

On Climate Action Plan 2030+

— Hong Kong's Opportunity in Renewable Energy



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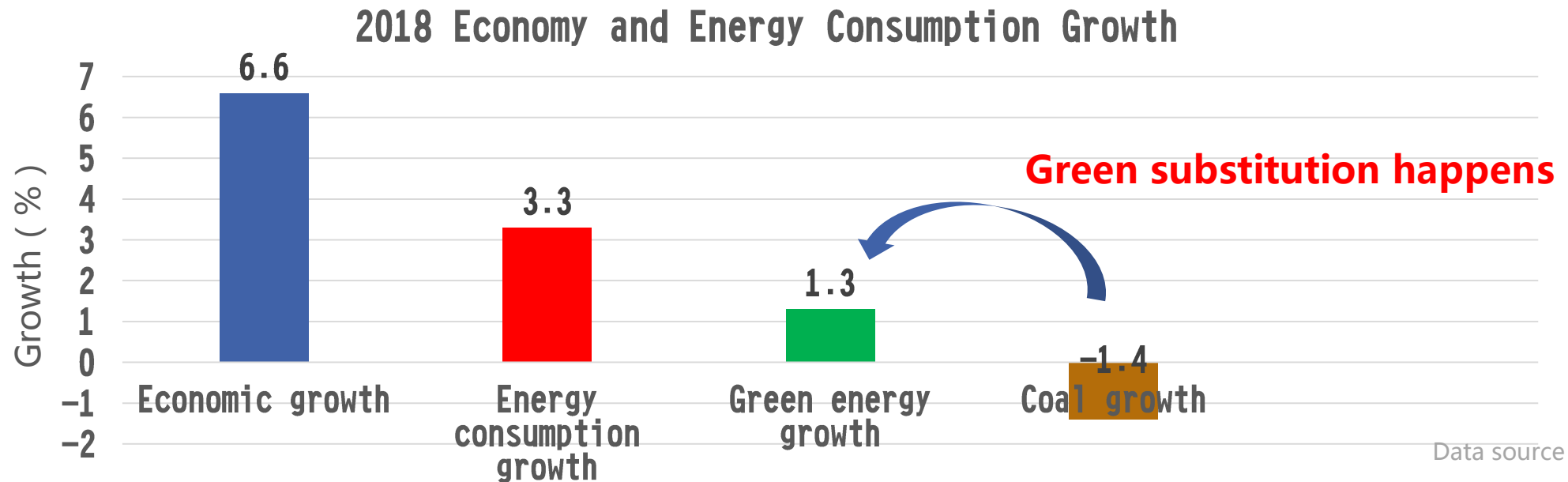
1. Energy Development Trends in China



1. Energy Development Trends in China

Economy and Energy Consumption Growth in 2018

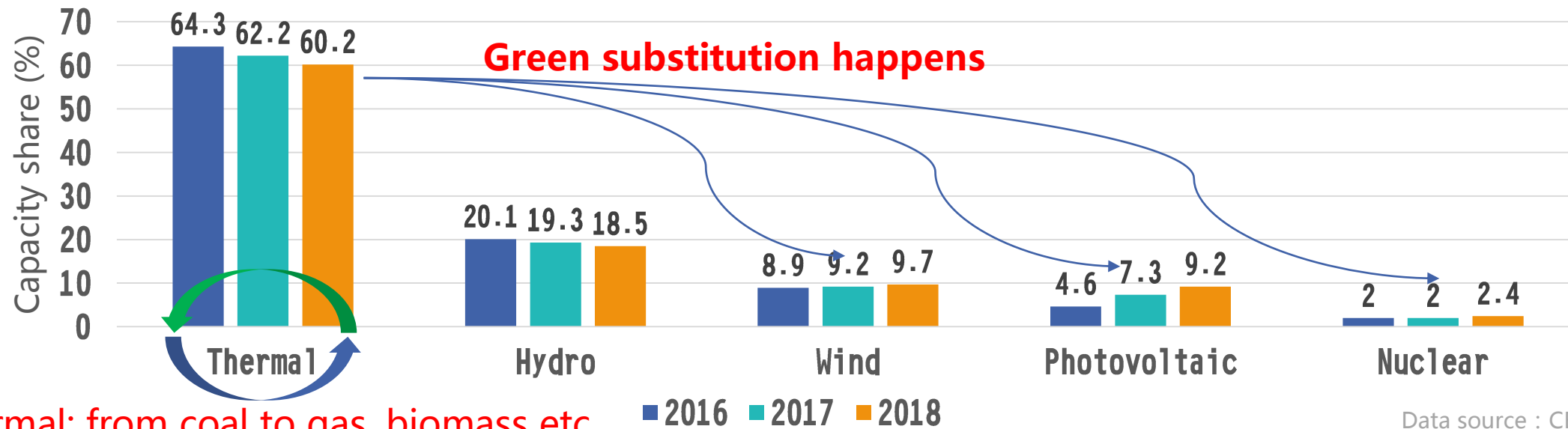
-  In 2018, national energy consumption reached **4.64 billion** tons of standard coal
-  Recording a growth of **3.3%**
-  Supporting an economy growth of **6.6%**
-  Energy consumption elastic factor: **0.5**



