



ENERGY FOUNDATION  
能源基金会

# 2022 Coal Tracker

*FU Sha, Energy Foundation China*

*March 2, 2023*

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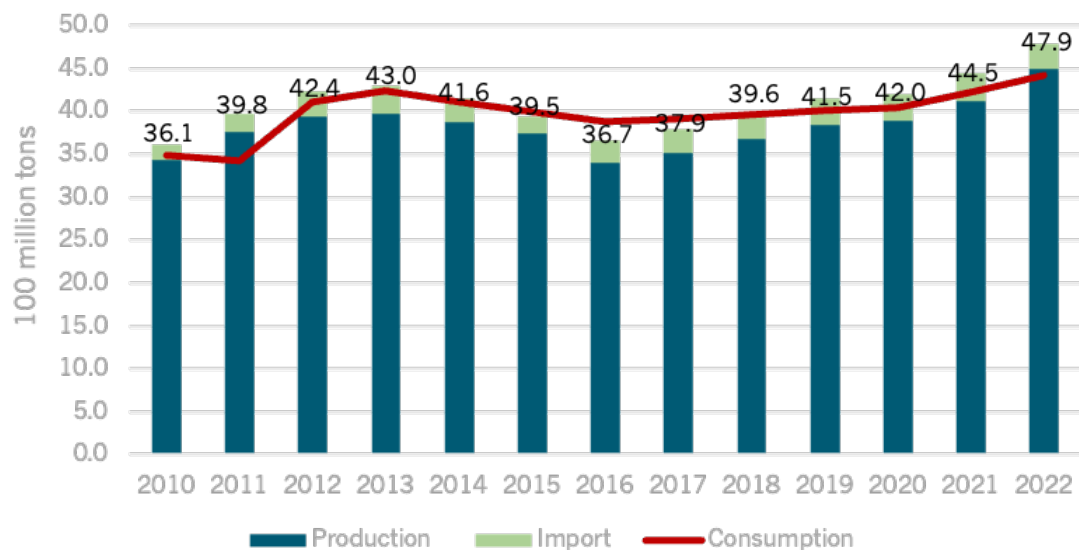
- ① Coal and Power Overview
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# Coal and Power Overview

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# China Coal Supply and Demand

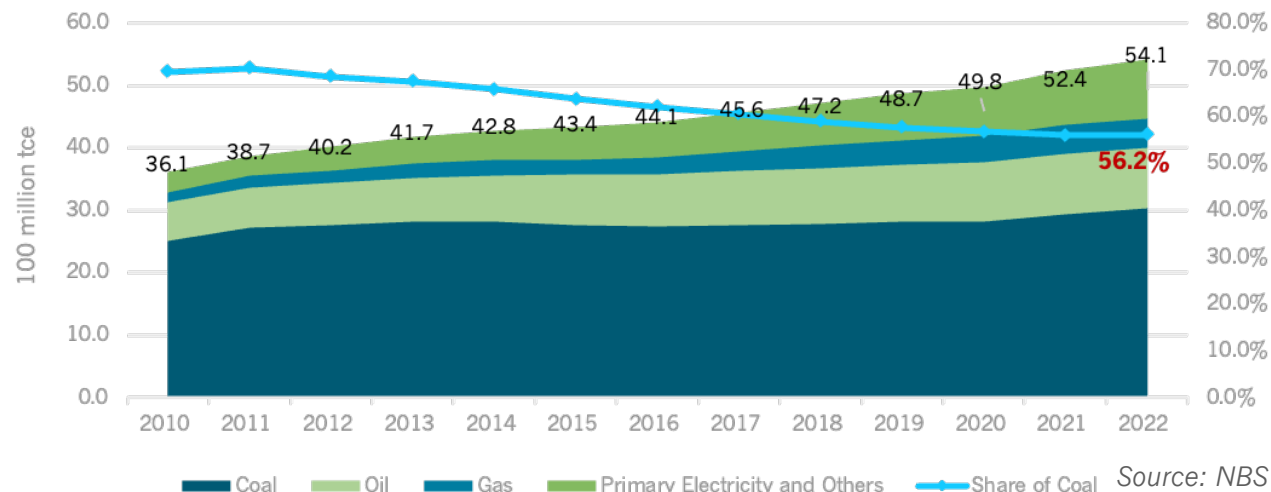
## Coal Supply and Demand



Source: NBS & CNCA

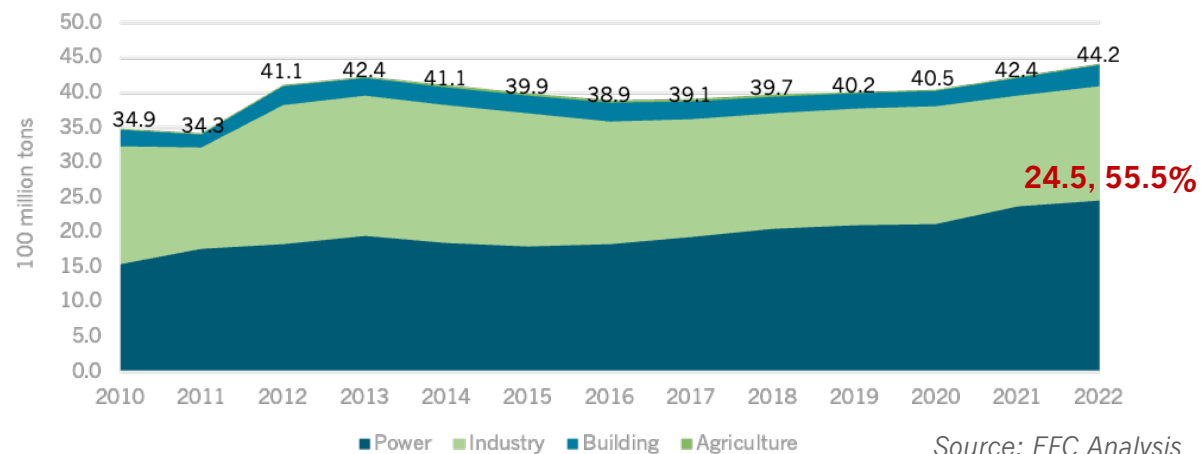
- China coal supply and demand growth re-picked up momentum since 2021.
- Share of coal in total primary energy consumption rebound to **56.2%**
- Power generation consumed **more than 55% of coal** in 2021 and 2022, a new high in the past decade, but a slight decline in 2022

## Share of Coal in Primary Energy Consumption



Source: NBS

## Coal Consumption by Sector



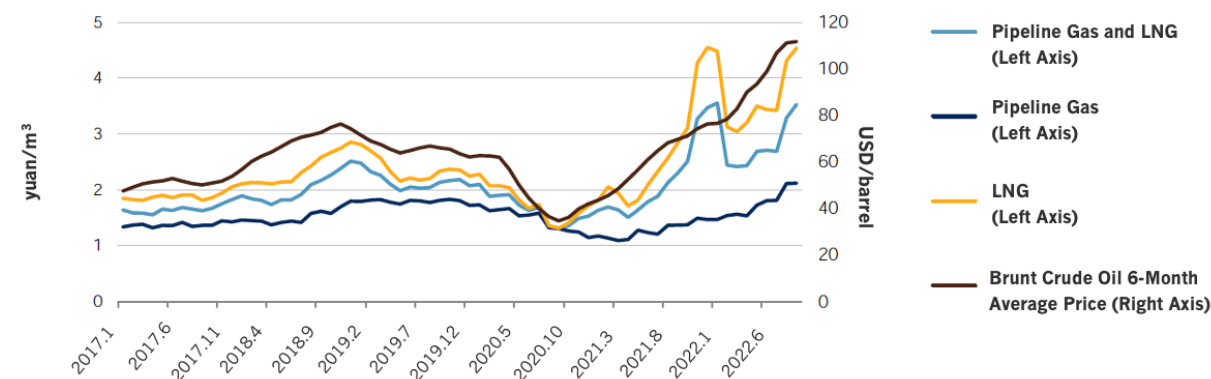
Source: EFC Analysis

# Rationale Behind Recent Increase in Coal Consumption

1. Share of **natural gas** in energy consumption **decreased** for the first time from 8.9% to 8.5%, leaving an energy supply gap of 43 Mtce (compared with historical trend); **coal was thereby employed to fulfill the gap.**
2. Coal consumption in **building** (tertiary industry and residential) **increased** by more than 10%, mainly for heating.
3. Coal consumption by **industry went up** a bit as well mainly because of increase in coal chemistry and inventory.
4. **Power coal use** saw a **slight increase** by around 0.5%, together with a rebound stock of coal in coal power plant.
  - This trend might not continue in 2023 as per our analysis
5. **Colorific value** of coal was also **lower** last year, also contributing to the increase in total physical value of coal consumption:
  - In coal equivalent value, the coal consumption increased by 3.6%.
  - In physical value, the coal consumption increased by 4.3%

Unit: 10,000 tons	2021	2022	2022 Change
Coal	293,440	304,042	+ 10,602
Oil	96,940	96,839	- 101
<b>Gas</b>	<b>46,636</b>	<b>45,985</b>	<b>- 651</b>
Primary Electricity and Others	86,984	94,134	+ 7150
Total	524,000	541,000	+ 17,000

China Monthly Natural Gas Import Price

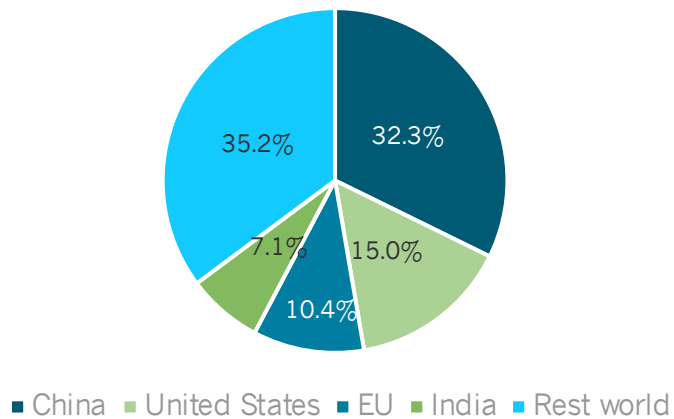


Source: China Customs, S&P 500  
Copyright 2022 Standard & Poor's Financial Services LLC.

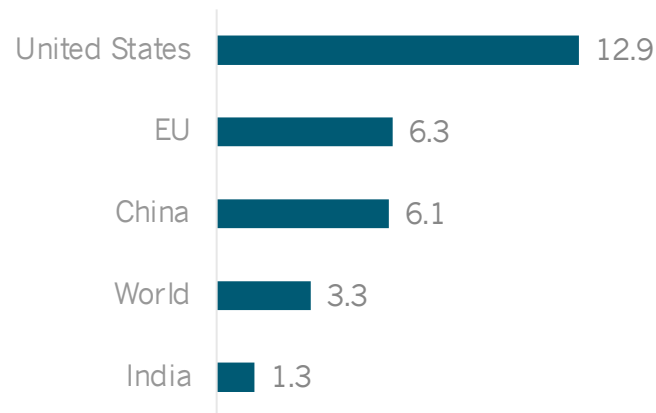
# Huge and Growing Power Demand in China

- Total electricity demand increase 3.6% in 2022, around 1/3 of world's electricity demand.
- Per capita consumption is getting close to EU.
- Great growth potential lies in **Residential** and **Commercial and Public Services** sectors. (Only 1/5 and 1/10 of US level)

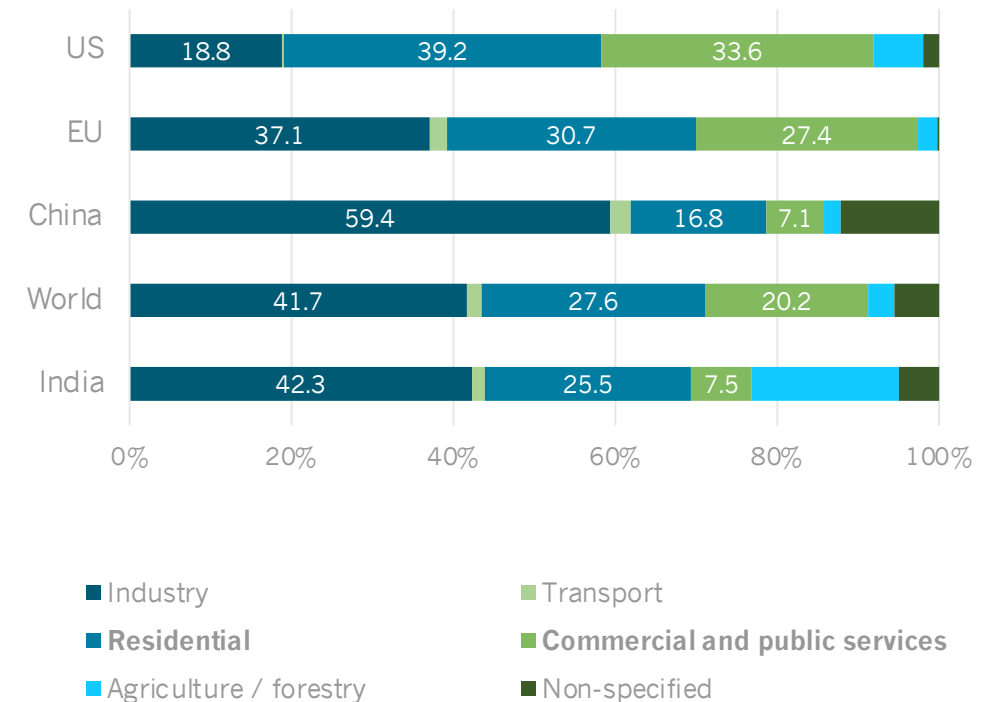
Shares of Electricity Consumption by Country in 2022



