国家电网
STATE GRID
国网能源研究院有限公司
STATE GRID ENERGY RESEARCH INSTITUTE CO., LTD.

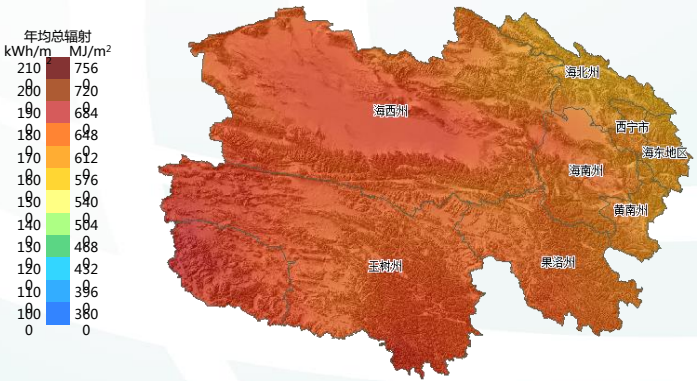
100% Renewable Energy Supply in Qinghai Province

2019.03

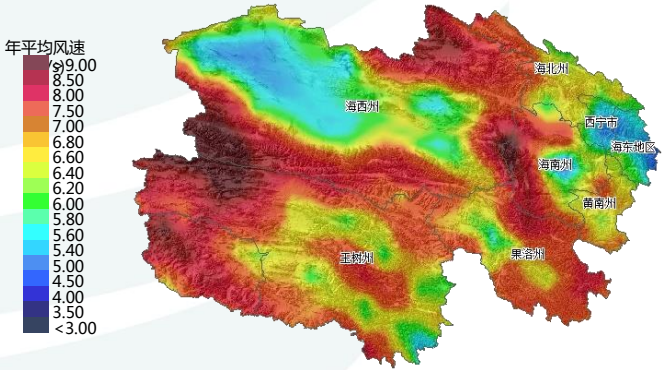
Content

1. Renewable Energy Resources

- Rich in **hydropower resource** and the theoretical reserve of hydro power is **21.87 GW**.
- Ranking 2nd nationwide in **solar resource**, and the technical potential of **solar power** is **3,000GW**.
- Located in **Class IV wind zone** in China, and the technical potential of **wind power** is about **75GW**.