1. Energy Development Trends in China





Power capacity breakdown

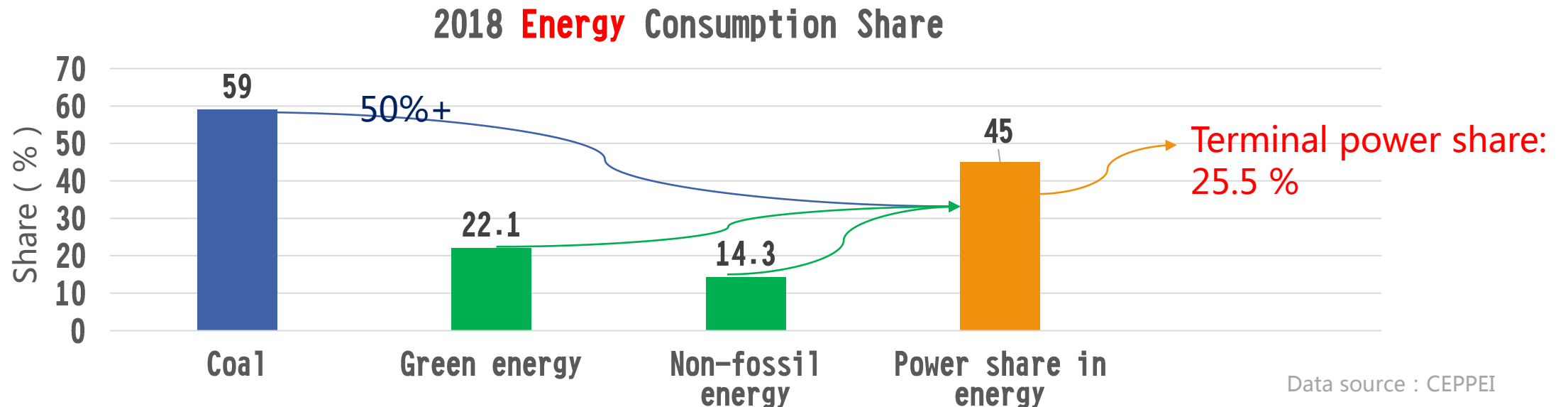
- In 2018, power capacity breakdown falls into:
- Thermal: 60.2%, in which coal-fired: 53%; Hydro: 18.5%;
- Wind: 9.7%; PV: 9.2%; Nuclear: 2.4%



1. Energy Development Trends in China

Power share in energy consumption

-  In 2018, coal consumption share: **59%**, growth rate: **-1.4%**;
-  Green energy share: **22.1%**, growth rate: **1.3%**;
-  Non-fossil energy share: **14.3%**;
-  Power share in energy: approx. **45%**, growth rate: approx. **2.2%**.

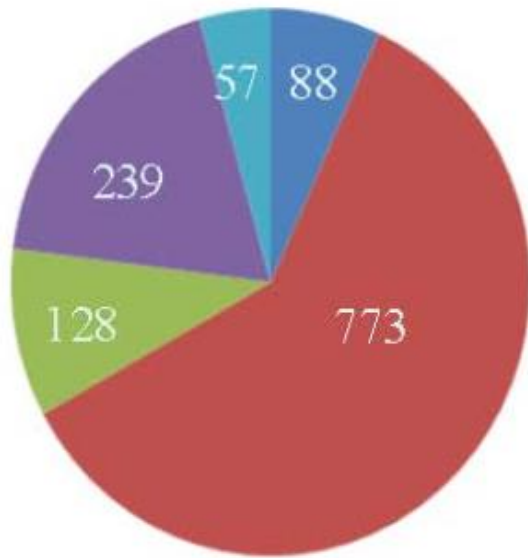


1. Energy Development Trends in China

Electricity substitution strategy

According to **State Grid and Southern Power Grid**:

- In 2017, electricity substitution achieved 128.6 billion kWh; Power consumption share: **2.0%**
- In 2018, electricity substitution achieved power consumption share: approx. **2.3%**

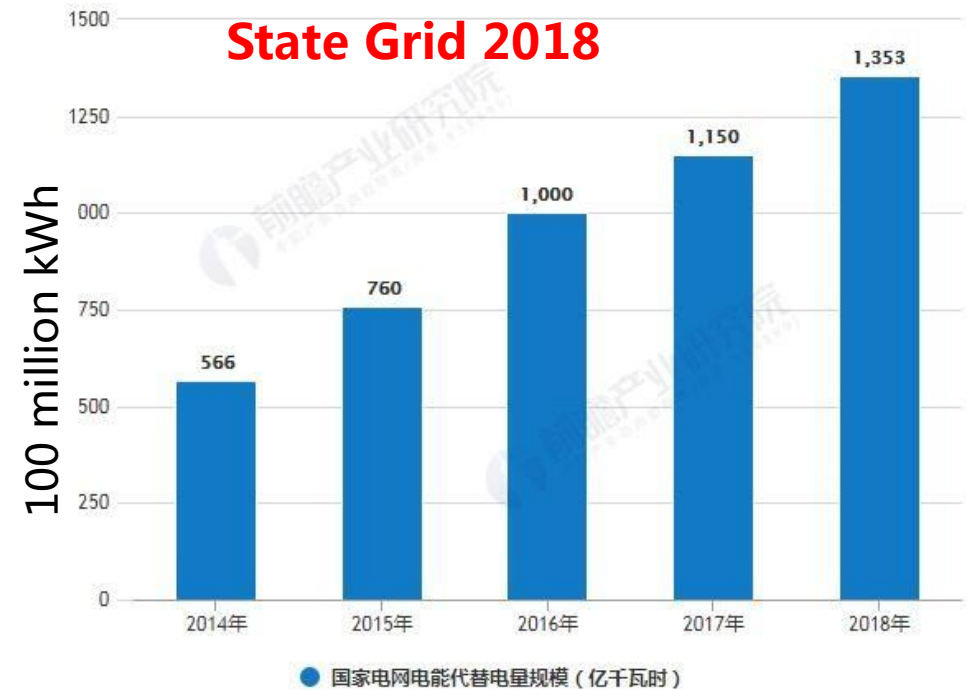


- Residential heating
- Production / manufacture
- Transportation
- Power supply and consumption
- Home powering etc.