2022 Per Capital Power Consumption in MWh



Power Consumption Structure 2020

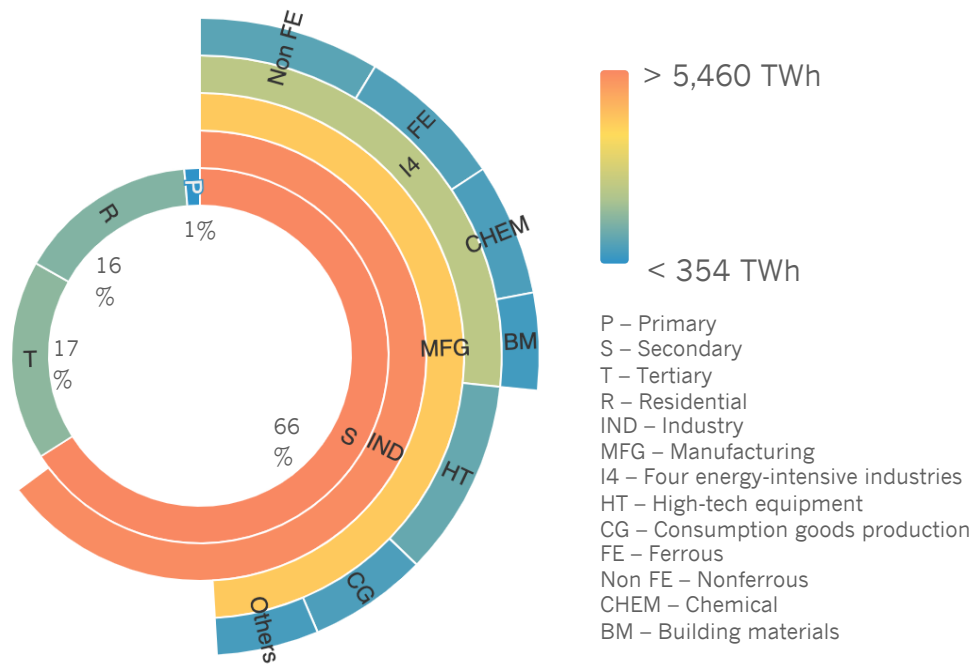


Source: EFC Analysis, IEA

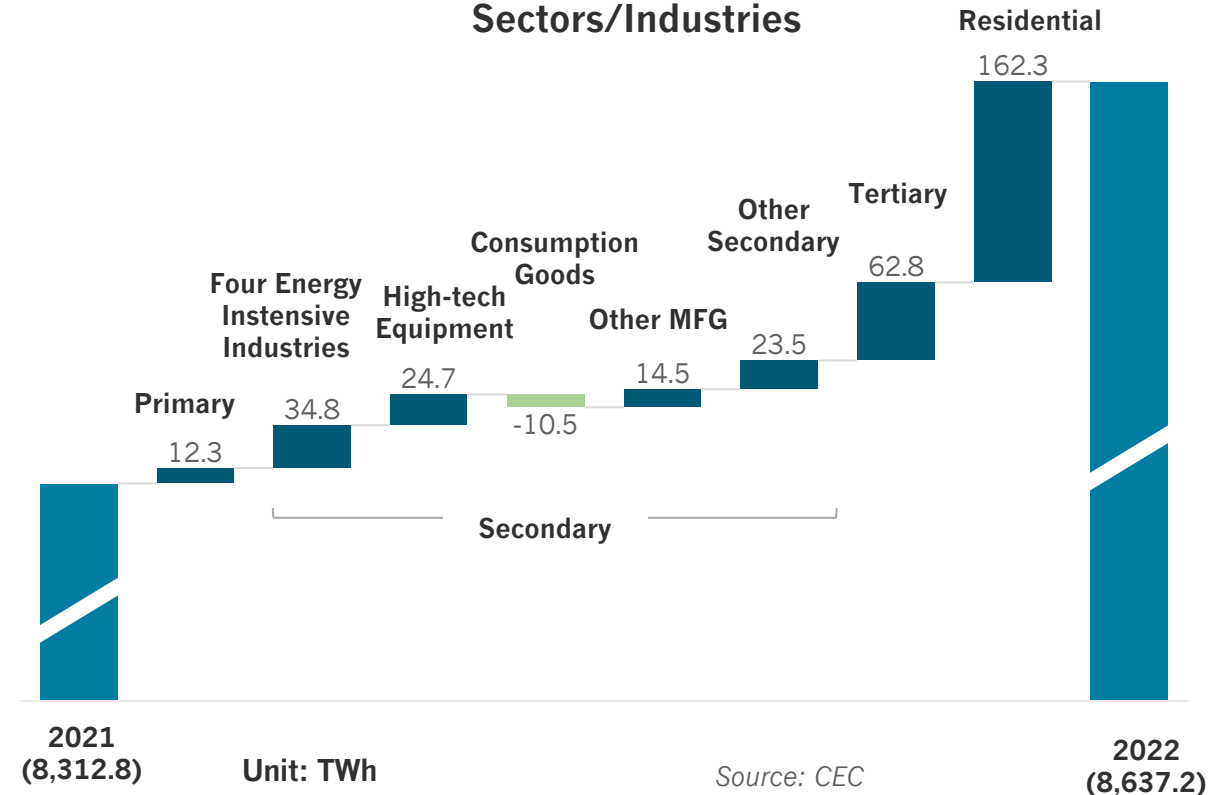
# Manufacturing Uses the Most Power and Residential Grows Faster

- Manufacturing consumed almost 49.1% of the electricity, with 27% from the four energy-intensive industries.
- New vehicle manufactory: **+71.1%**; Charging service: **+38.1%**; Cement: **-15.9%**; Iron&steel: **-4.8%**
- **Half of** the growth in consumption was driven by **residential use**.

Electricity Consumption by Sectors/Industries in 2022



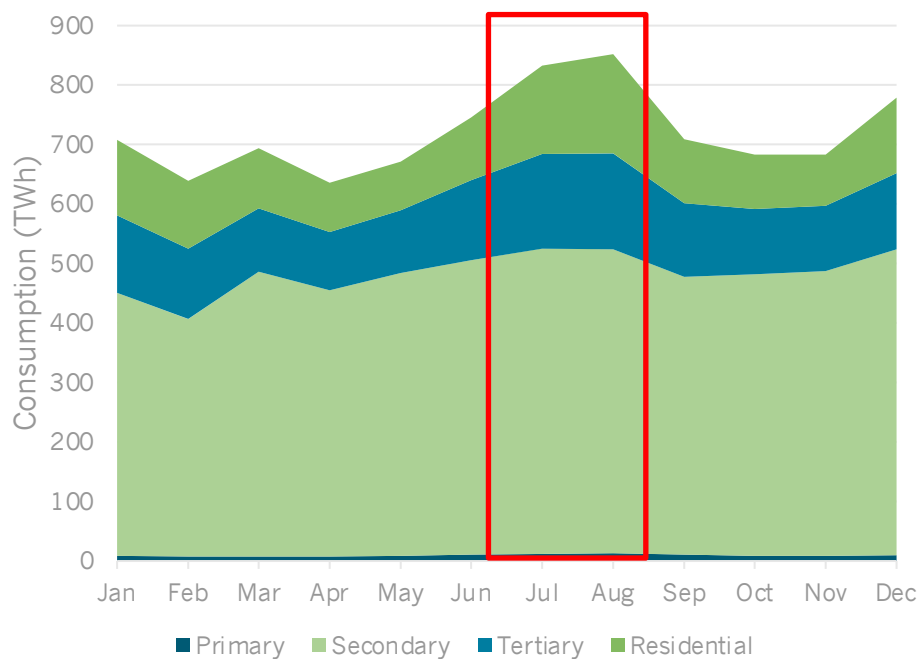
Electricity Consumption Change by Sectors/Industries



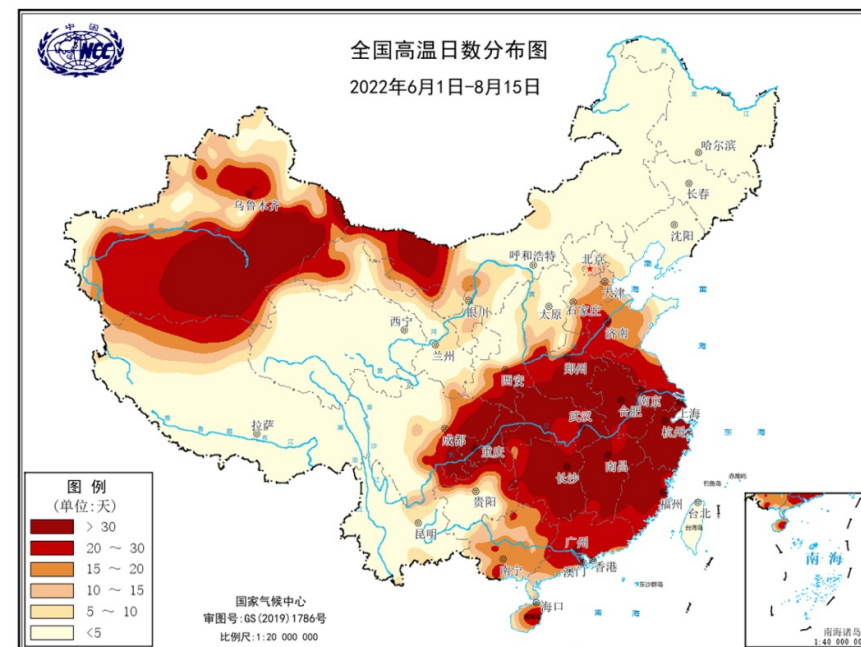
# The Historical Heatwave/Cold wave Lead to Residential Power Demand Increase in Summer and Winter

- A heatwave across central and eastern China lasted for more than 70 days, making it the country's longest and strongest heatwave on record since 1961, leading to **33.5%** increase in residential power demand in August.
- In December, 4 cold wave lead to an increase of 35% in residential electricity demand.

Monthly Electricity Demand by Sector



Number of High Temperature Days from June 1 to August 15, 2022

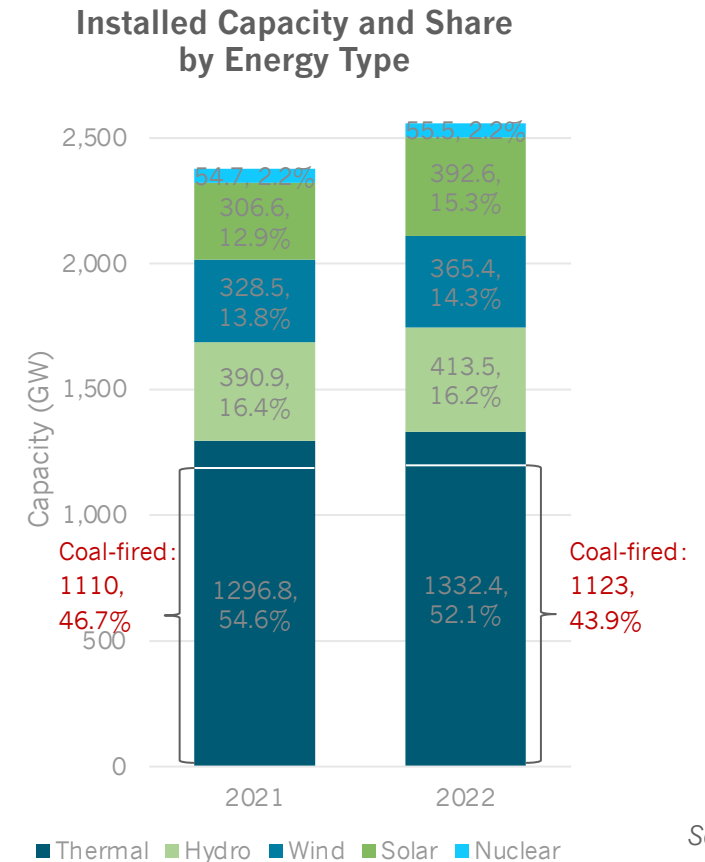
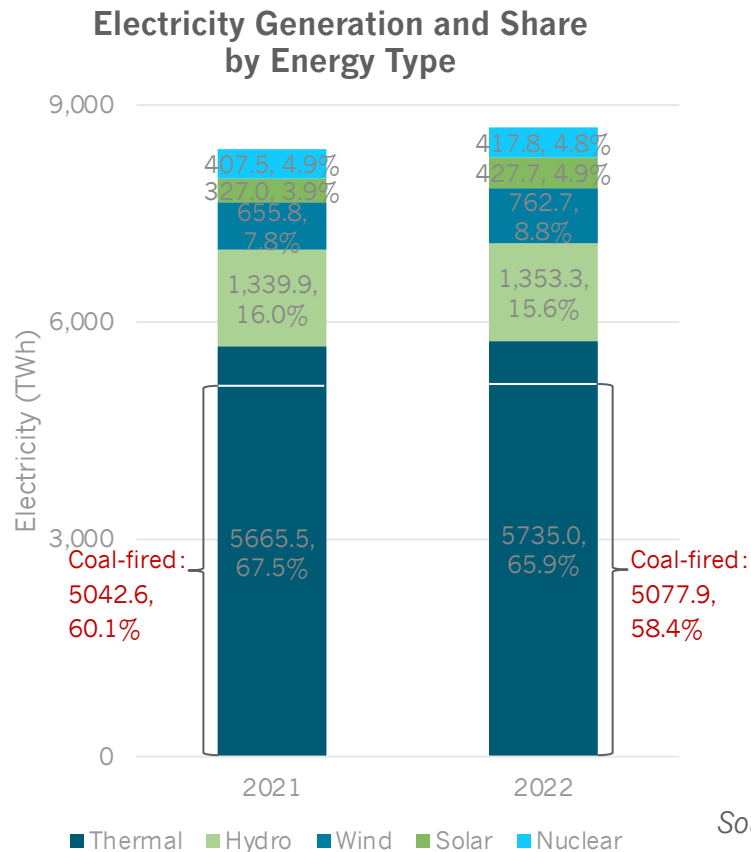


Source: CMA



# Coal-Fired Power: Stable in Value and Decrease in Share

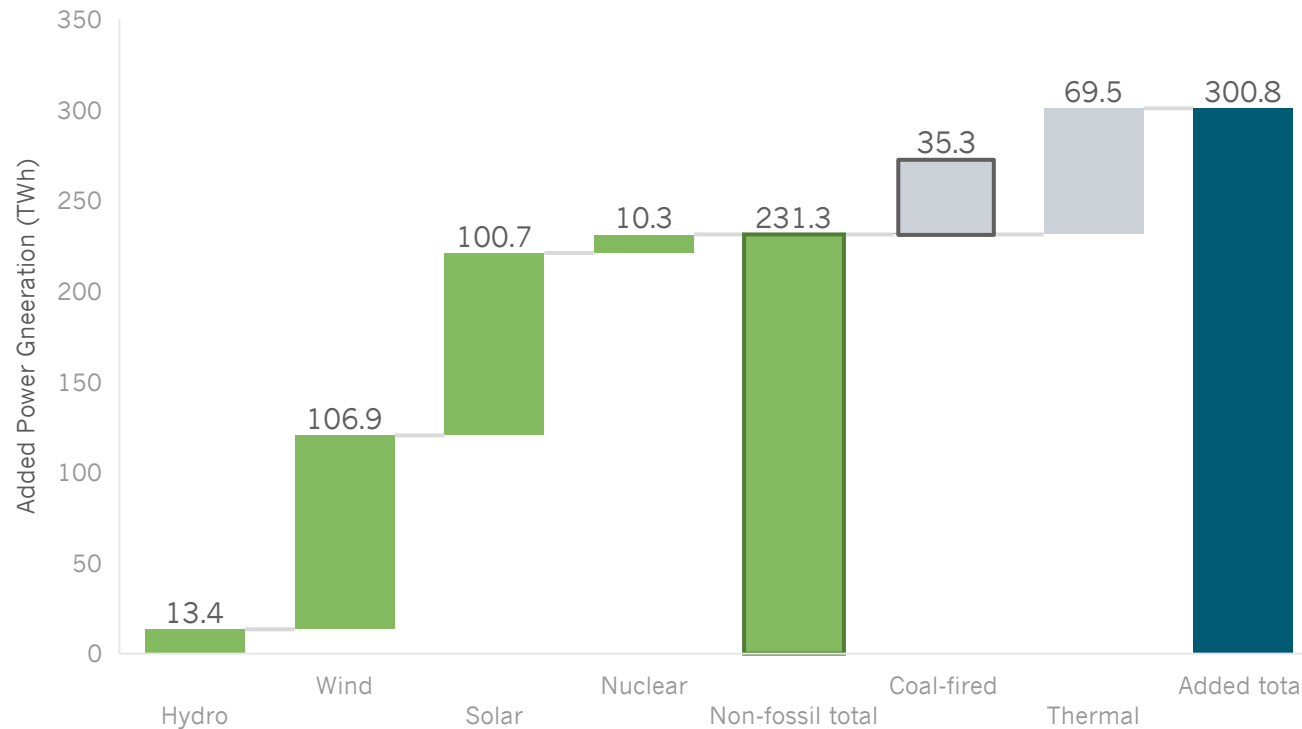
- Coal-fired power took up **58.4%** of total electricity generation and **43.9%** of total installed capacity.
- The percentage of coal-fired power installation **decreased** from 46.7% to 43.9%.
- The installed capacity of solar and wind reached **125 GW (13GW for coal)**, more than 100GW for the third consecutive year



# Clean Energy Grow Fast, not yet Enough to Fulfill Increased Needs

- Clean energy satisfied 3/4 of new power demand in 2022, meaning **1/4** needs to be filled by thermal power, **half** of which was coal-fired.
- The increased clean energy was **6.5 times** the increased coal-fired power.