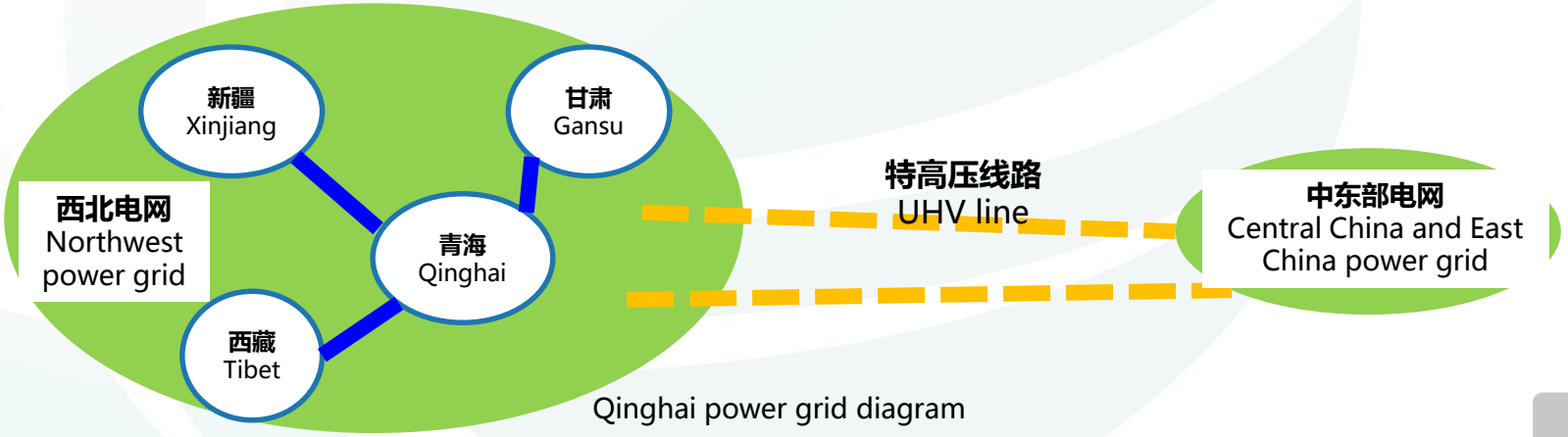
Solar resources distribution in Qinghai



Wind resources distribution in Qinghai

2. Qinghai Power Grid

- The Qinghai power grid is an AC-DC hybrid power grid.
- Connecting Gansu in the east, Xinjiang in the west and Tibet in the south, Qinghai power grid is an important part of the northwest power grid. Northwest power grid is connected to Central China and East China power grid through UHV lines. The main voltage levels of Qinghai grid are 750/330/110kV.



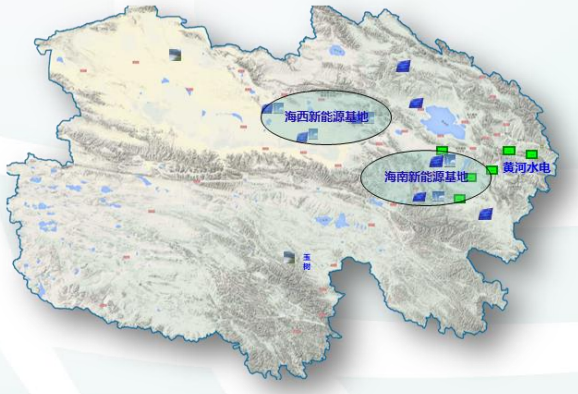
Qinghai power grid diagram

3. Power Generation Structure

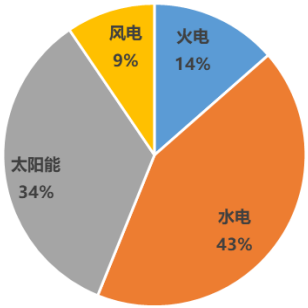
By the end of 2018, the total installed capacity of generation in Qinghai is **27.99 GW**.

Capacity of Renewable energy: **24.20GW** (86.4%)

- Hydropower: **11.92 GW**
- Solar power: **9.62 GW**
- Wind power: **2.66 GW**



RE energy base distribution in Qinghai



Generation capacity structure in Qinghai

Content

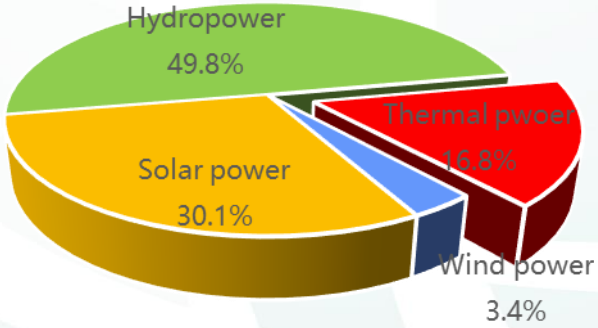
1. General Situation

Qinghai power grid carried out 100% RE supply trials twice, respectively in 2017 and 2018. One lasts 168 hours for 7 consecutive days and the other 216 hours for 9 consecutive days.

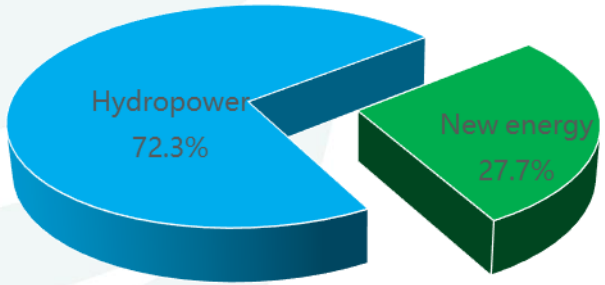
2. Operation of 7-day 100% RE Supply

Time Period: 0:00 June 17th to 24:00 June 23th in 2017, 7 days, 168 hours.