In 100 million kWh

Data source : CEPPEI

Electricity substitution
in various areas **2017**

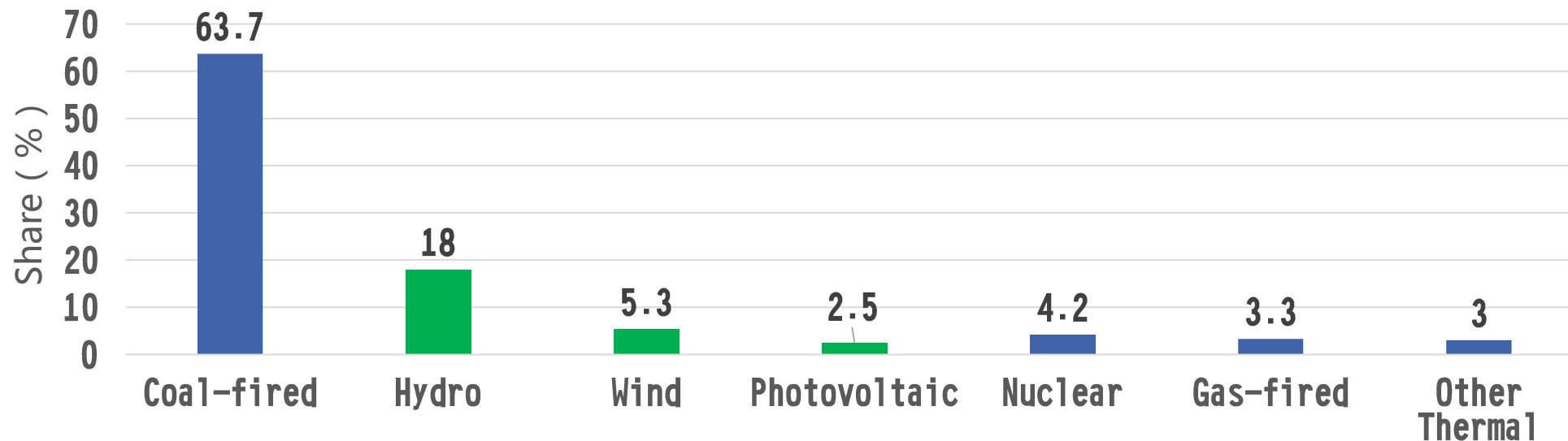


1. Energy Development Trends in China

Power consumption share breakdown

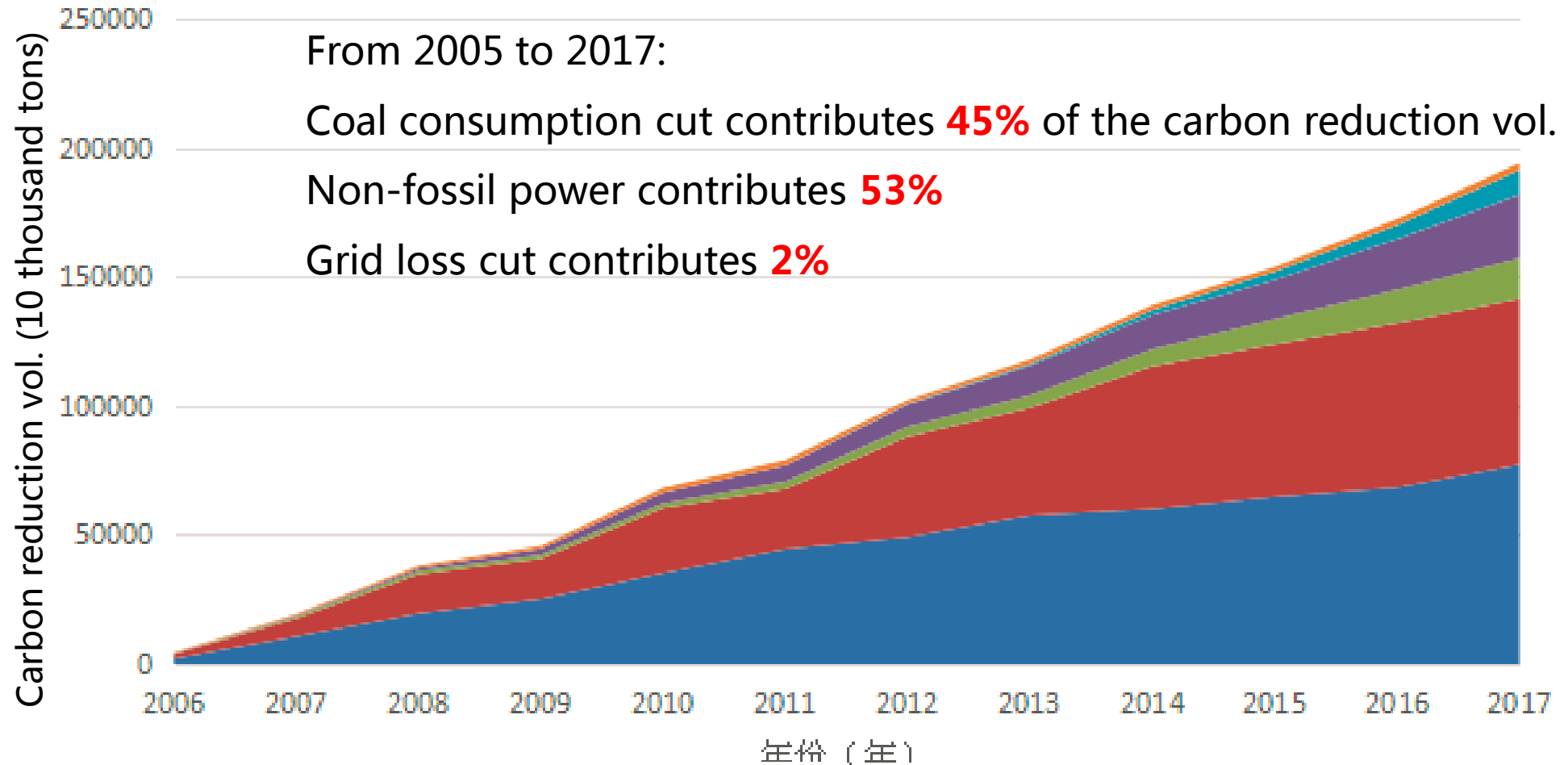
- In 2018, national power consumption: **6800 billion kWh**; Growth rate: **8.5%**
- Coal-fired power consumption share: **63.7%**; Hydro power share: **18%**;
- Wind share: **5.3%**; PV share: **2.5%**; Nuclear share: **4.2%**; Gas-fired share: **3.3%**
- Other terminal power share: **3.0%**. Non-fossil energy share: **25.8%**;