Newly Added Power Generation 2021—2022

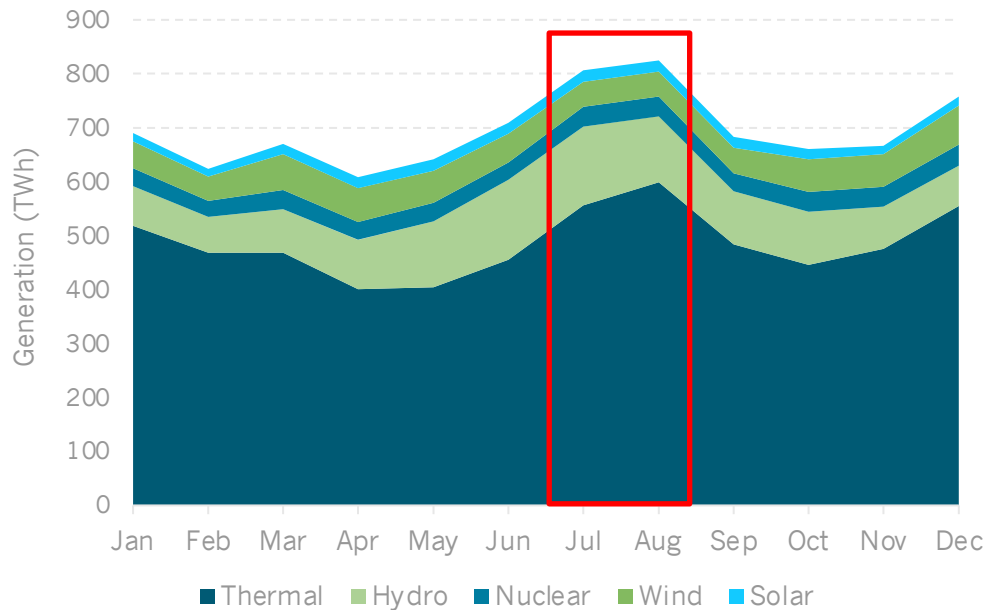


Source: EFC Analysis, NBS

# Coal-Fired Power was Urgently Needed at Power Demand Peak

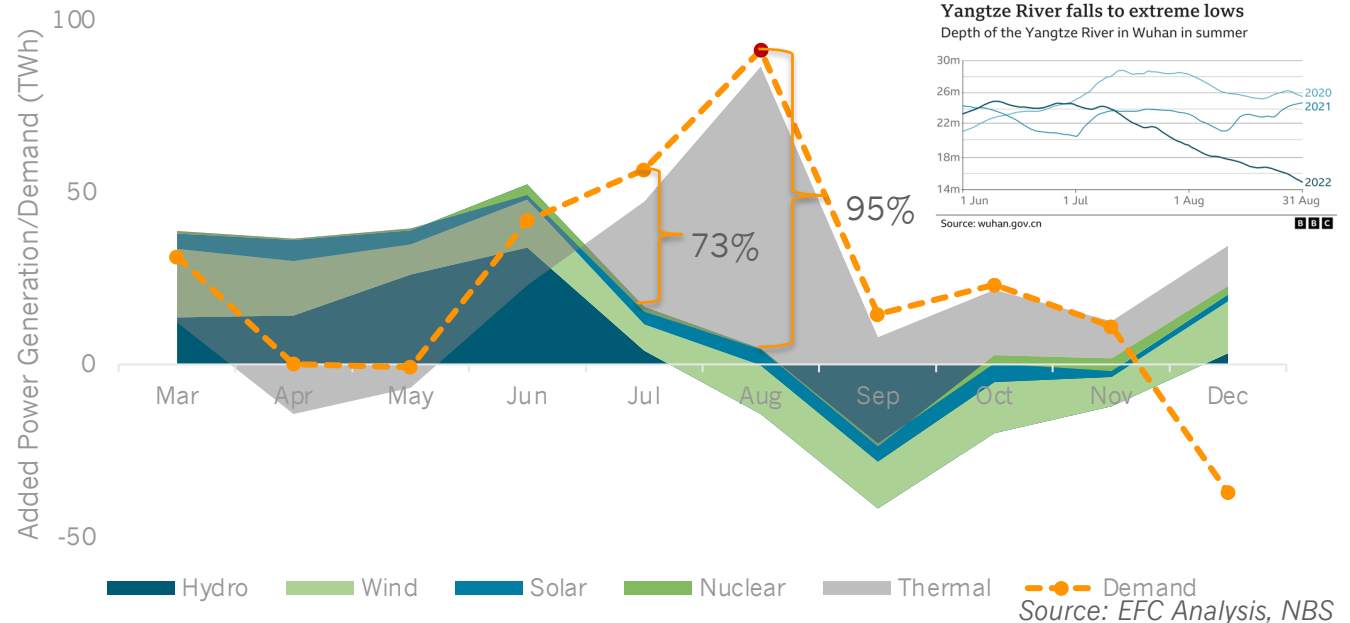
- In summer 2022, **hydro power plunged** with **surging power demand**, both due to high temperature.
- The power gap that clean energy was not able to fill reached **73%** and **95%** in **July** and **August**, respectively.
- Coal-fired power was urgently needed to fill in the huge gap starting from July.
- Before June, the newly generated clean power completely met the added demand and thermal power kept declining.

Monthly electricity generation by power source, 2022



Source: CEC

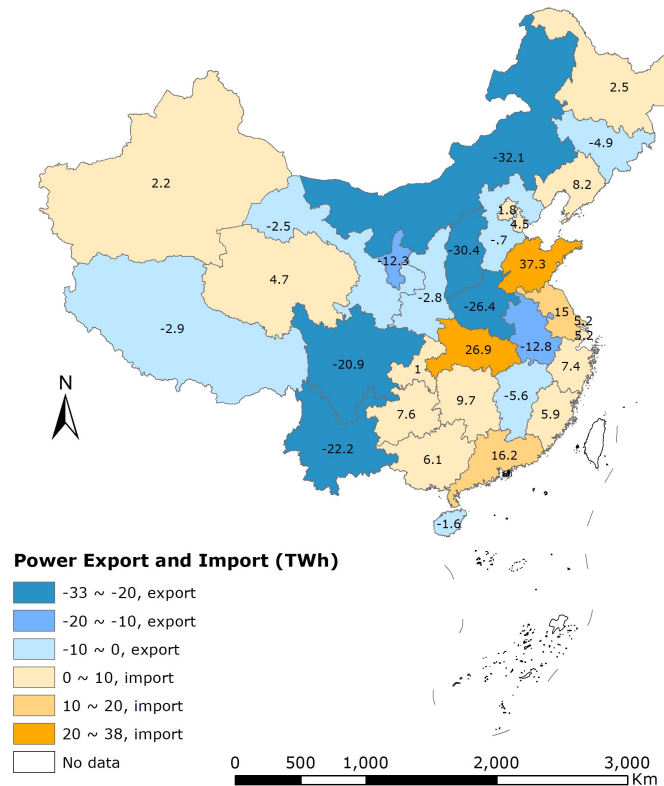
Month-to-month Added Power Demand VS. Added Power Generation 2021—2022



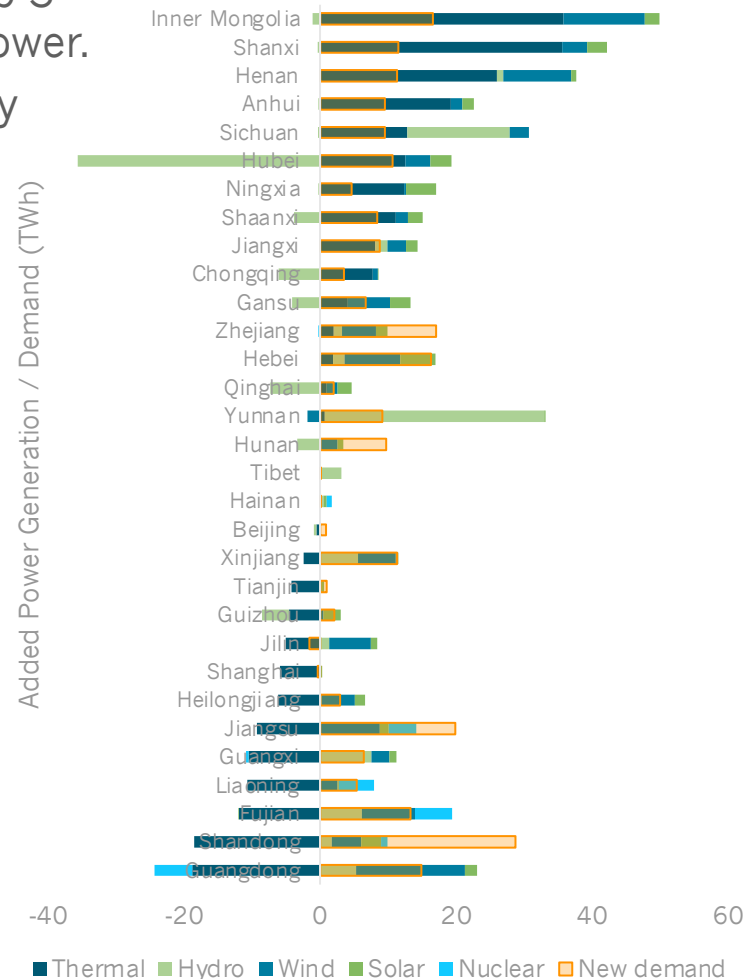
Source: EFC Analysis, NBS

# Distribution of Newly-Added Power Demand/Capacity in 2022

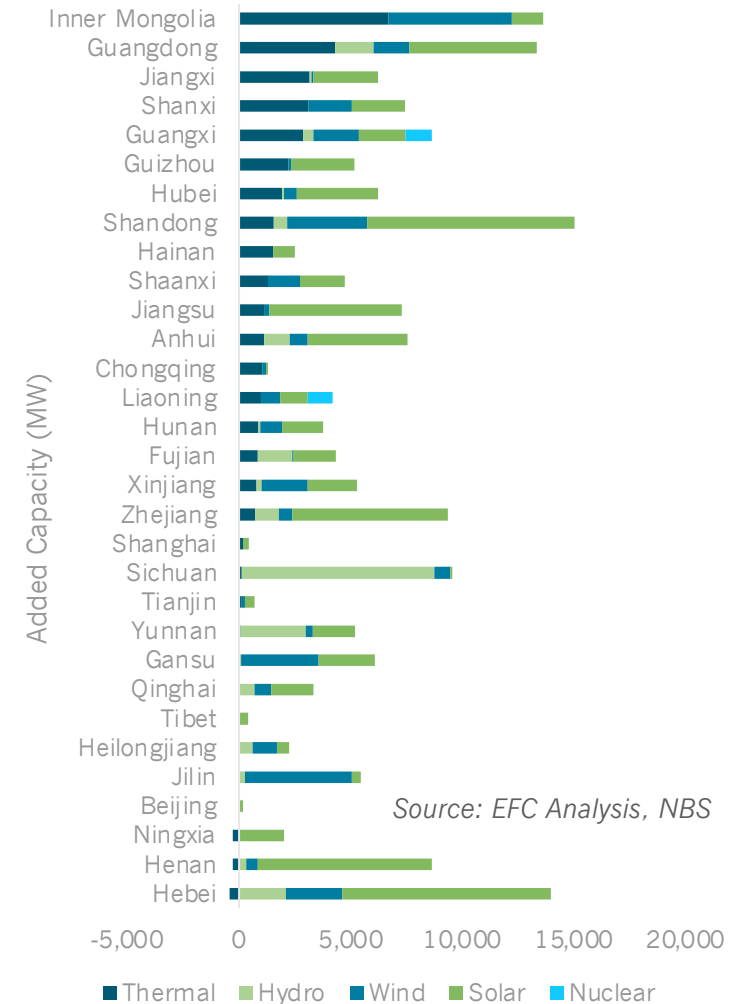
- **Inner Mongolia, Shanxi, Henan, Yunnan, and Sichuan** are the major power sources; the top 3 accounted for 1/2 of newly added thermal power.
- **Inner Mongolia and Guangdong** led the newly installed thermal power capacity.



Newly Added Power Generation VS. New Demand 2021—2022



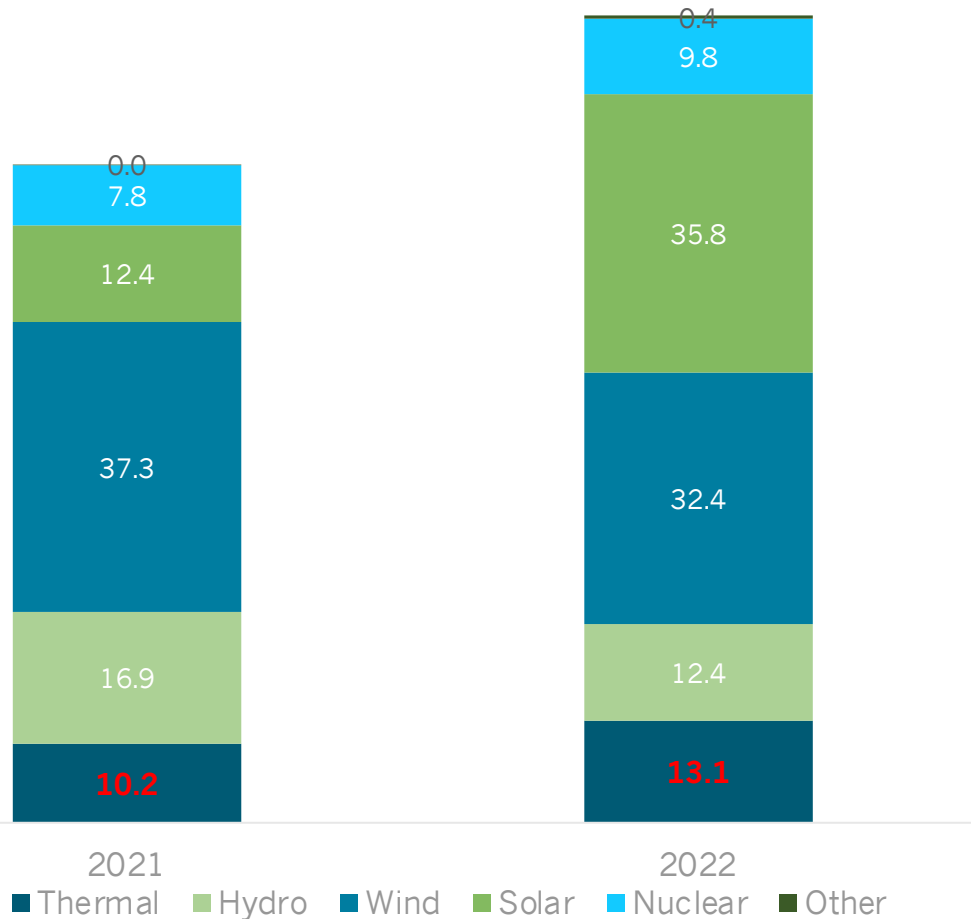
Newly Installed Power Capacity 2021—2022



Source: EFC Analysis, NBS

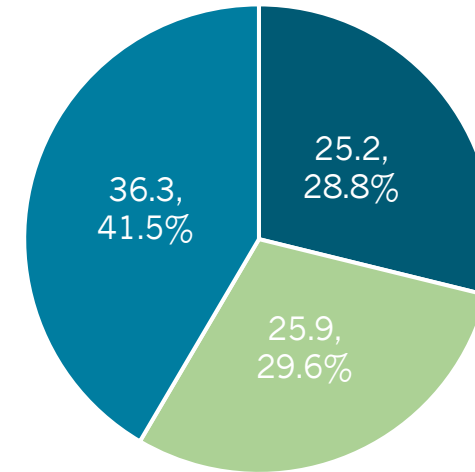
# Growing Investment in Power Generation Driven by RE

Power Generation Investment in 2021 and 2022  
(Billion USD)



Source: NEA

Mix PV Installation in 2022  
(GW)