The power demand was all supplied by hydropower, solar power and wind power. When the local RE generation was insufficient in extreme weather, RE was purchased from other provinces.



Generation capacity structure during the 7-day 100% RE Supply

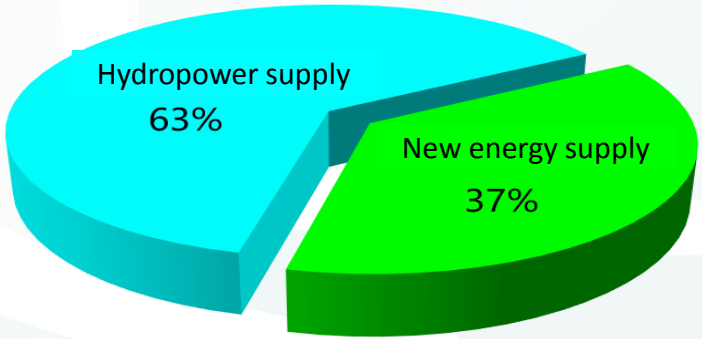


Generation structure during the 7-day 100% RE Supply

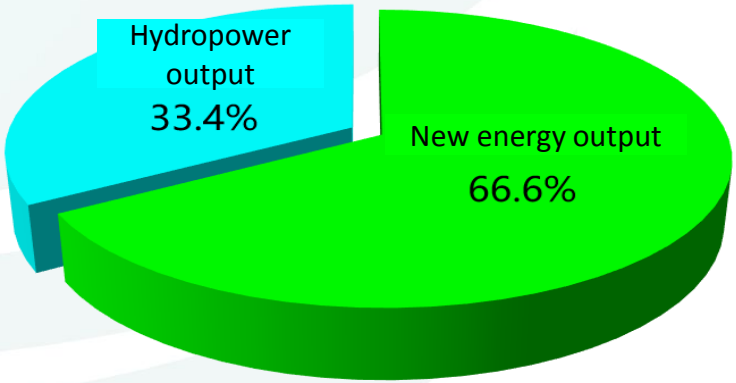
2. Operation of 7-day 100% RE Supply

During the 7 days, the daily maximum power generation from new energy was 63.11 GWh, accounting for 37% of Qinghai's total generation.

The daily maximum power output from new energy was 4.75 GW, accounting for 66.6% of the real-time load.