2018 **Power** Consumption Share



1. Energy Development Trends in China

Carbon reduction breakdown in power industry



Data source : CEPPEI

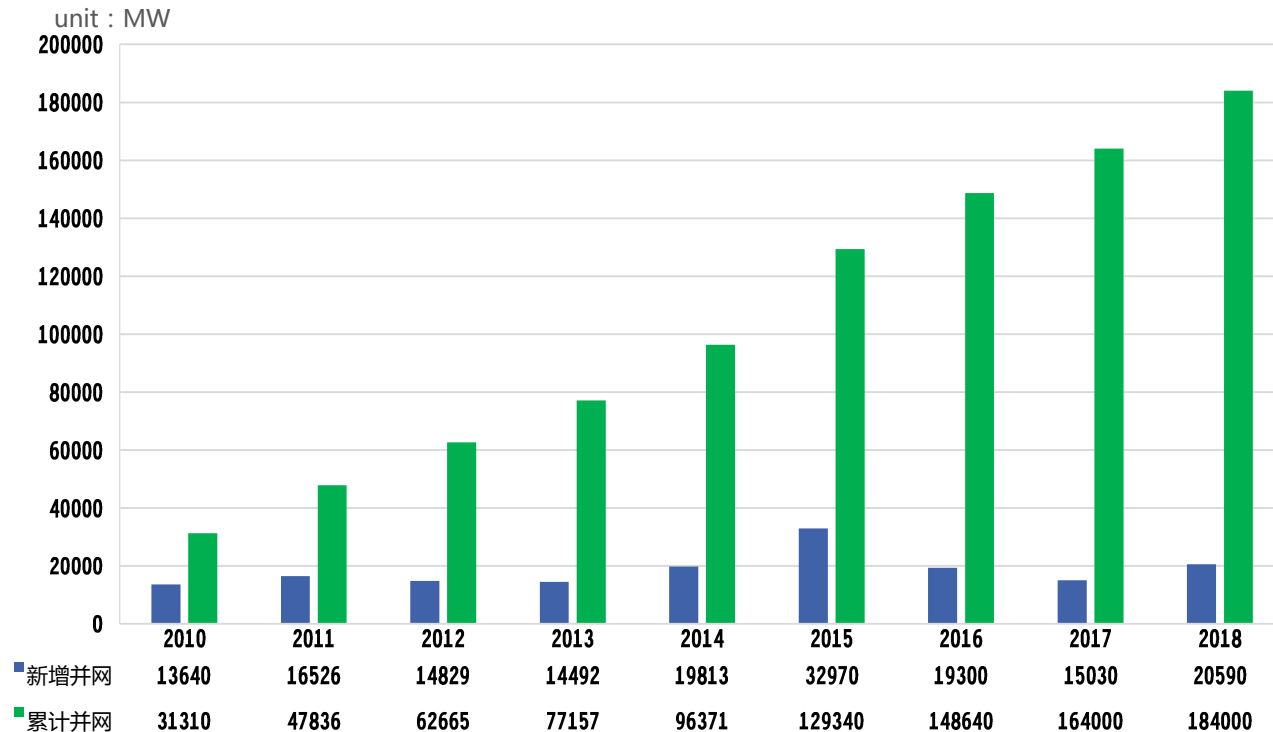
■ Coal cut ■ Hydro ■ Nuclear ■ Wind ■ Photovoltaic ■ Grid loss cut