- Distributed - Households
- Distributed - Industrial & Commercial
- Centralized

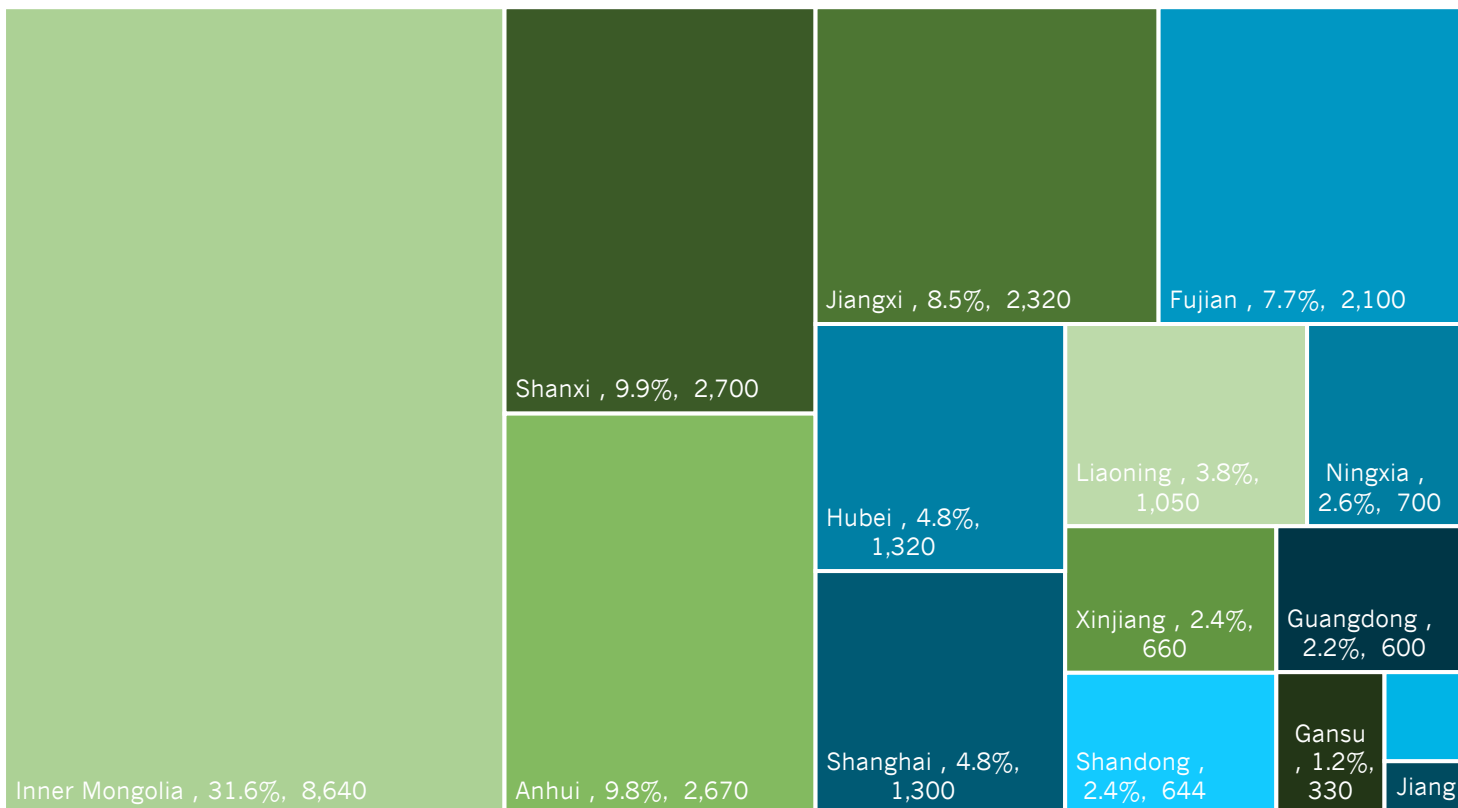
Source: NEA

- Power investment increased 13.3% in 2022, in which non-fossil fuel accounted for 87.7%.

# Boots not yet on the ground: New Power Coal

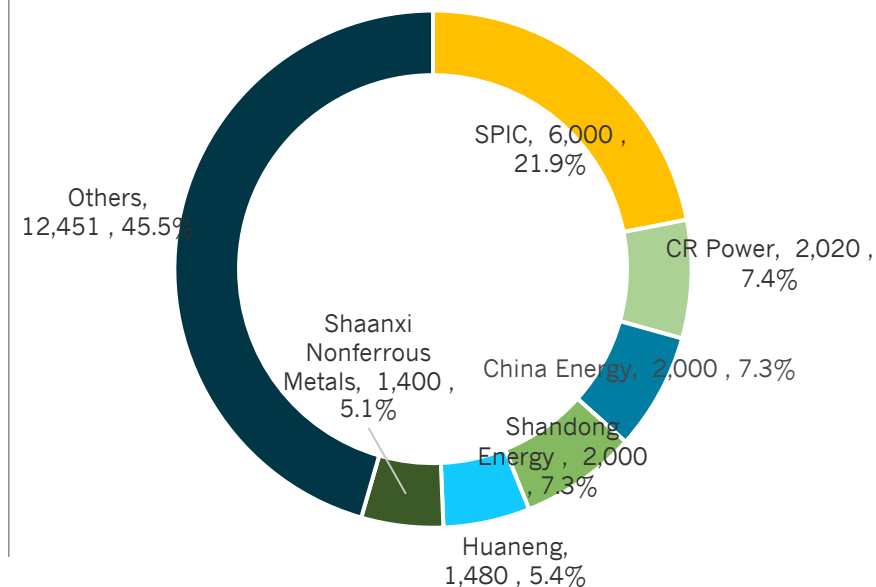
# Status of Newly Operating Coal Power Projects in 2022

Distribution, MW



- The newly operating (incl. trial operation) coal-fired power capacity had reached **27.4 GW** in 2022.

Investor and Share

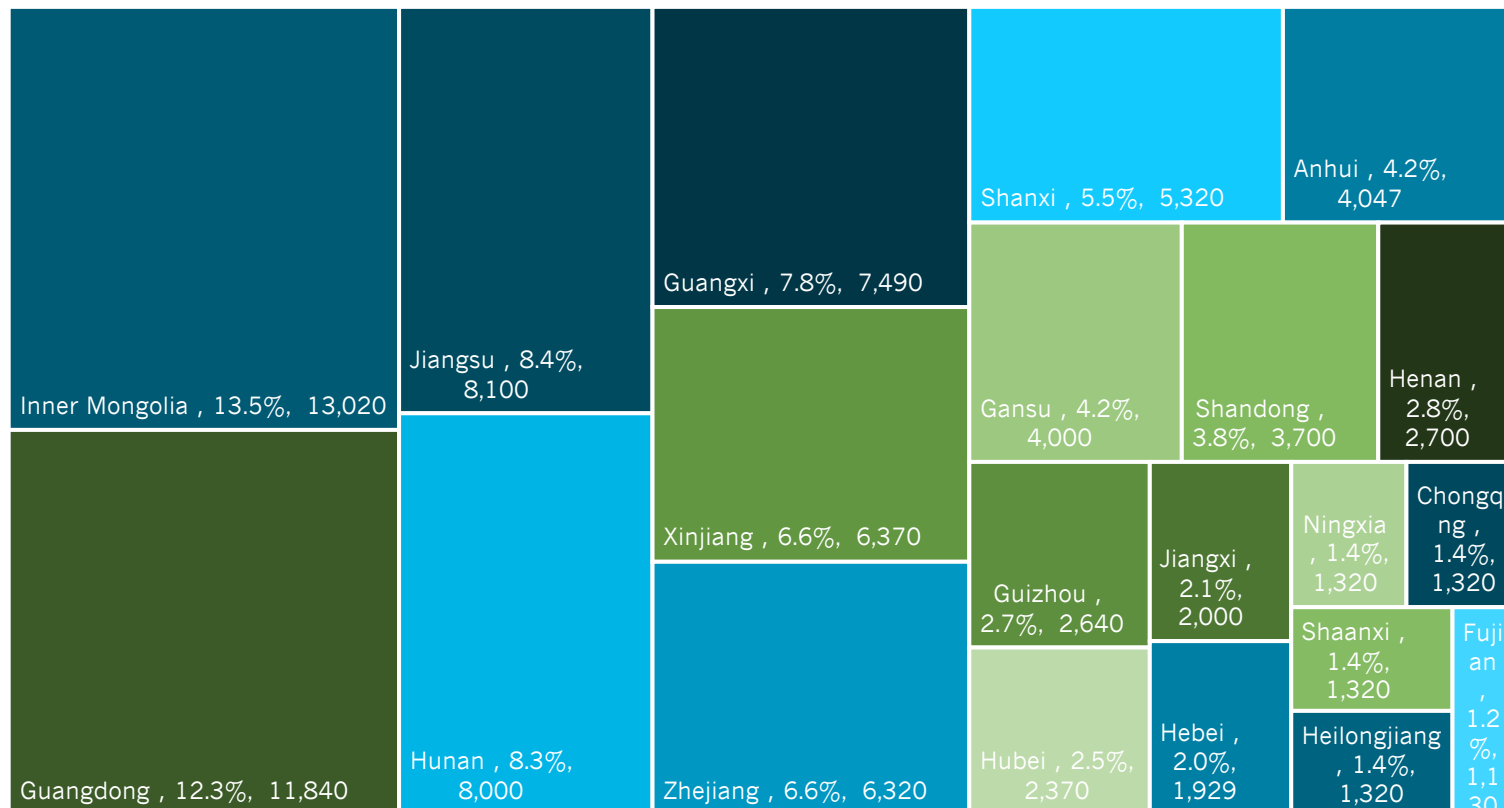


Note: State Power Investment Corporation (SPIC); China Resources Power Holdings (CR Power); China Energy Investment Corporation (China Energy).

Source: EFC Analysis

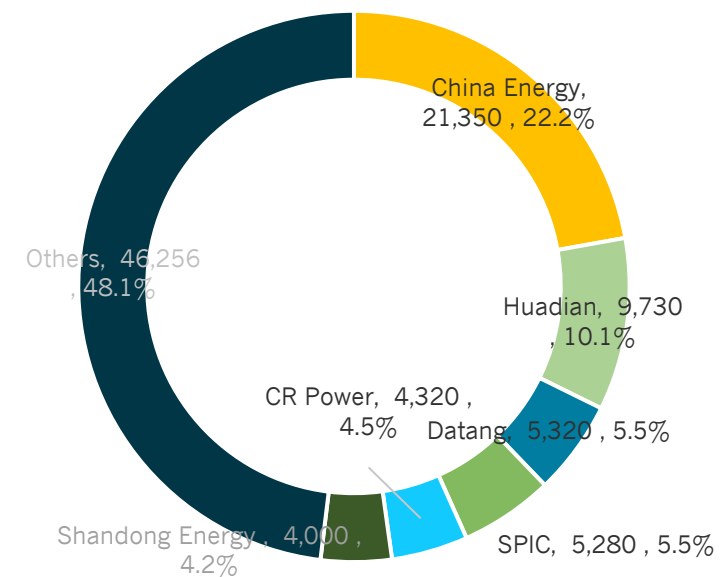
# Status of New Coal Power Projects Under Construction in 2022

Distribution, MW



- The newly coal power projects under construction had reached **96.3 GW** in 2022.

Investor and Share, MW



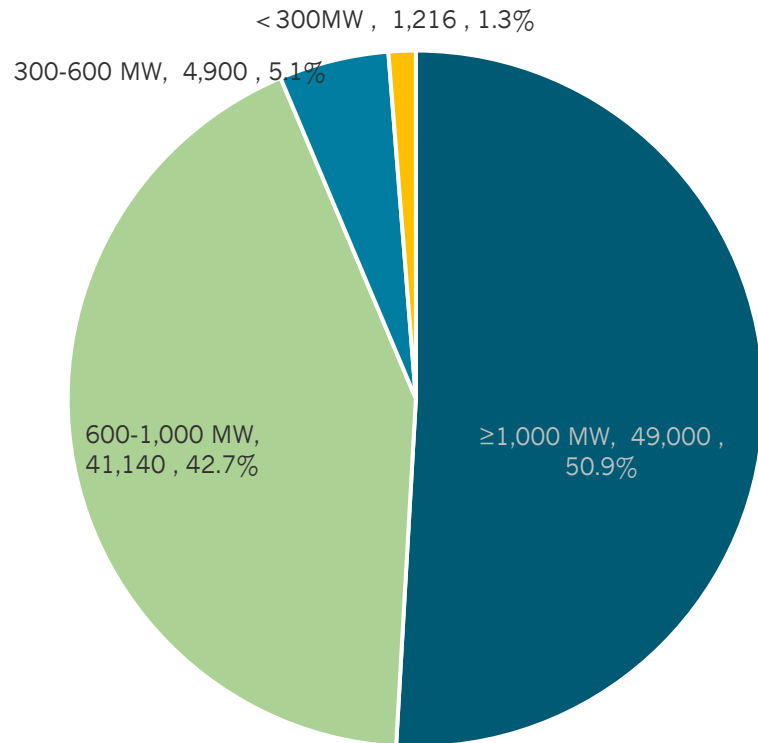
Note: China Energy Investment Corporation (China Energy); State Power Investment Corporation (SPIC); China Resources Power Holdings (CR Power).

Source: EFC Analysis



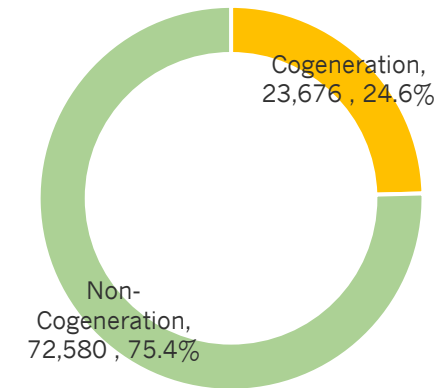
# Status of New Coal Power Projects Under Construction in 2022 Cont.

## Types and Share, MW

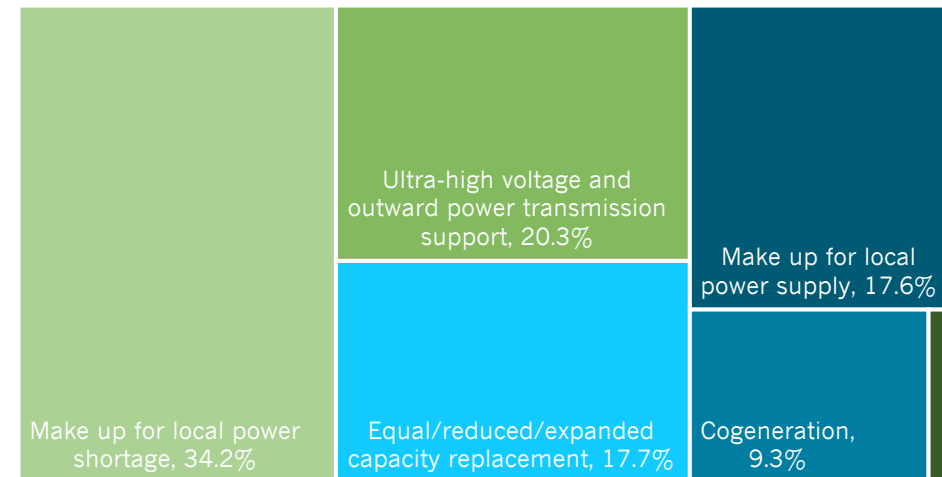


- Around **93.6%** of newly operating coal power projects are  $\geq 600$  MW.