Energy supply structure when power generation from new energy is maximum



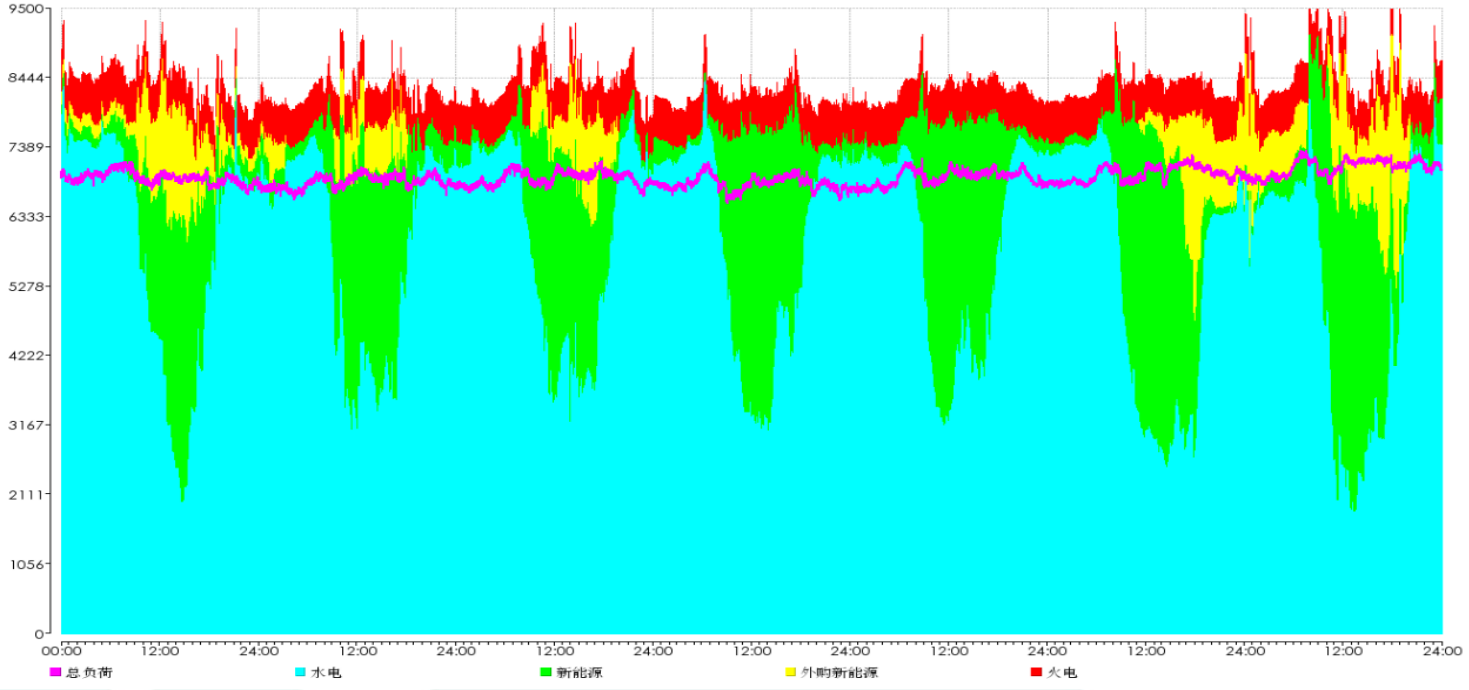
Power output structure when power output from new energy is maximum

2. Operation of 7-day 100% RE Supply

The cumulative energy supply was **1,178 GWh** during the 7 days, equivalent to reducing coal consumption by **535,000 tons** and reducing carbon dioxide emissions by **964,000 tons**.

2. Operation of 7-day 100% RE Supply

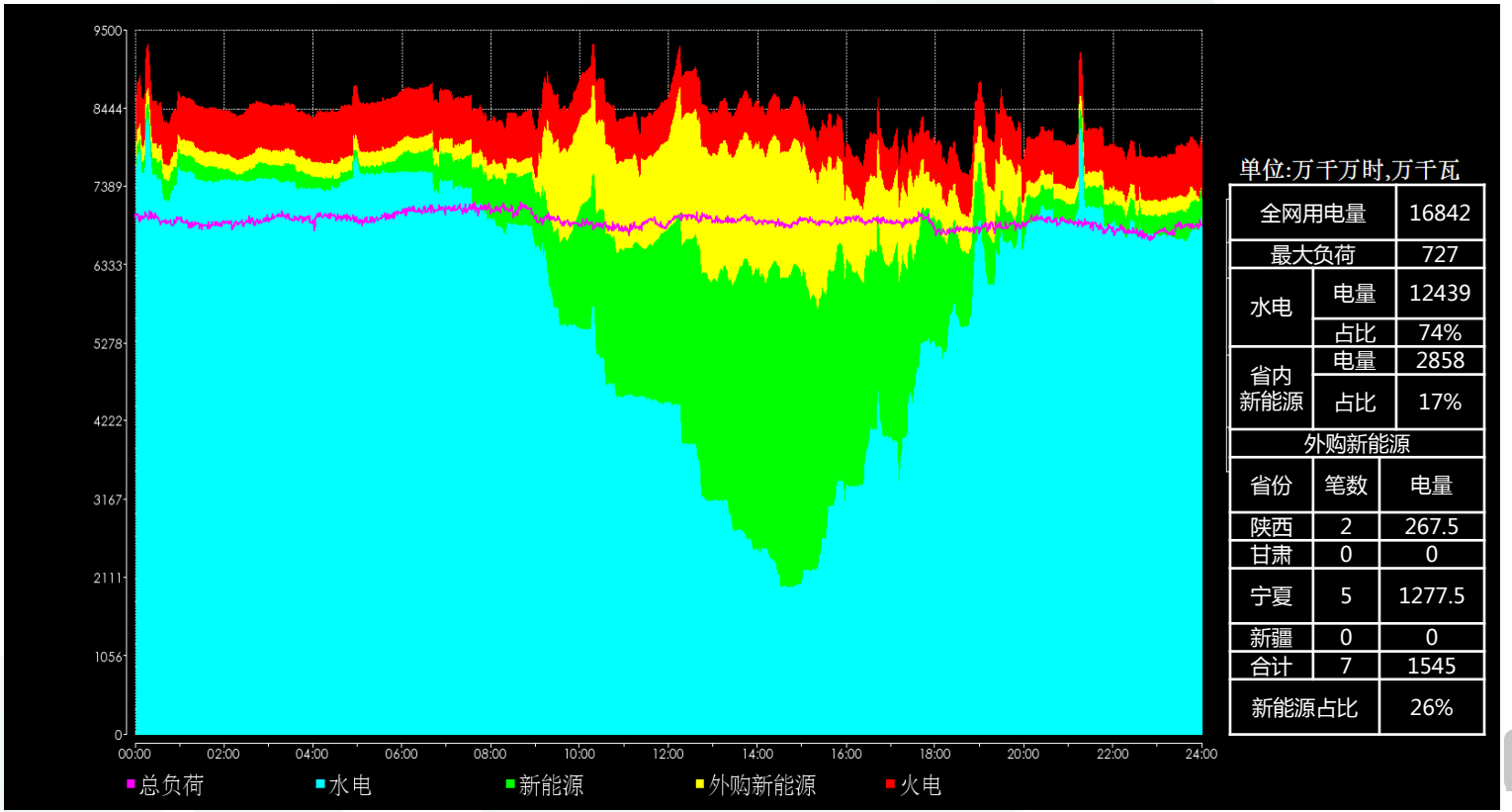
Real-time power generation structure of Qinghai Power Grid during the 7-day 100% RE Supply