1. Energy Development Trends in China

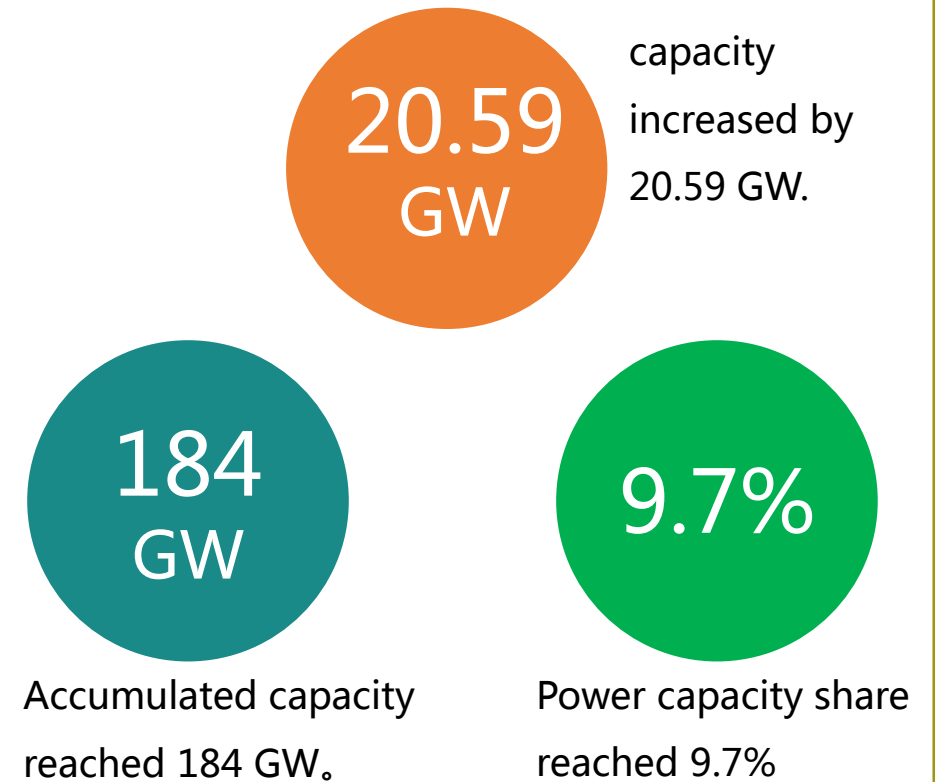


Green power: wind

2010-2018 increased and accumulated capacity



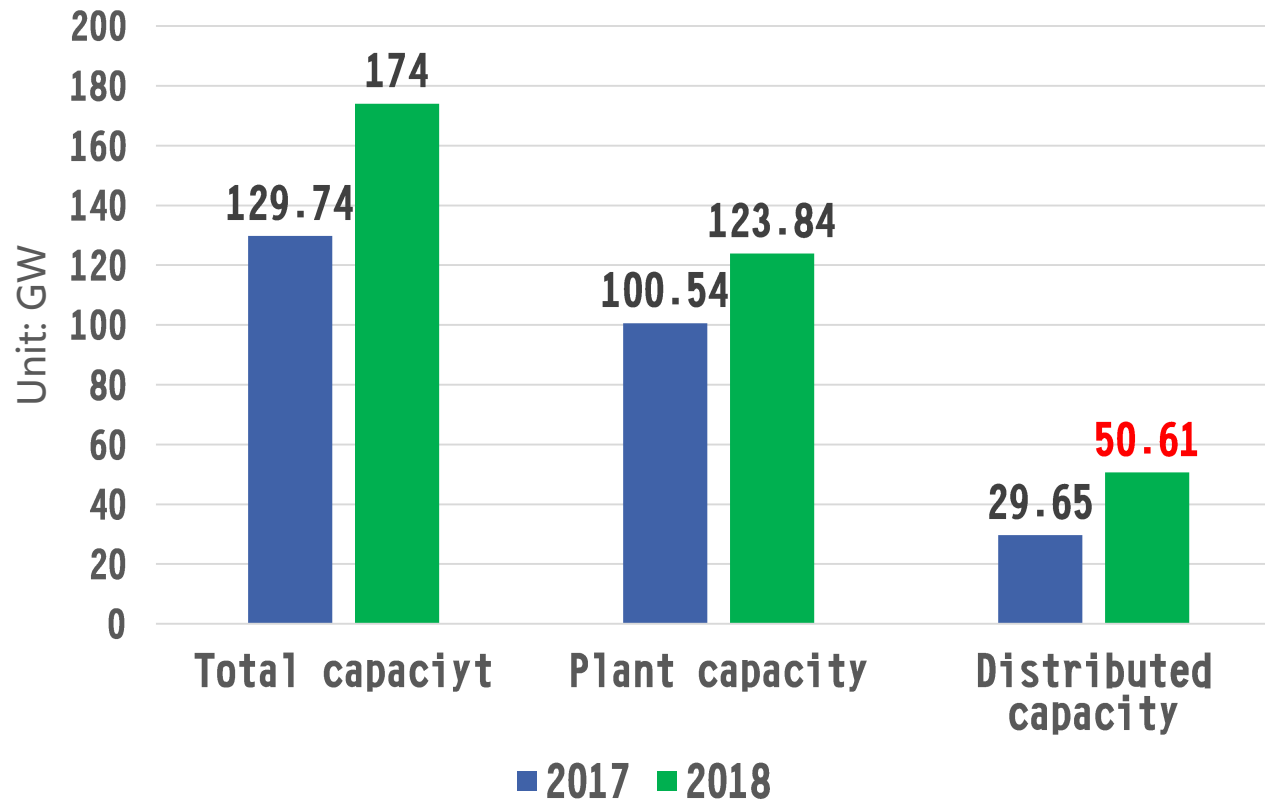
Wind power facts 2018



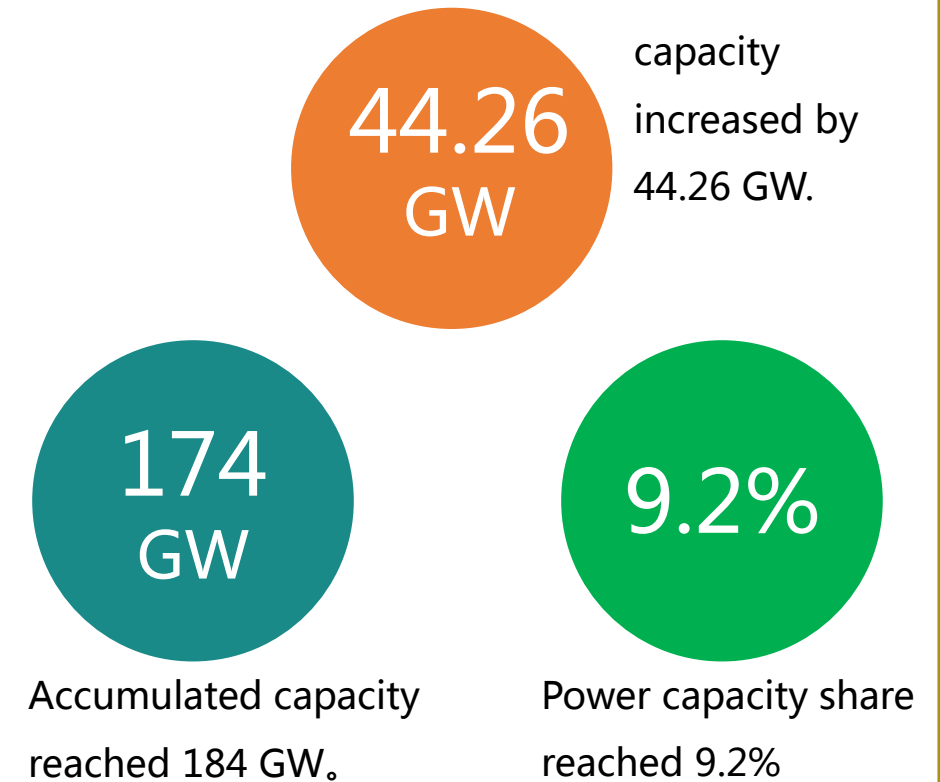
1. Energy Development Trends in China

Green power: **Photovoltaic**

2010-2018 increased and accumulated capacity



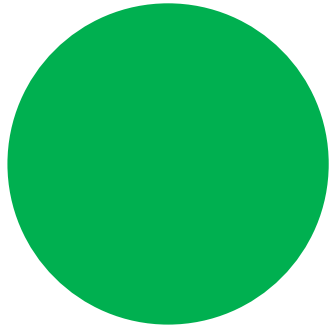
Photovoltaic power facts 2018



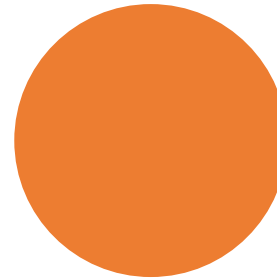
1. Energy Development Trends in China

Wind vs Photovoltaic: the difference

Total capacity of wind farms



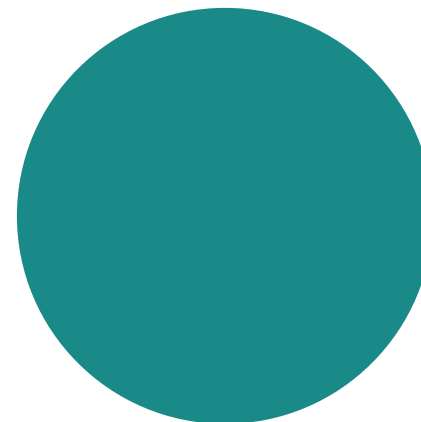
Total capacity of photovoltaic plants



Total capacity of distributed wind power



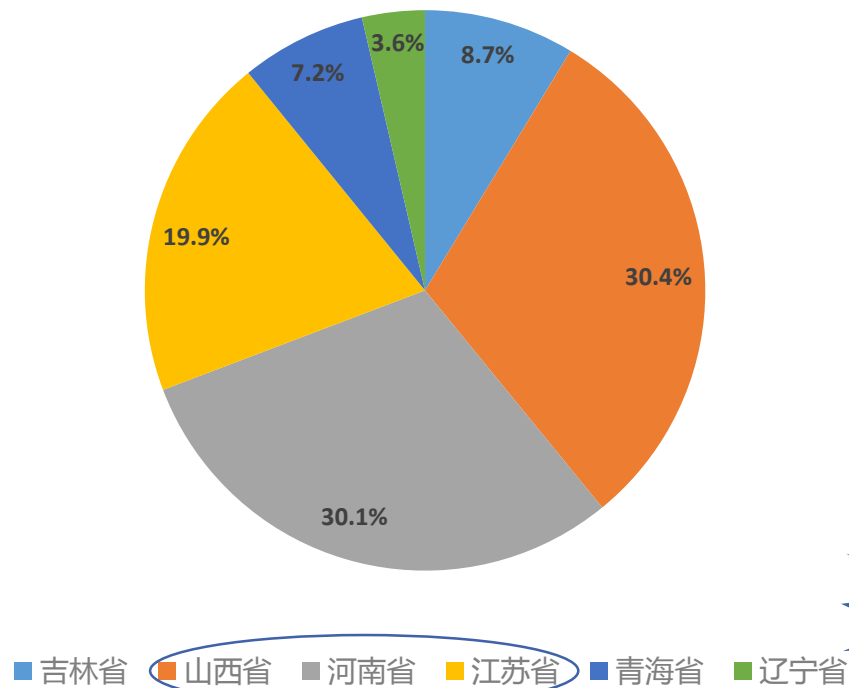
Total capacity of distributed photovoltaic power



1. Energy Development Trends in China