## Cogeneration and Non-cogeneration, MW



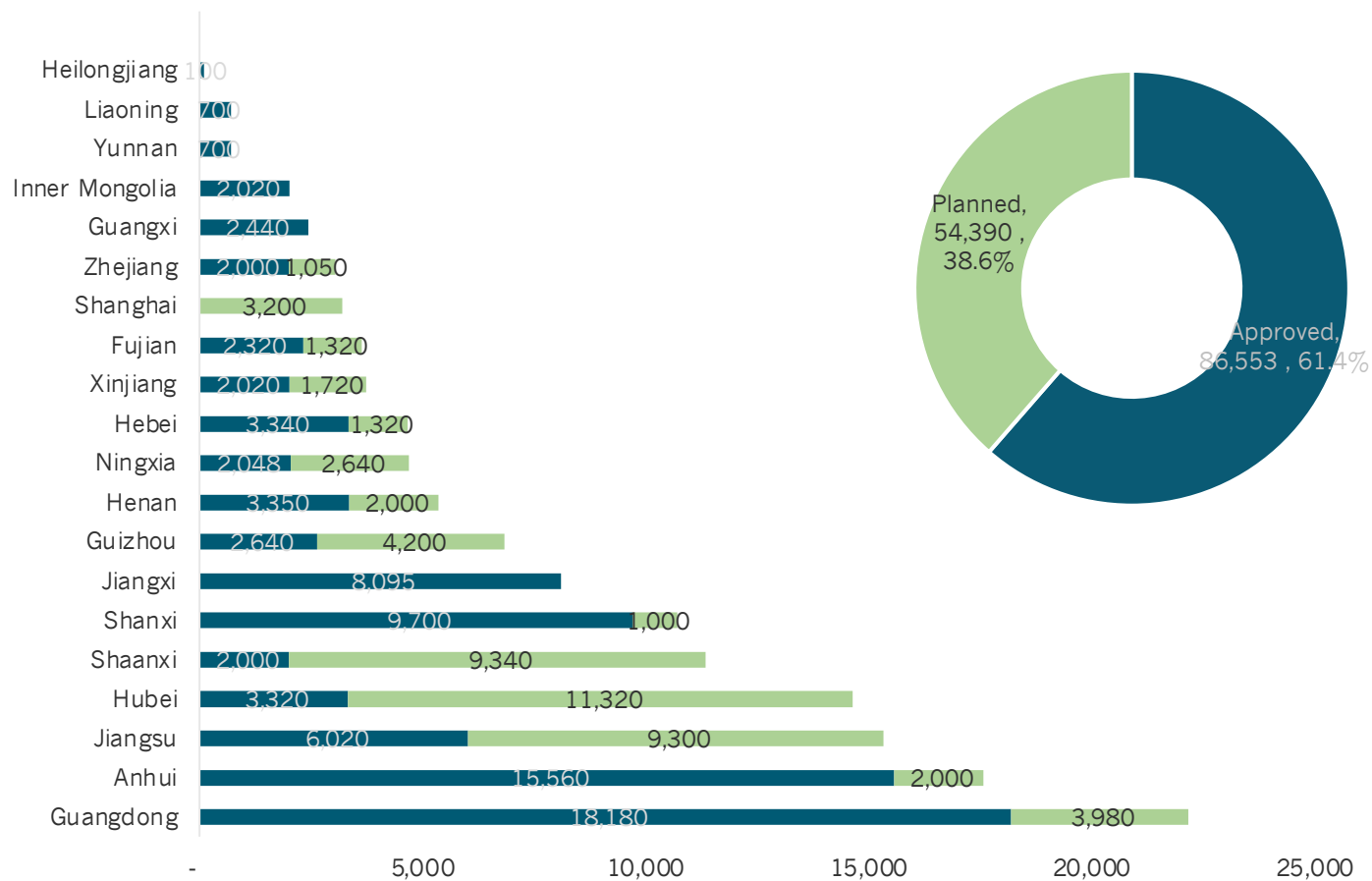
## Reasons, MW



Source: EFC Analysis

# Status of Newly Promoted Coal Power Projects in 2022

Distribution of Newly Approved or Planned Coal Power Projects in 2022, MW

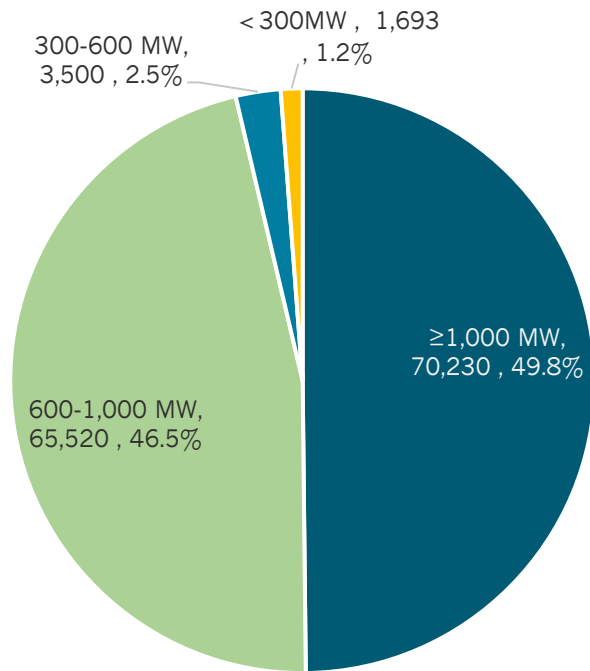


- In 2022, the newly promoted coal-fired power capacity had reached **140.9 GW**.
- A total of **86.6 GW** of coal power plants were approved, in comparison to **18.6 GW** in the previous year (2021).
- **Guangdong, Anhui, Shanxi, and Jiangxi** are the provinces with the largest approved capacity.
- **Hubei, Shaanxi, and Jiangsu** are the provinces with the largest planned capacity.

Source: EFC analysis, Greenpeace

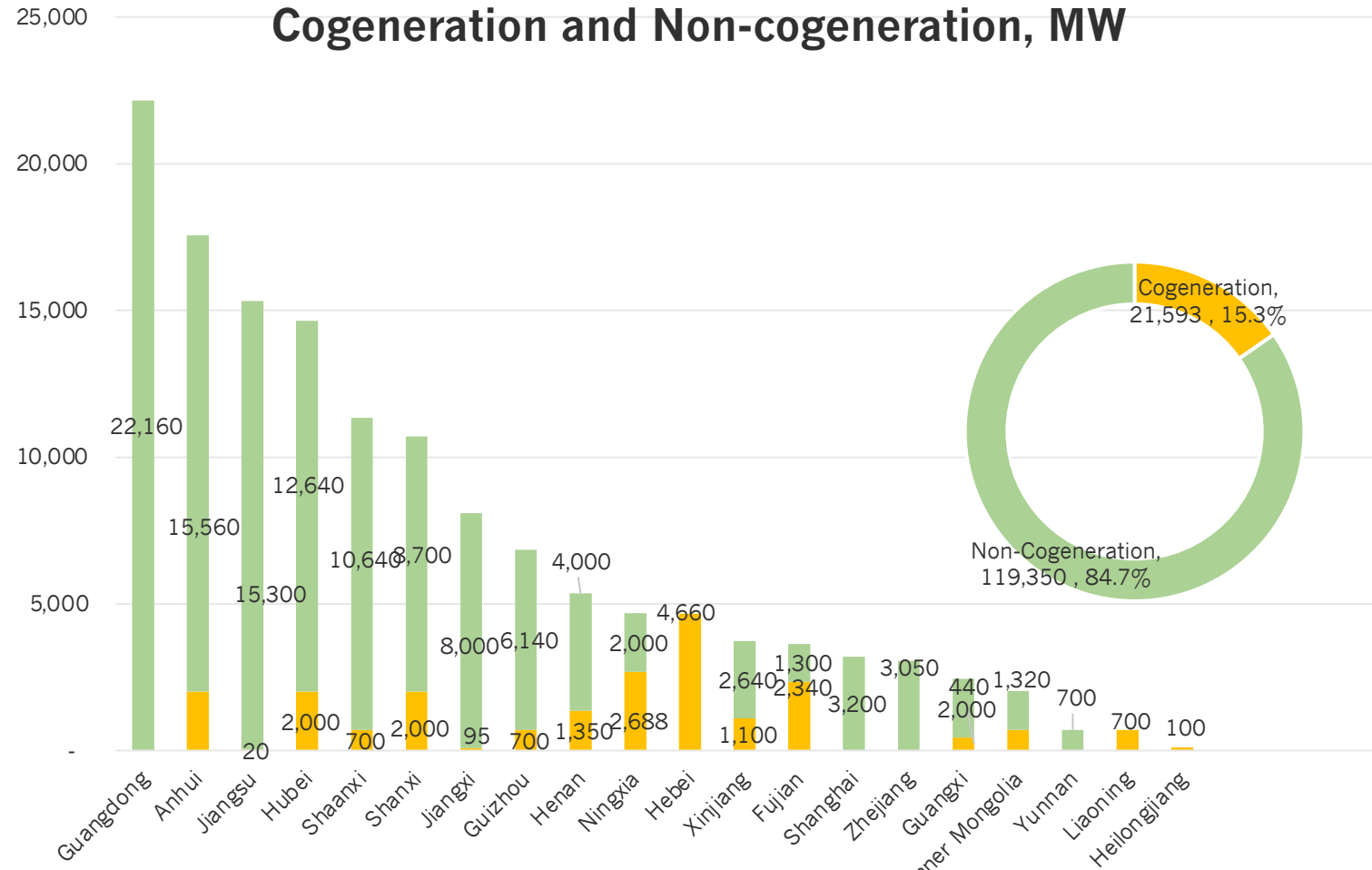
# Status of Newly Promoted Coal Power Projects in 2022

## Types and Share, MW



- Around **96.3%** of newly promoted coal power projects are ≥600 MW.

## Cogeneration and Non-cogeneration, MW

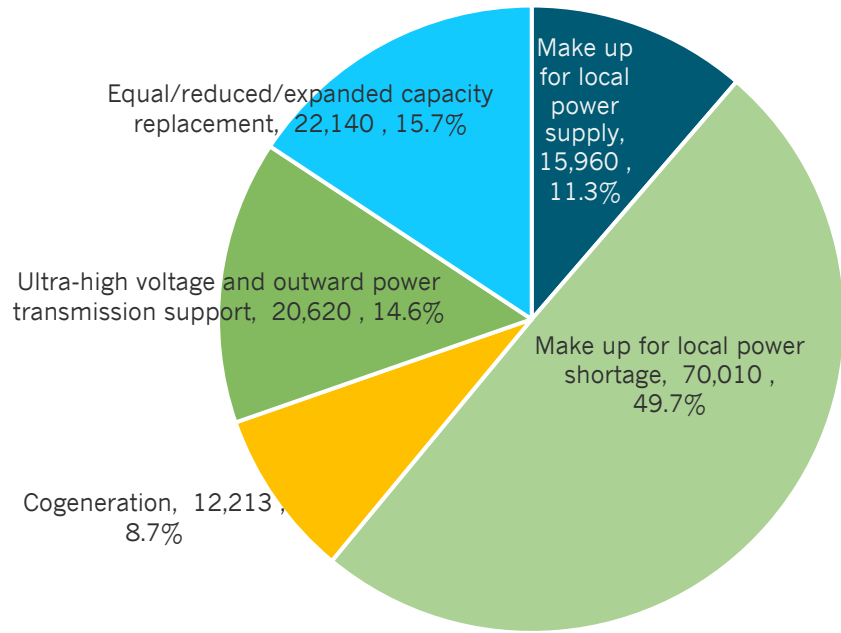


- **Hebei, Ningxia, and Fujian** are the regions with the highest number of approved or planned cogeneration projects.