Load Hydro New Energy Import Thermal

2. Operation of 7-day 100% RE Supply

Real-time power generation structure of Qinghai Power Grid on June 17, 2017



单位:万千万时,万千瓦

全网用电量		16842
最大负荷		727
水电	电量	12439
	占比	74%
省内新能源	电量	2858
	占比	17%

外购新能源		
省份	笔数	电量
陕西	2	267.5
甘肃	0	0
宁夏	5	1277.5
新疆	0	0
合计	7	1545
新能源占比		26%

2. Operation of 7-day 100% RE Supply

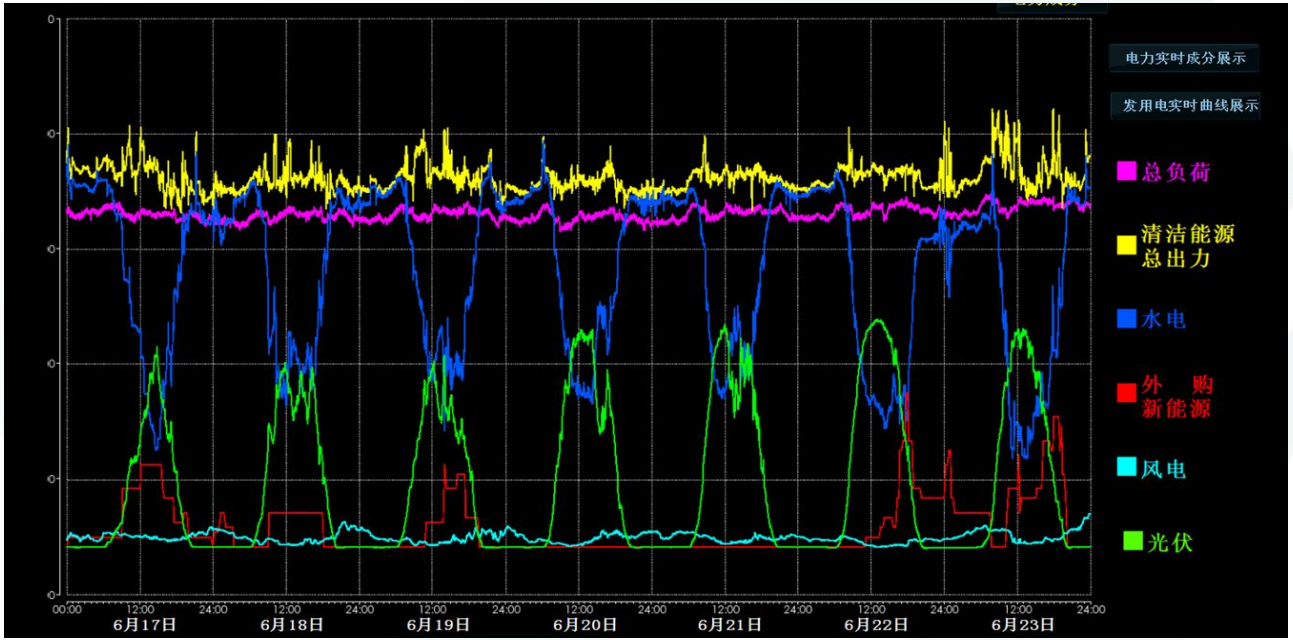
Real-time power generation structure of Qinghai Power Grid on June 20, 2017