Distributed wind vs Photovoltaic: enormous difference

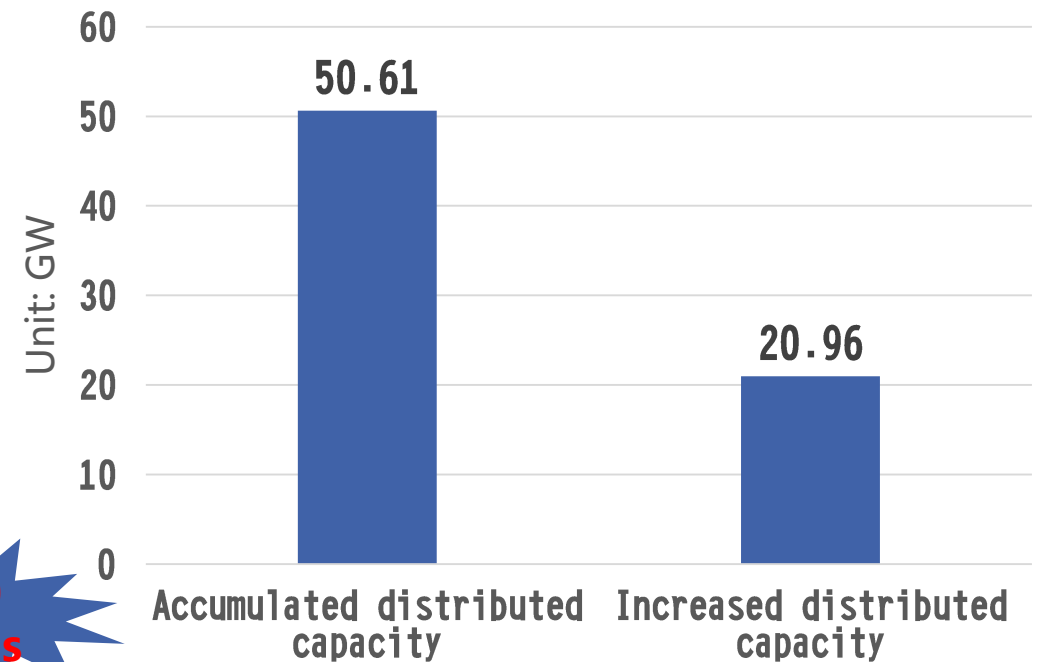
2018 increased distributed **wind** power capacity share



Increased distributed wind power capacity: **138MW**.

Data source : CWEA

2018 distributed **Photovoltaic** power capacity



150 times

Increased distributed Photovoltaic power capacity:

20.96 GW.

Data source : CPIA

1. Energy Development Trends in China

Wind vs Photovoltaic: the REASON for the difference

A few player with higher threshold level

Distributed Wind



Thousands of players with enthusiasm

Distributed Photovoltaic



1. Energy Development Trends in China

Wind vs Photovoltaic: the Feed-in tariffs going down



Feed-in tariffs of wind power
VAT inclusive (RMB/kWh)

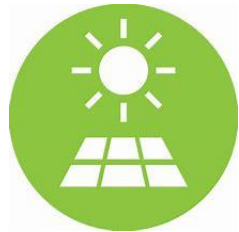
发改价格[2009]1906号
Onshore : class I 0.51
class II 0.54
class III 0.58
class IV 0.61

发改价格[2014]3008号
Onshore : class I 0.49
class II 0.52
class III 0.56
class IV 0.61

发改价格[2014]1216号
Offshore wind :
Tidal belt: 0.75
Inshore 0.85

发改价格[2015]3044号
Onshore : class I 0.47
class II 0.50
class III 0.54
class IV 0.60

发改价格[2016]2729号
Onshore : class I 0.40
class II 0.45
class III 0.49
class IV 0.57



Feed-in tariffs of photovoltaic power
VAT inclusive (RMB/kWh)

发改价格[2011]1594号
Class I 1.15
Other 1.00

发改价格[2013]1638号
Class I 0.90
Class II 0.95
Class III 1.00

发改价格[2015]3044号
Class I 0.80
Class II 0.88
Class III 0.98

发改价格[2016]2729号
Class I 0.65
Class II 0.75
Class III 0.85

发改价格[2017]2196号
Normal plant
Class I 0.55
Class II 0.65
Class III 0.75

December 2017

1. Energy Development Trends in China

Wind vs Photovoltaic: the Feed-in tariffs going down

 2018.5.24, The National Energy Administration launched the new rules by bringing in the competitive bidding rules for feed-in tariffs.

