission lines are planned in the 14th 5-year plan , adding new transmission capacity by 56 GW.

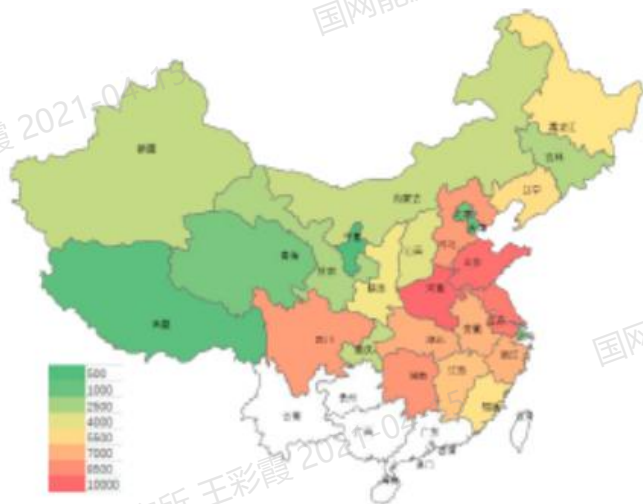
- 7 new UHV DC transmission lines

- ✓ North Hami-Chongqing
- ✓ Longdong-Shandong
- ✓ North Shaanxi-Wuhan
- ✓ Baihetan-Jiangsu

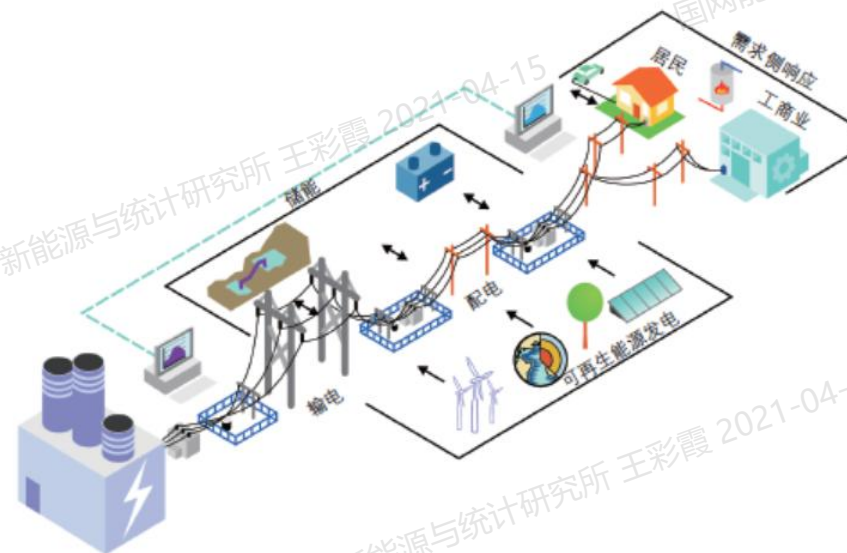
- ✓ Baihetan-Zhejiang
- ✓ Upstream Jinshajiang-Hubei
- ✓ Yazhong

(3) Outlook of the Future Grid Development

□ **Support the development of distributed energy resources and microgrids.** Enhance the distribution grids interconnection and intelligent controls. Integrate microgrids to fully take the advantages of microgrids on the local accommodation of distributed energy resources.