单位:万千万时,万千瓦

全网用电量		16638
最大负荷		726
水电	电量	12679
	占比	76%
省内新能源	电量	3959
	占比	24%
外购新能源		
省份	笔数	电量
陕西	0	0
甘肃	0	0
宁夏	0	0
新疆	0	0
合计	0	0
新能源占比		24%

2. Operation of 7-day 100% RE Supply

Power generation curve of each type of RE of Qinghai Power Grid during the 7 days



Purple: electric load

Yellow: sum of all clean energy

Blue: Hydro

Red: Import RE

Light Blue: Wind

Green: Solar

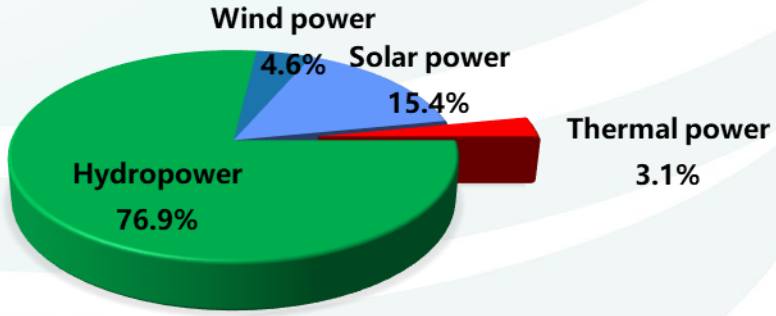
As shown in the 7-day power generation curve, the operation of solar, wind and hydropower was highly complementary.

3. Operation of 9-day 100% RE Supply

Time Period: 0:00 June 20th to 24:00 June 28th 2018, 9 days, 216 hours.

Total power generation was 2,095 GWh, and clean energy accounts for 96.9%.