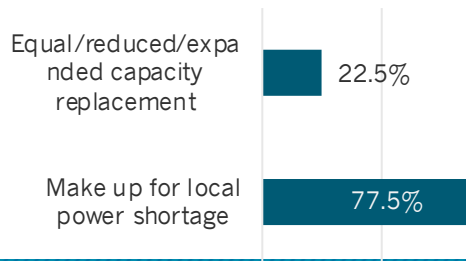
Source: EFC Analysis

# Status of Newly Promoted Coal Power Projects in 2022

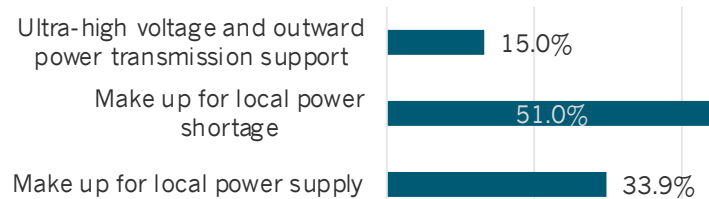
Reasons, MW



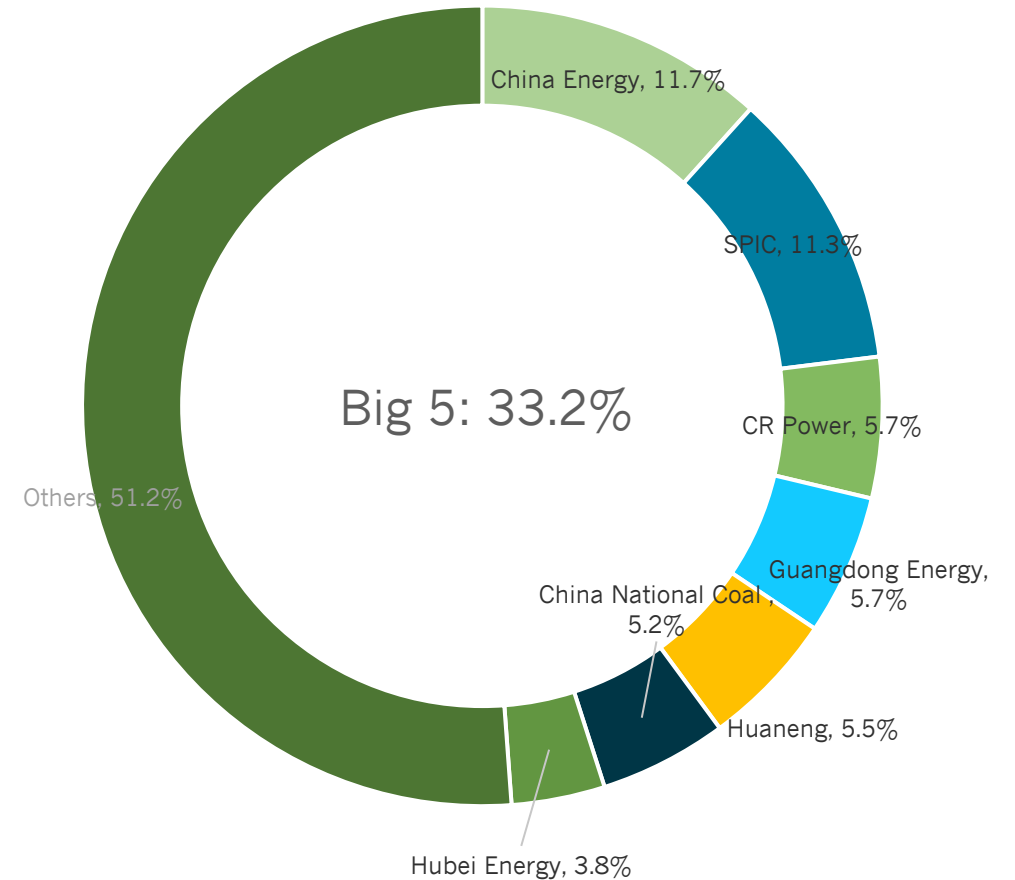
Guangdong



Anhui



Investor and Share

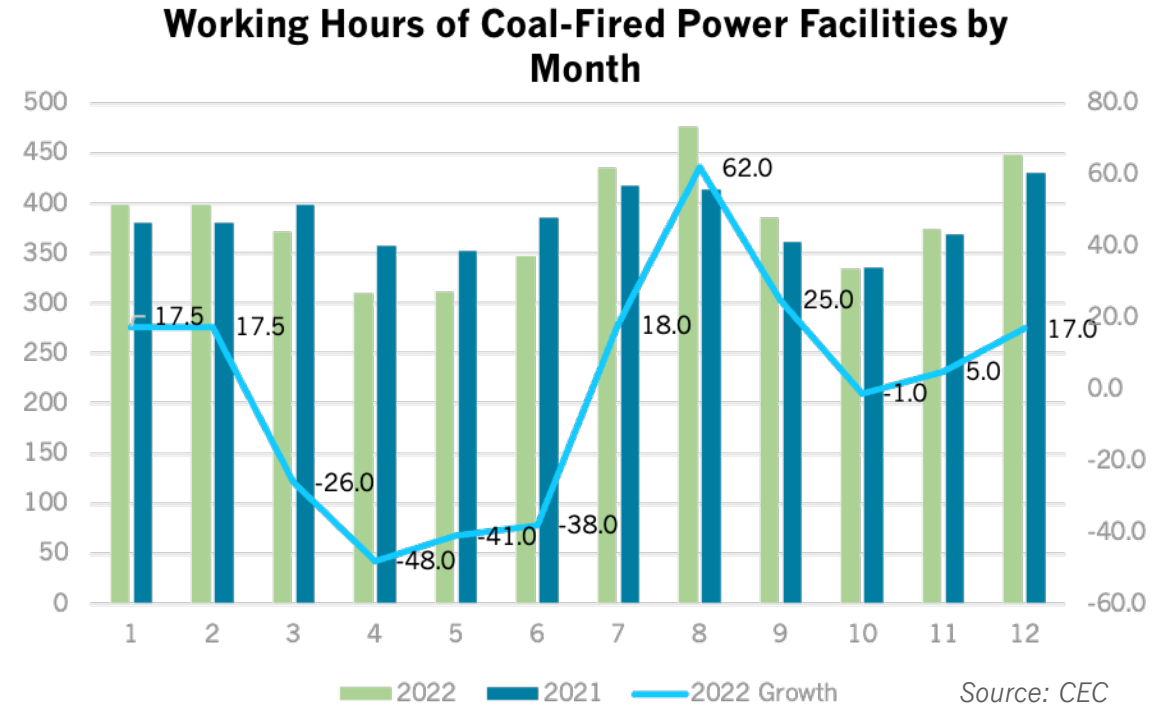
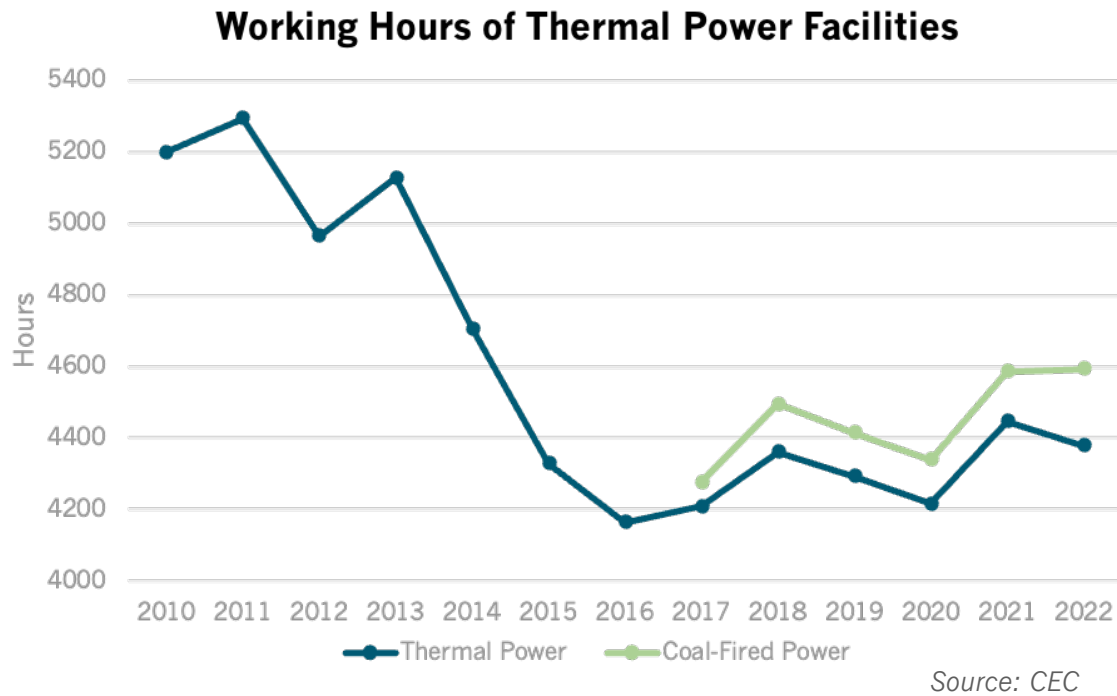


- **93.6%** investor are State-Owned Enterprises.

Source: EFC Analysis

# Evolving Role of Coal-Fired Power

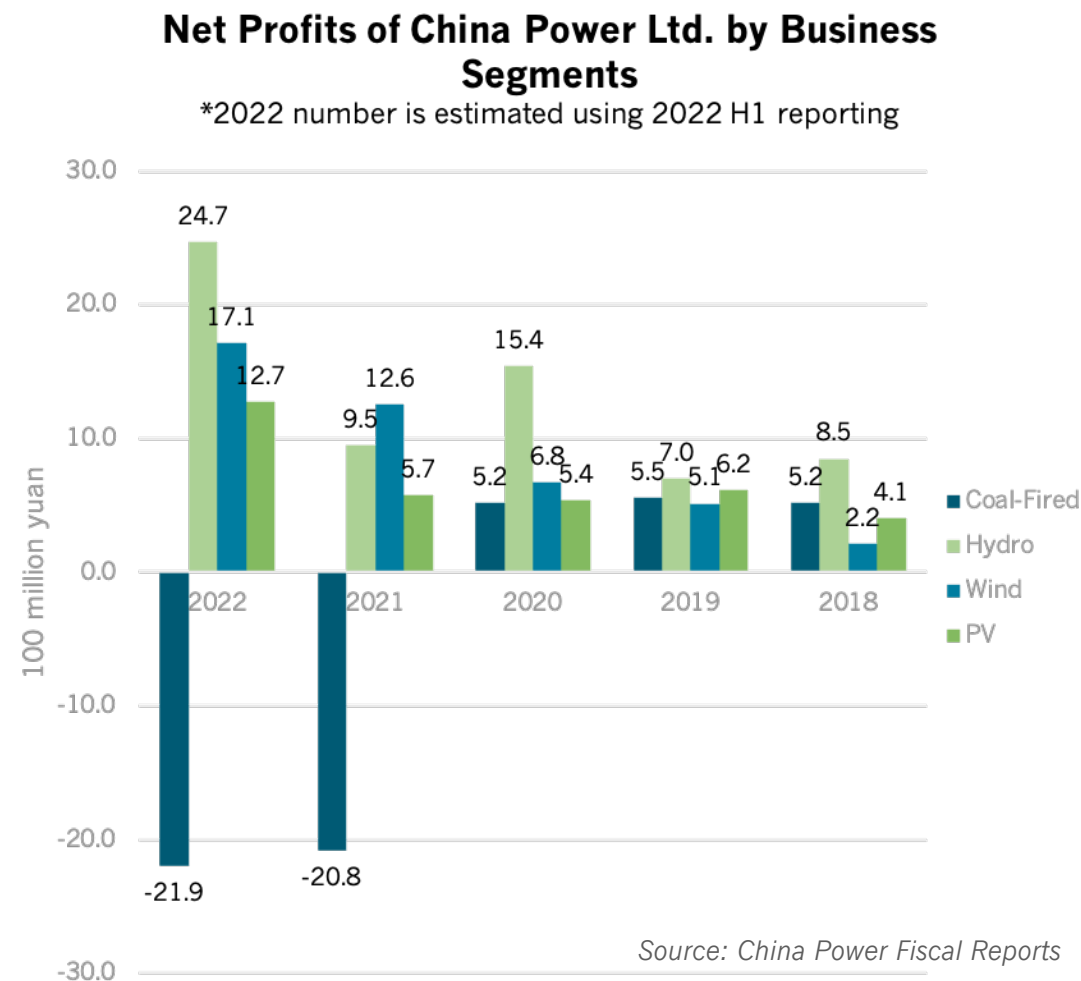
# Uneven Increasing Working Hours of Coal-Fired Power



- Thermal power facilities (incl. coal-fired) worked **longer** since 2021.
- Working hour of coal-fired facilities continued increase despite reduced working length for thermal power.
- Summer 2022 registered a sudden hike in working time of coal-fired power plants to **make up power shortage**.

# Coal-Fired Power Business Continue Losing Money

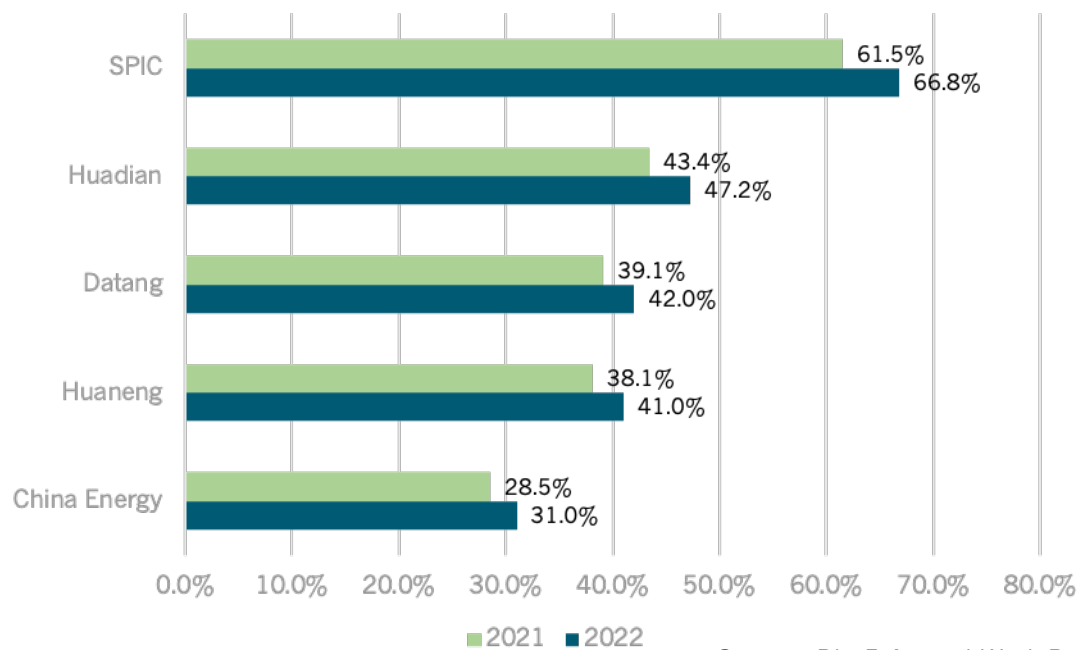
- Overall performance improvement of thermal power companies in 2022:
  - 2021: over **80%** of coal-fired power companies reported negative profits, adding to a total loss of **100 billion yuan** for entire thermal power sector.
  - 2022: still around **50%** of listed thermal power companies sent out negative profit alerts, totaling a loss of **10 billion yuan**.
  - This is likely a result of governmental intervention rather than market results.
- Coal-fired power business is still **dragging down** the profitability of power companies.
- Power companies are seeking to diversify power sources in business portfolio.



Estimated profits of *China Power* in 2022 are 2.3—2.7 billion yuan.

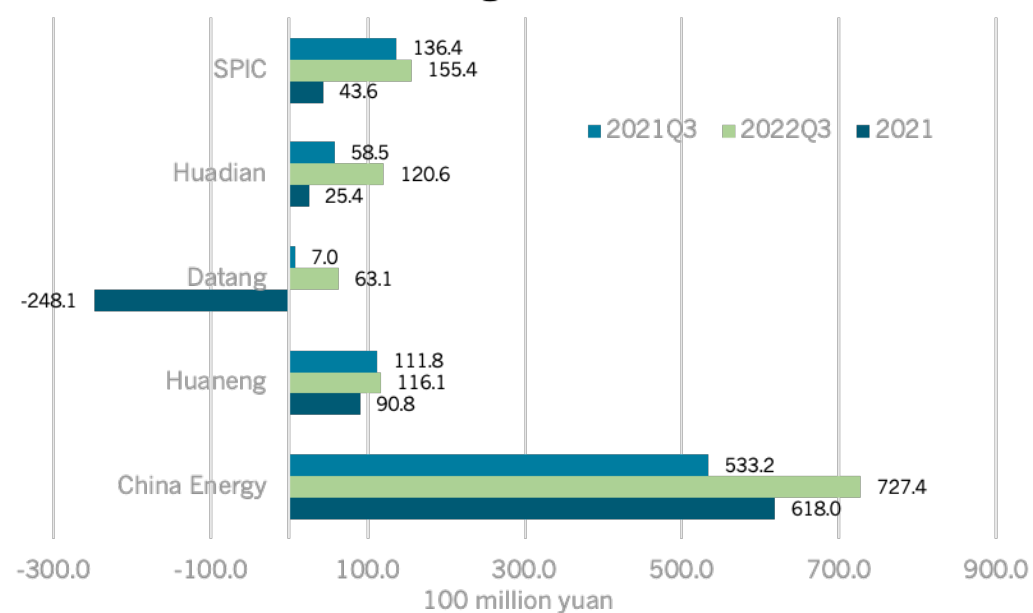
# Big 5: Profits Rose in Tandem with Clean Energy Share

Clean Energy Capacity Share of Big 5 Power Producers



Source: Big 5 Annual Work Review

Net Profits of Big 5 Power Producers



Source: Big 5 Fiscal Reports

- **All** Big 5 **increased** the proportion of clean energy capacity in their business portfolio.
- Net profits **overall improved** for all Big 5 power producers.
  - China Energy profits rocketed due to considerable revenues from the coal business of *China Shenhua Energy* in 2022.
  - SPIC has maintained a substantial amount and **growth of net gains** due to stable revenues from **clean power**.



# Is Flexibility Retrofit Worth It?

## 14<sup>th</sup> FYP National Target: **200 GW**

- Add **30—40 GW** regulating capacity to grid
- Fixed retrofit costs estimation (by regulating capacity added)
  - CEC: RMB 500—1,500/kW
  - NRDC & NCEPU: CHP: RMB 300—500/kW  
Non-CHP: RMB 600—700/kW
- Other costs:
  - Incremental coal consumption by 14—20 g/kWh due to low-load operation; **smaller capacity** ≤ 30MW suffers less efficiency loss
  - Increased depreciation of equipment and reduced longevity
- Weak economic viability majorly due to **lack of proper value realization mechanism** or pricing mechanisms for ancillary services.

## Inner Mongolia

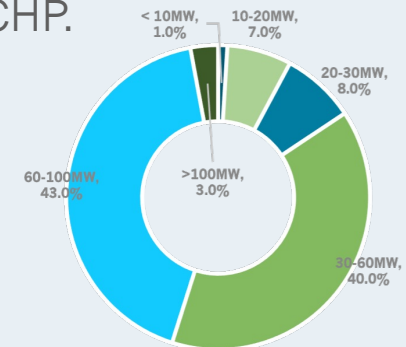


### 14<sup>th</sup> FYP-Period Targets:

- To install **80 GW** renewable energy
- To finish **20 GW** of flexibility retrofit, adding **4—5 GW** regulating capacity (by 2023)
- 1GW of newly-added regulating capacity is matched with 1GW of RE.