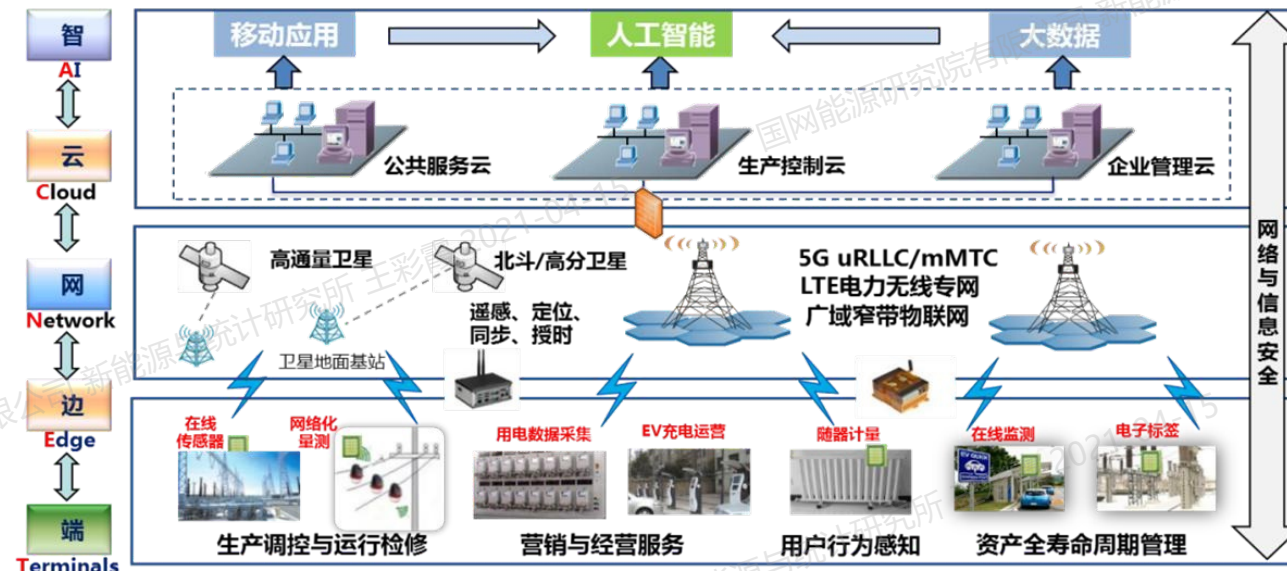


分布式光伏技术可开发潜力分布 (单位: 万千瓦)



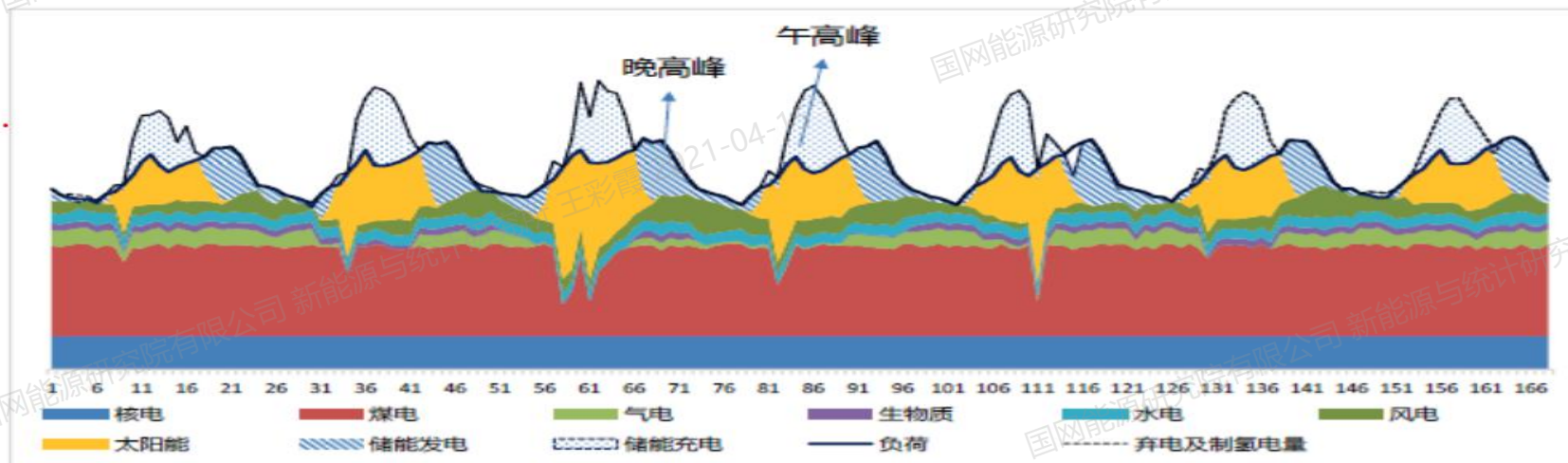
(3) Outlook of the Future Grid Development

□ Implementation and integration of new technologies such as big data, cloud computing, IoT, AI, and blockchain in energy and power sector to promote the interaction among various types of energy resources and support the friendly interconnection of renewable generation, multi-types of energy storage, and new types of electric load. Information could be shared between different energy resources and new values be explored.



(3) Outlook of the Future Grid Development

- **Further enhancement of system flexibility.** Speed up building of pumped hydro, continuously support the retrofit of coal-fired plant and **deploy large-scale energy storage.**
- **Optimization of power dispatch and operation for better coordination of various energy resources.** Improve inter-provincial support and spinning reserve sharing scheme, and promote the multi-level coordinated dispatch of renewable energy. Enhance the coordinated dispatch of wind, solar, hydro, and thermal generation.



(3) Outlook of the Future Grid Development

□ **Facilitate the construction of electricity markets that adapt to high penetrations of renewable energy.** Build the market scheme to enhance the accommodation of new energy, Deepen the building of provincial spot market. Adopt flexible pricing scheme to promote renewable energy participation in spot market.

□ **Support various integrated energy services to unlock the value of demand side resources in power systems.** Establish online-offline integrated customer service platform. Timely distribute demand side information. Drive the establishment of intelligent energy system to extract demand side resource potential to participate in demand response.

Thank you!