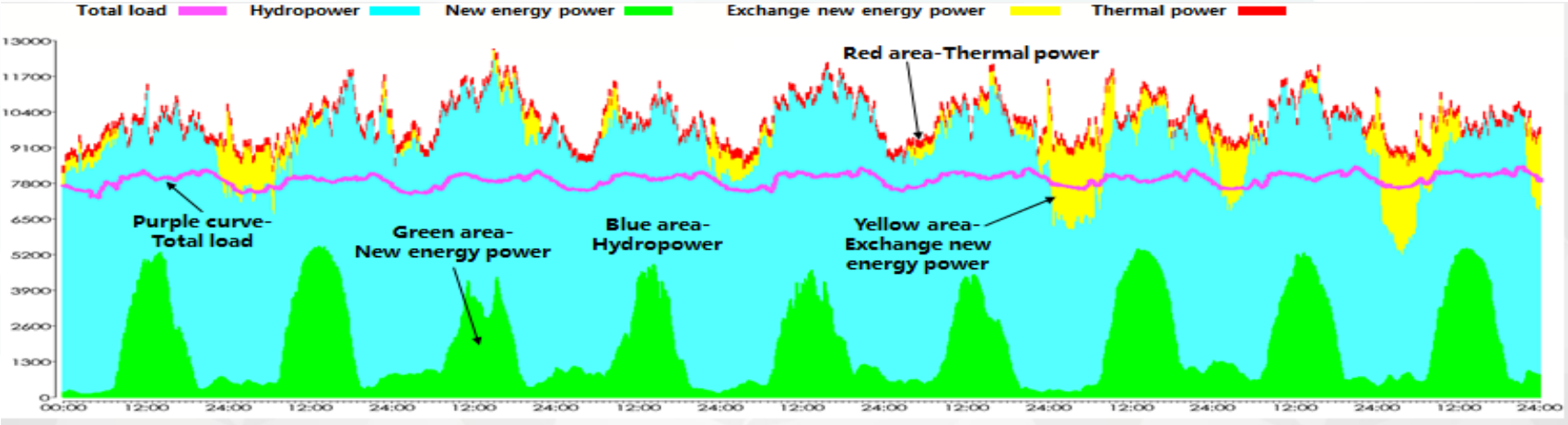
- ✓ Hydropower: 76.9% (1,612 GWh)
- ✓ Wind power: 4.6% (96 GWh)
- ✓ Solar power: 15.4% (323 GWh)
- ✓ Thermal power:3.1% (64 GWh). Export to other provinces via power exchange



Generation structure during the 9-day 100% Clean Energy Supply

3. Operation of 9-day 100% RE Supply

Hourly power generation structure of Qinghai Power Grid during the 9-day 100% RE Supply



3. Operation of 9-day 100% RE Supply

During the 9 days, the peak load was **8.54 GW**. The total electricity consumption was **1760 GWh.** Power supply from new energy was **23.8%,** and power supply from hydropower was **76.2%**.

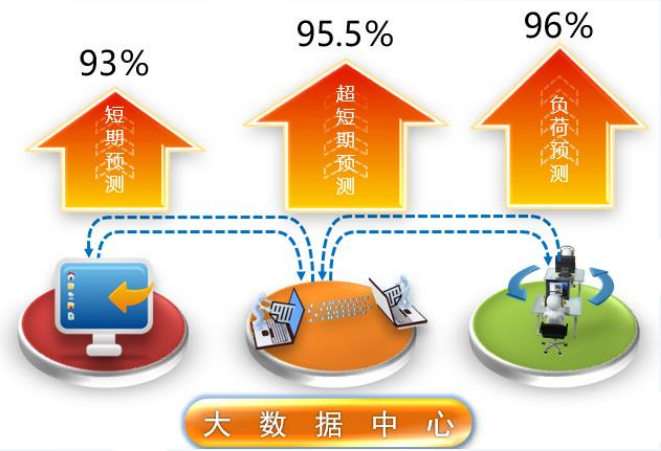
Daily energy supply during the 9-day 100% RE Supply

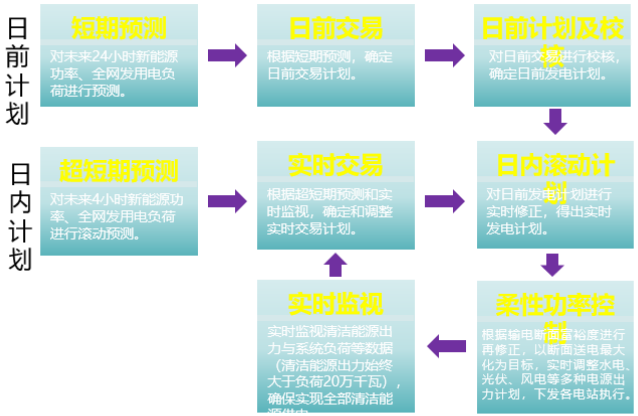
Unit: GWh

	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	Total of 9 days
Electricity consumption in Qinghai	191.72	194.98	193.57	195.54	195.44	197.19	194.49	196.02	200.64	1759.58
New Energy Supply	41.50	52.89	40.22	41.81	41.80	39.30	52.74	51.97	56.67	418.89
Hydropower Supply	150.22	142.09	153.35	153.73	153.64	157.89	141.75	144.05	143.97	1340.69
Total Generation Supply in Qinghai	227.40	228.25	250.41	237.58	247.63	238.19	217.01	237.79	210.48	2094.74