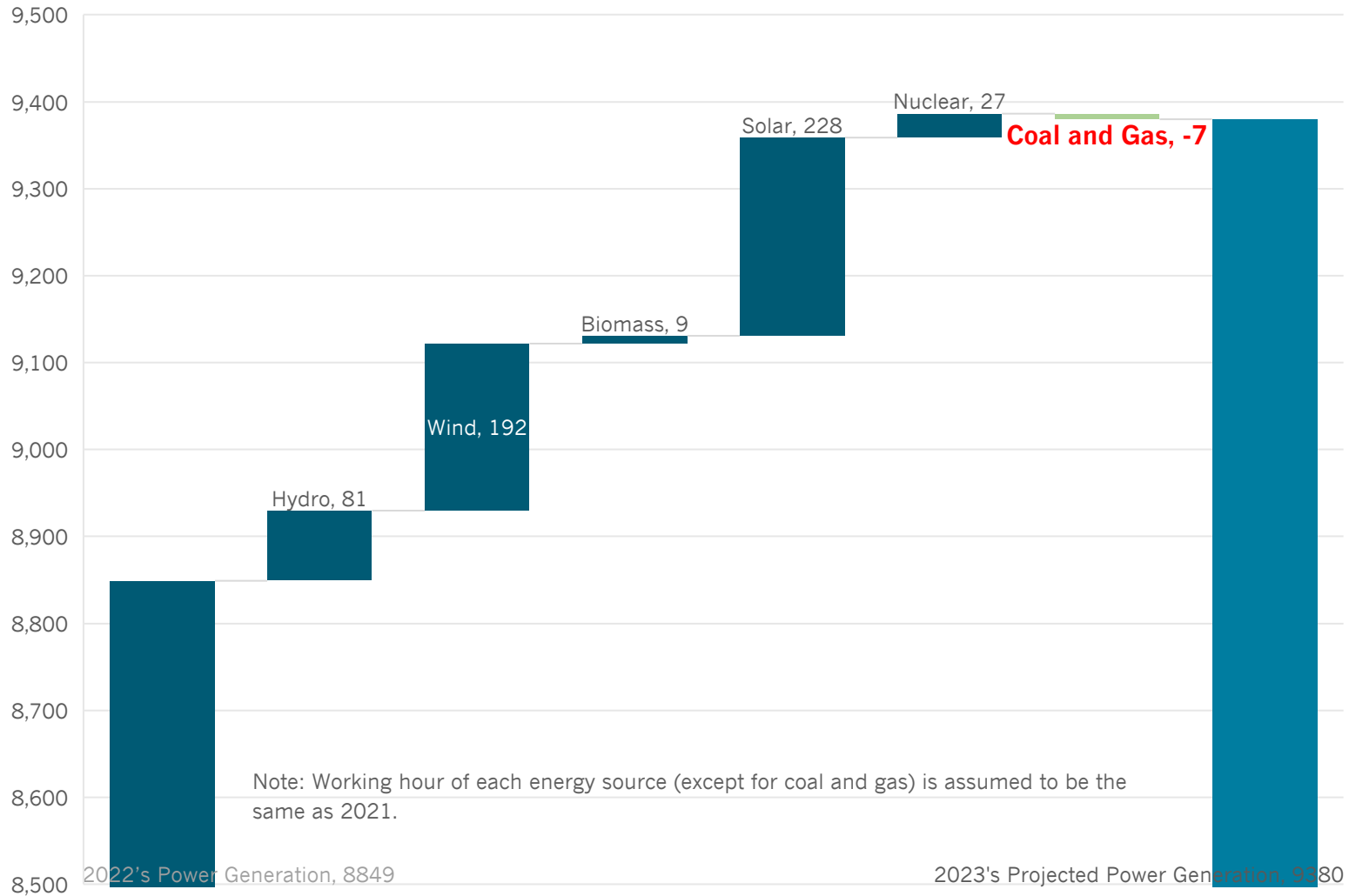
### Summary of 2022 retrofit projects:

- **23.3GW finished, adding 5.1GW regulating capacity**
- 84.6% were CHP, 15.4 were non-CHP.
- By capacity:
  - ≤ 30MW : 6.1 GW, 26.5%
  - 30—60MW: 12.2 GW, 52.3%
  - > 60MW: 5.0 GW, 21.3%



# Power Generation Projection in 2023

Projection of Power Generation by Energy Source in 2023, TWh



- Growth rate for power consumption and generation will be around 6%.
- Around **250 GW** of new power generation capacity will be added, with **180 GW** being non-fossil fuels. Of this amount, over **160 GW** will come from wind and solar sources.
- Non-fossil fuels will contribute 101% of incremental power supplies to meet demand growth. With **237.2 GW** of coal capacity in the pipeline, the working hours of coal-fired power generation will likely decrease (see left graph).

Source: EFC Analysis

# Measures to Curb Coal-Fired Power Growth

Role of coal-fired power	UHV and outbound power transmission	Power shortage makeup	Power supply makeup	Heating services
Coping measures	<ol style="list-style-type: none"> <li>1. Replace coal-fired power with <b>other supply-side flexibility resources</b> (e.g., PSH, battery energy storage).</li> <li>2. Promote deployment of distributed <b>energy storage</b> at the <b>demand side</b>.</li> <li>3. Explore <b>grid-to-grid</b> (vs. plant-to-grid) transmission mode for renewable power, esp. in large solar and wind bases.</li> </ol>	<ol style="list-style-type: none"> <li>1. Establish coordinating mechanism to realize <b>cross-grid and inter-provincial power dispatching</b>.</li> <li>2. Promote deployment of distributive PV, nuclear power, and offshore wind power at places with abundant resources.</li> <li>3. Guide <b>industrial re-layout</b> where energy-intensive sectors/enterprises relocate near renewable power sources.</li> </ol>	<ol style="list-style-type: none"> <li>1. Establish coordinating mechanism to realize <b>cross-grid and inter-provincial power dispatching</b> at high or peak load.</li> <li>2. Expedite and expand deployment of <b>energy storage</b>.</li> <li>3. Recommend <b>demand-side response</b>, eps. big industrial users, through power market and pricing mechanism.</li> </ol>	<p>Replace with alternative clean heat sources:</p> <ol style="list-style-type: none"> <li>1. Improve the utilization rate of <b>industrial waste heat</b> for district space heating.</li> <li>2. Subsidize <b>heat pump</b> to expand its deployment.</li> <li>3. Promote utilization of <b>nuclear waste heat</b>.</li> <li>4. Pilot <b>long-distance thermal waste heat transmission</b>.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Curbing new investment by introducing risk of stranded assets &amp; potential systematic financial risk</li> </ol>			

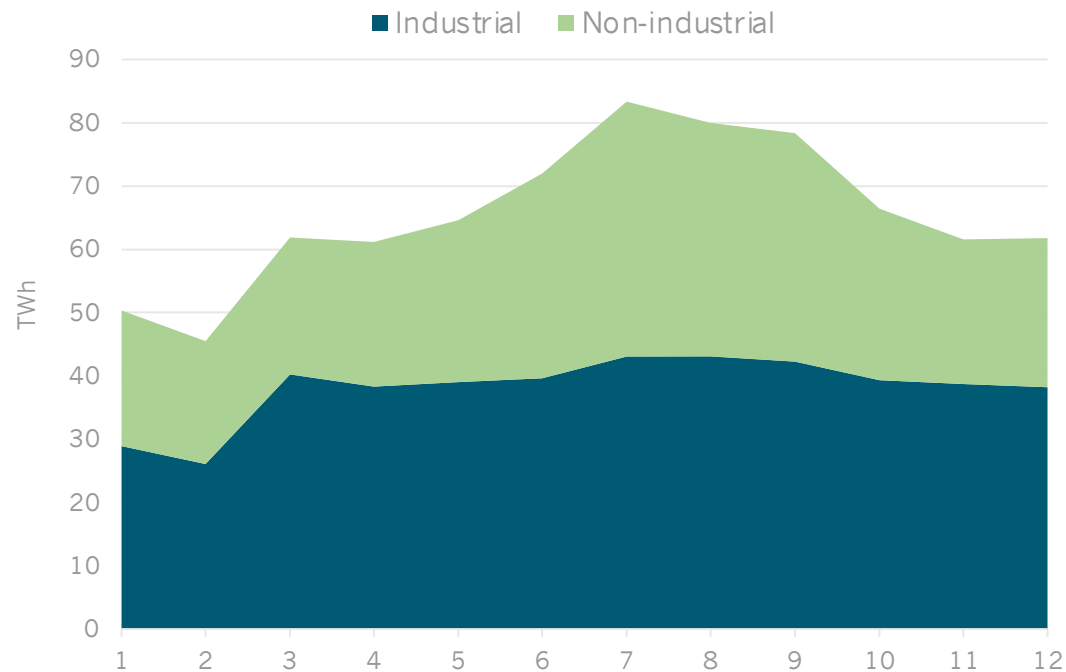
# Deep-dive: Guangdong

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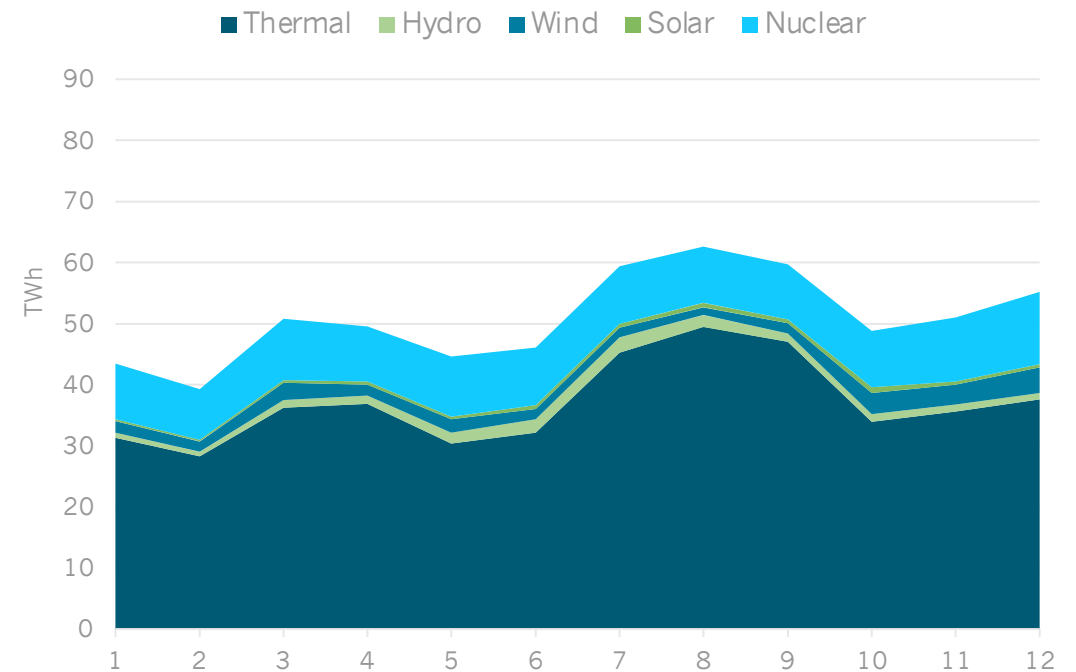
# Guangdong: Electricity Consumption & Generation

- Electricity consumption goes high in summer due to increasing cooling demand.
- Need to import green electricity from other provinces.