Content

- **Improve the precision of power prediction**. Relying on the big data, accuracy of short-term and ultra-short-term new energy power generation, as well as day-ahead planning is improved. Besides, dynamic check and rolling generation planning is carried out to guarantee real-time power balance.





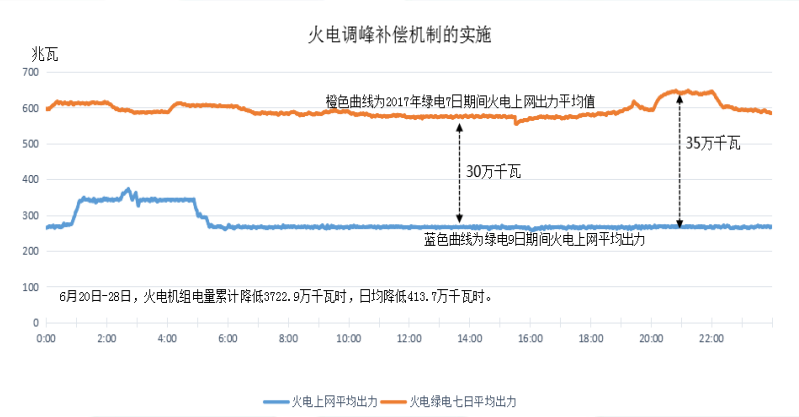
发电计划流程动态校核、滚动闭环，达到实时电力电量平衡

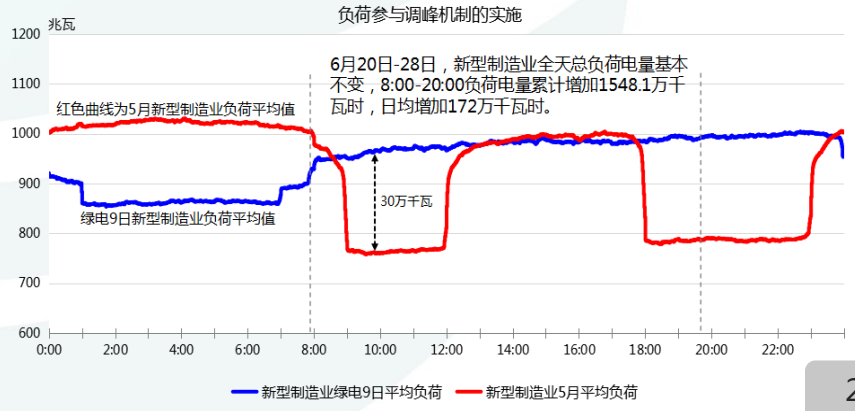
- **Increase provincial and inter-provincial power exchanges**
  - ✓ Generation right trading
  - ✓ Bilateral trading between new energy and electricity consumers
  - ✓ Power trading between Qinghai and Shanxi, Gansu, etc.

- **Rely on advanced technology to fully enhance the level of new energy consumption**. multi-energy complementary and coordinated control technologies, to coordinate the generation of water, wind and solar.

- **Optimize hydropower dispatch**. The operation strategy of large and medium-sized hydropower stations in the upper reaches of the Yellow River was optimized, with the coordination with national, regional and provincial dispatch centers. When solar power output is low, the output of hydropower is increased. When solar power output is high, the output of hydropower is decreased.

- **Introduce compensation mechanism for thermal power downward dispatch.** The market price mechanism is introduced. Thermal generators can bid for their capabilities to be dispatched down and they will be compensated based on the clearing price. The more they can be dispatched down, the higher compensation rate they will get.





Content

- Interconnection of power grids and a unified market
- Flexible generation structure
- Advanced operational technology
- Establishment of thermal power compensation mechanism
- …

Thank you!

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