### Electricity Consumption in Guangdong in 2022

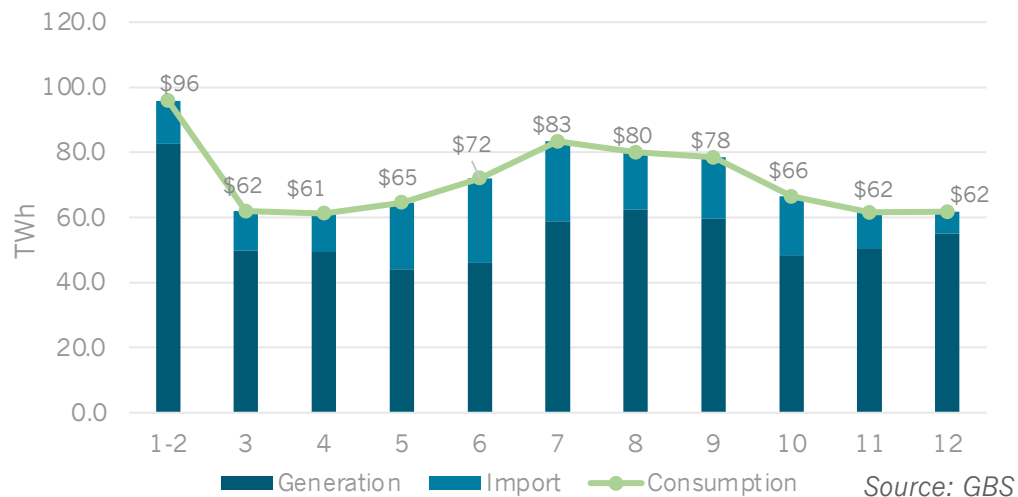


### Electricity Generation in Guangdong in 2022

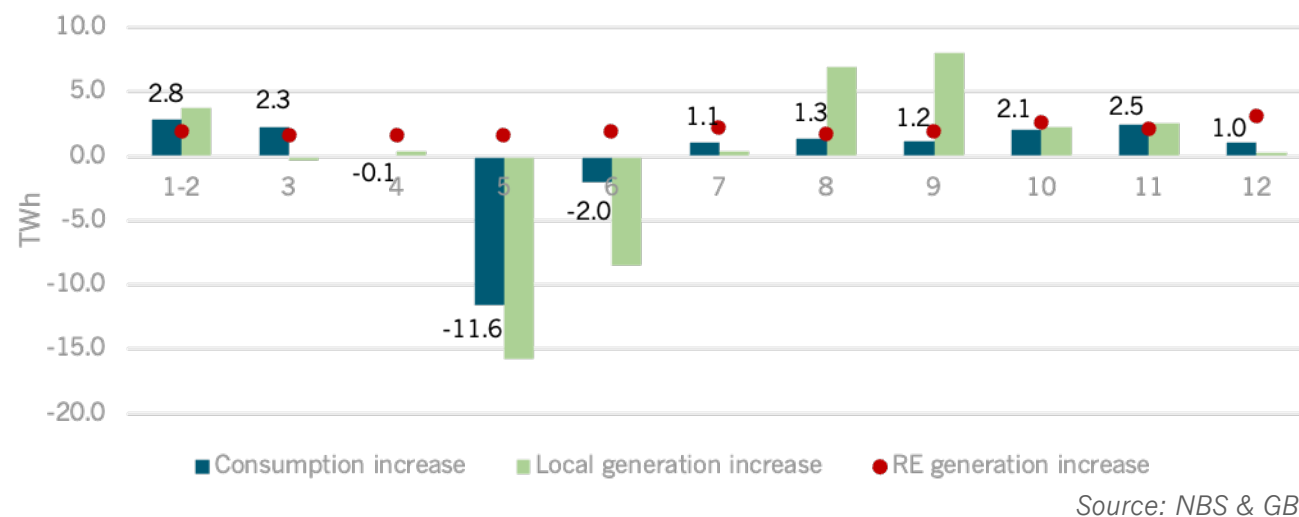


# Guangdong: 2022 Power Generation Screenshot

Power Supply and Demand in 2022 by Month

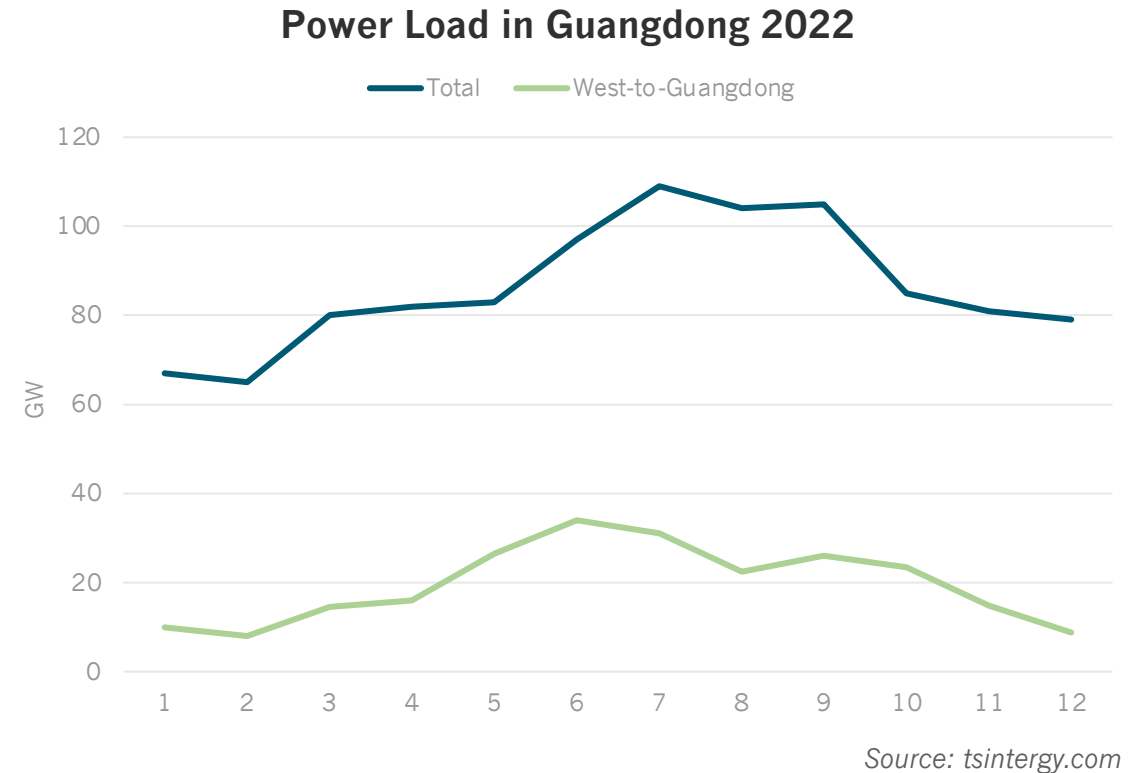
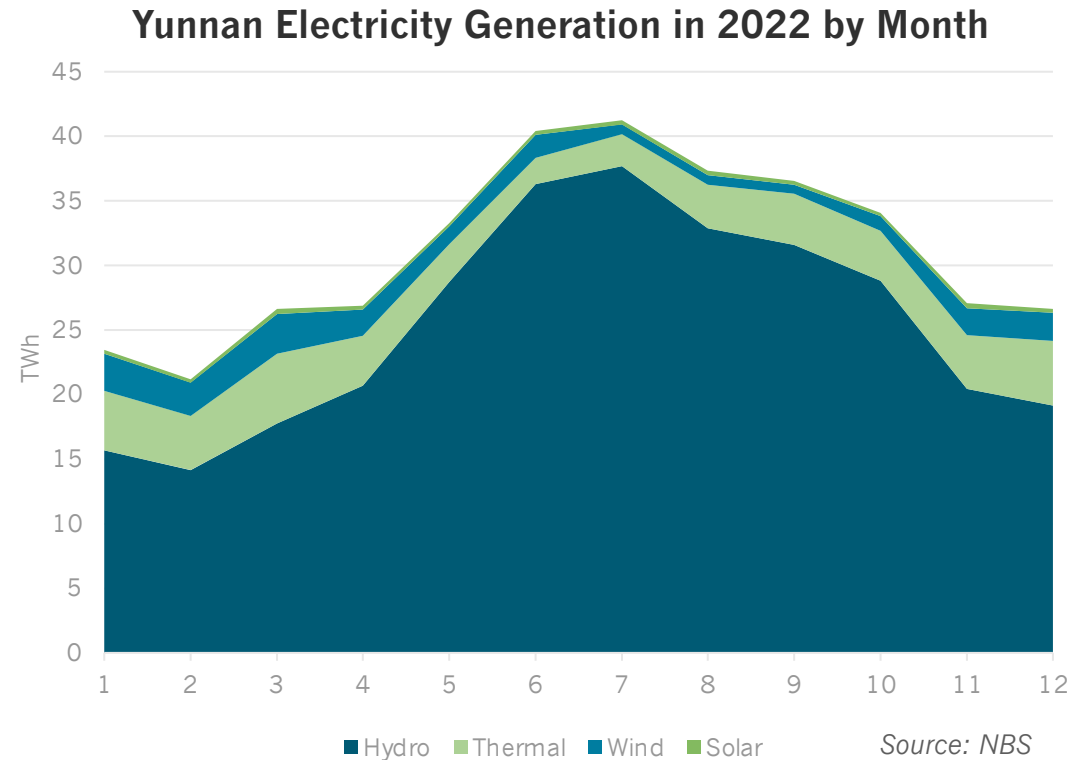


Power Generation and Consumption Increase by Month in 2022



- Peak demand for power in Guangdong appeared during summer months from **July to September**.
- RE could not satisfy the increased power demand in **January-February, August, September, and November**, calling for coal-fired power to fill the gap.
  - Thermal power generation increased by 2.7, 6.7, and 7.3 TWh in Jan-Feb, August, and September.
- Nuclear (19.8% and 15.3% of power generation and consumption) experienced substantial decline in generation in 2022 summer, adding extra stress on running coal-fired power plants.

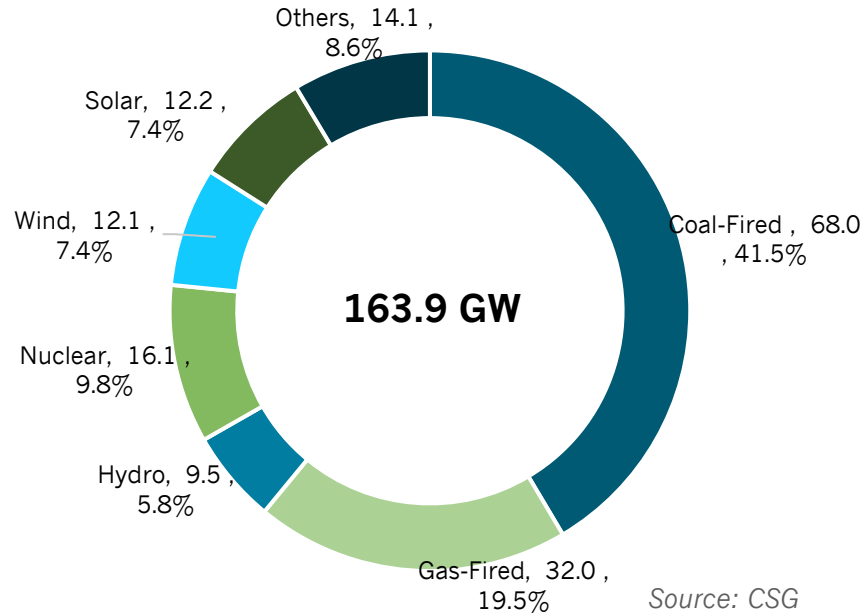
# West-East Electricity Transmission to Guangdong



- **24%** of electricity consumed by Guangdong were generated in **western provinces**.
- The power load from west provinces **dropped in July and August** when Guangdong was meeting the highest power demand.

# Guangdong: New Power Coal are more for Peak Load

Installed Power Capacity and Structure by 2022 H1



Unit: GW	2021	2022	2025E
Grid peak load	135	142	165
Total installed power capacity	144	163.9	238
Total thermal capacity	94.7	99.9	142.1
Total coal-fired capacity	65.9	68.0	77.7
Total installed RE capacity	22.2	33.8	77.4

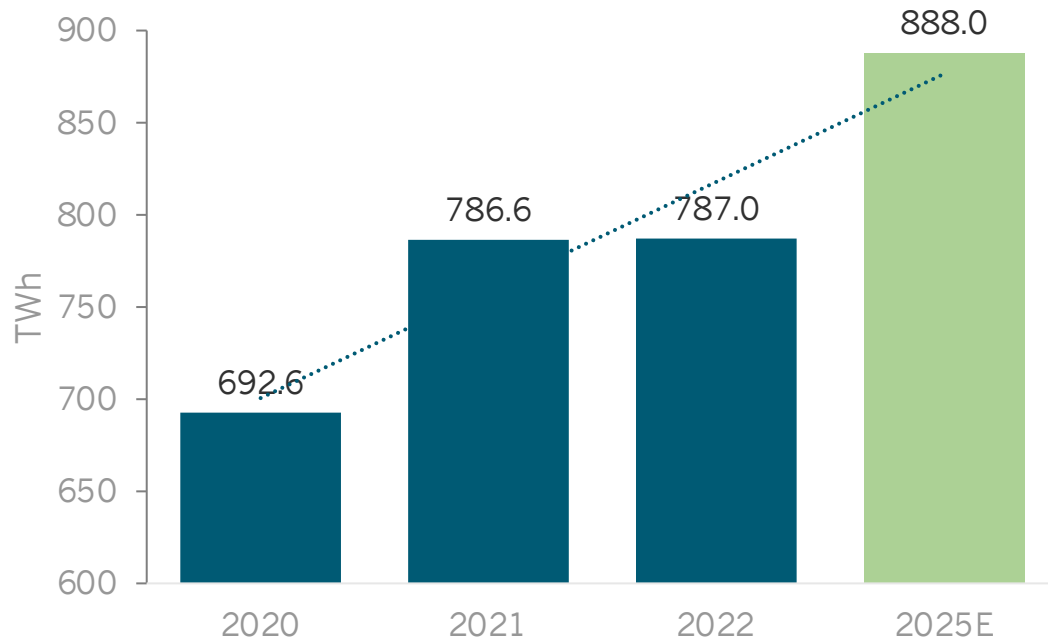
Source: CSG

- Coal-fired power takes up for **41.5%** of total capacity installed, with thermal power capacity in total accounting for **60%**.
- Existing and planning power capacity in Guangdong generally is **enough** to meet the increasing electricity needs.
- **Newly-added and coal-fired power projects in pipeline are built more to meet Guangdong's power shortage and to enhance its energy security by reducing reliance on imported power.**



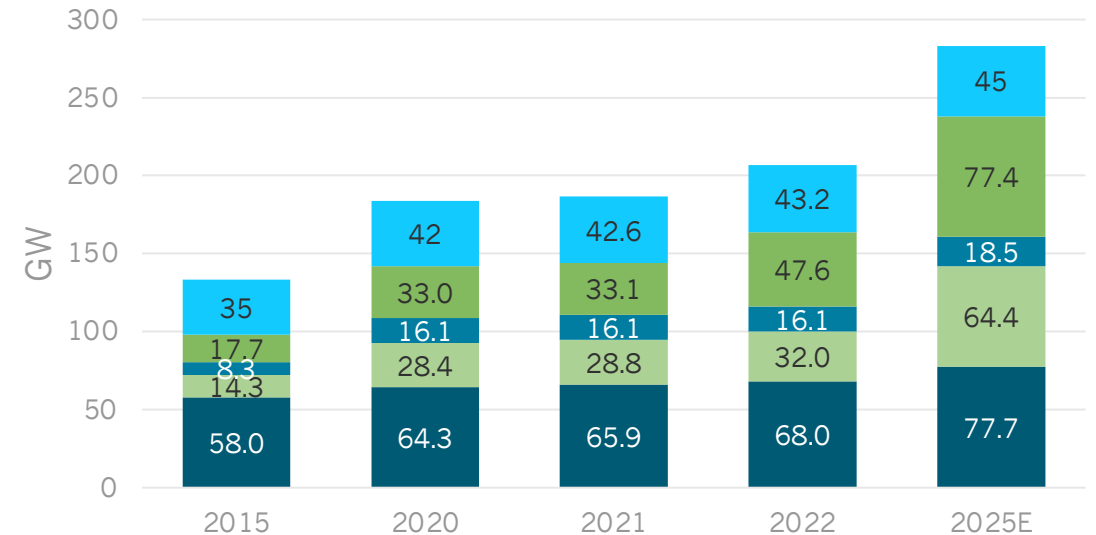
# Guangdong: Official Projection Towards 2025

## Projection of Electricity Demand



Source: Guangdong 145 Plan on Energy

## Installed Power Generation Capacity by 2025



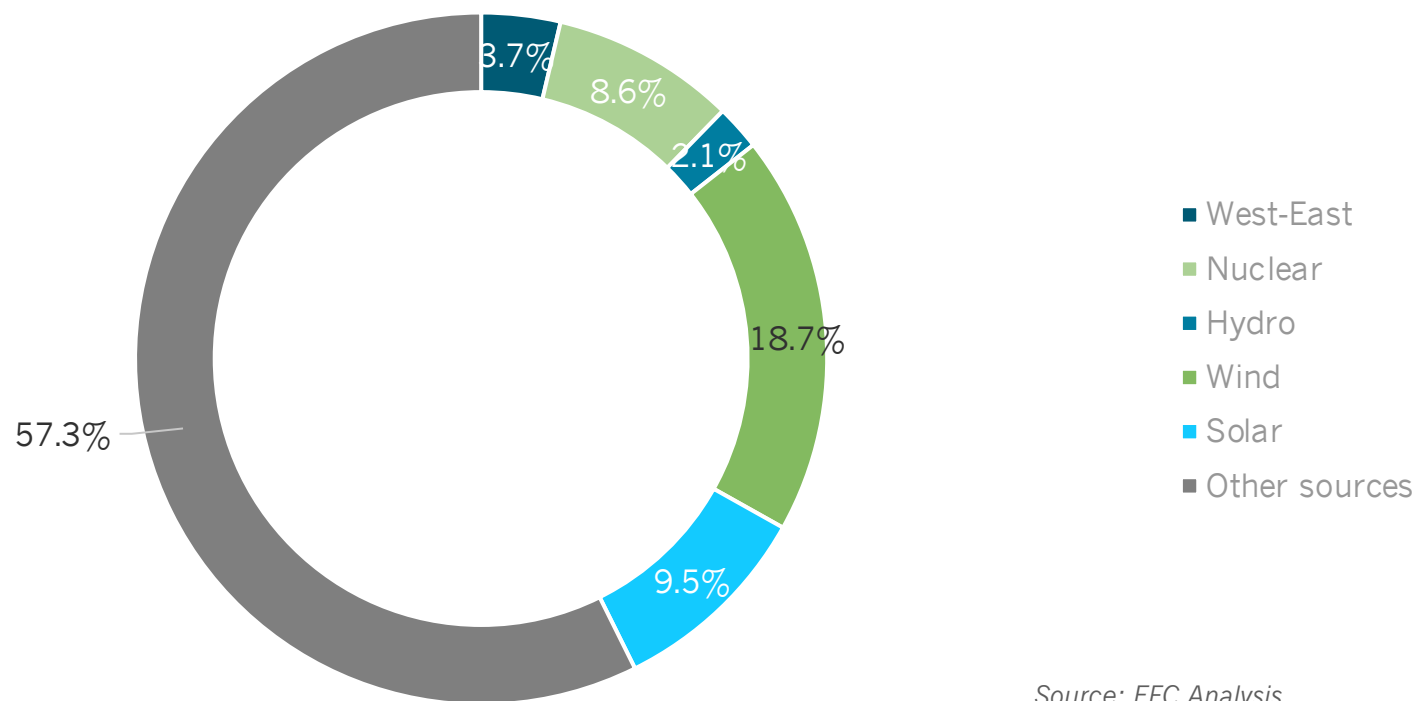
Legend: Coal (Dark Blue), Gas (Light Green), Nuclear (Medium Blue), Renewable & Other (Dark Green), Import (Light Blue)

Source: Guangdong Government

- According to its 14th FYP, Electricity demand in Guangdong is projected to be growing by 4.9% each year. By 2025, Guangdong needs to consolidate the source for another **195 TWh** of electricity demand, among which gas-fired power capacity would be **doubled** to over 64 GW and coal-fired capacity would increase from **68 GW to 77.7 GW**.
- However, considering the high cost of natural gas, there is a trend to use **Coal to substitute Gas**.

# Possible New Sources for the Gap of 195 TWh

Possible Source for Growth of Electricity Demand (Unit: TWh)



Source: EFC Analysis



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**THANK YOU**