 Until now, at least **7 provinces** have announced **competitive bidding rules**;

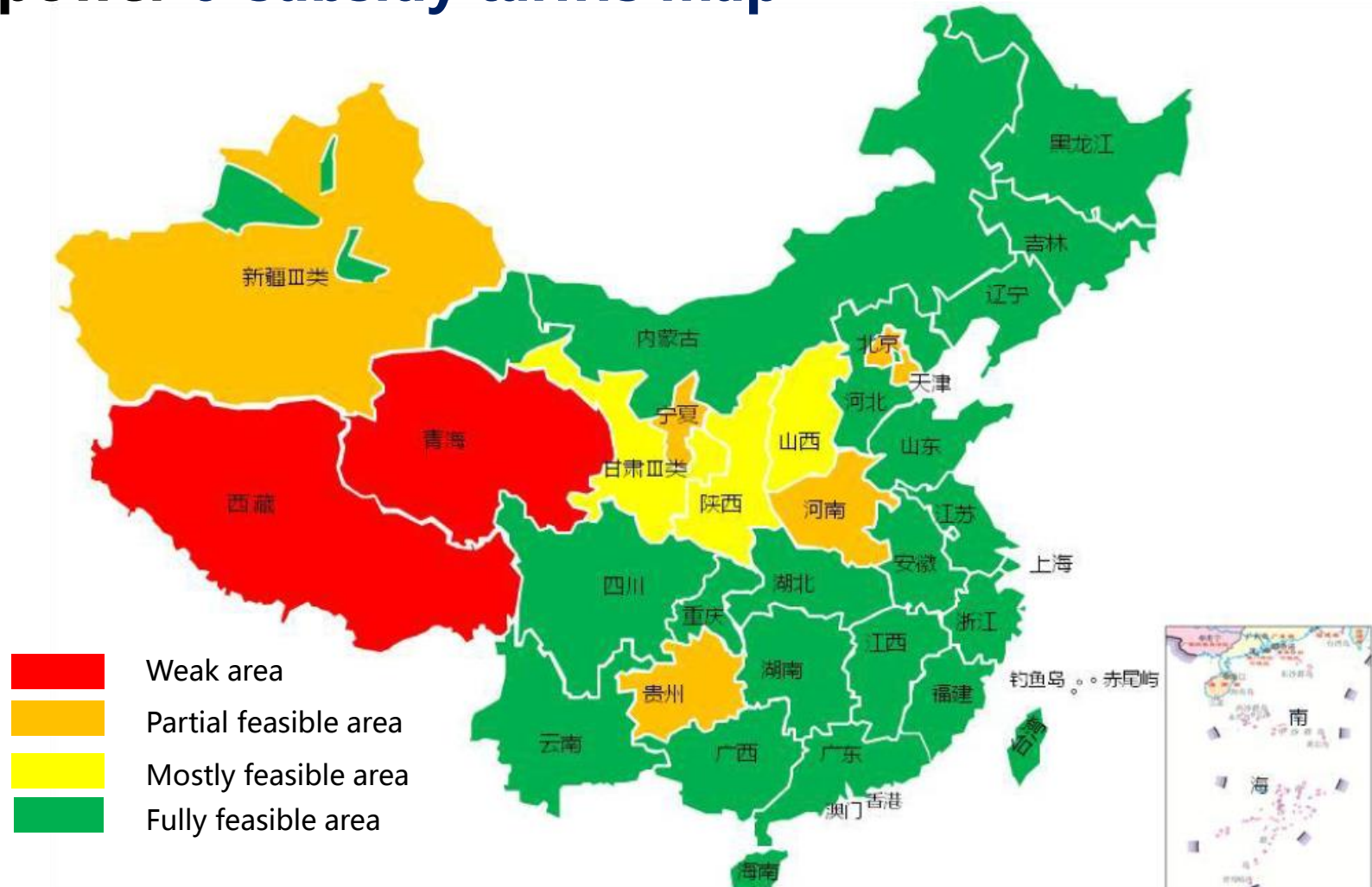
 Some provinces is planning for **0-subsidy tariffs**, e.g. Liaoning, Jilin, Inner Mongolian etc.

地区	发布时间	部门	政策名称
Guangdong	2018.12	能源局	《海上风电及陆上风电竞争配置办法(试行)》
Ningxia	2018.12	发改委	《宁夏风电基地项目 2018 年度风电项目竞争配置办法》
Shaanxi	2019.12.26	能源局	《关于征求陕西省集中式风电项目竞争性配置办法意见的函》
Fujian	2019.1.3	发改委	《福建省海上风电项目竞争配置办公（试行）》
Shanghai	2019.1.9	发改委	《上海市风电项目竞争配置管理办法》
Jiangsu	2019.1.17	发改委	《江苏省风电项目竞争配置暂行办法》、 《江苏省未确定投资主体风电项目竞争配置暂行办法》。
Tianjin	2019.1.22	发改委	《关于开展2019年陆上集中式风电项目申报工作有关事项的通知》

1. Energy Development Trends in China



Chinese wind power 0-subsidy tariffs map



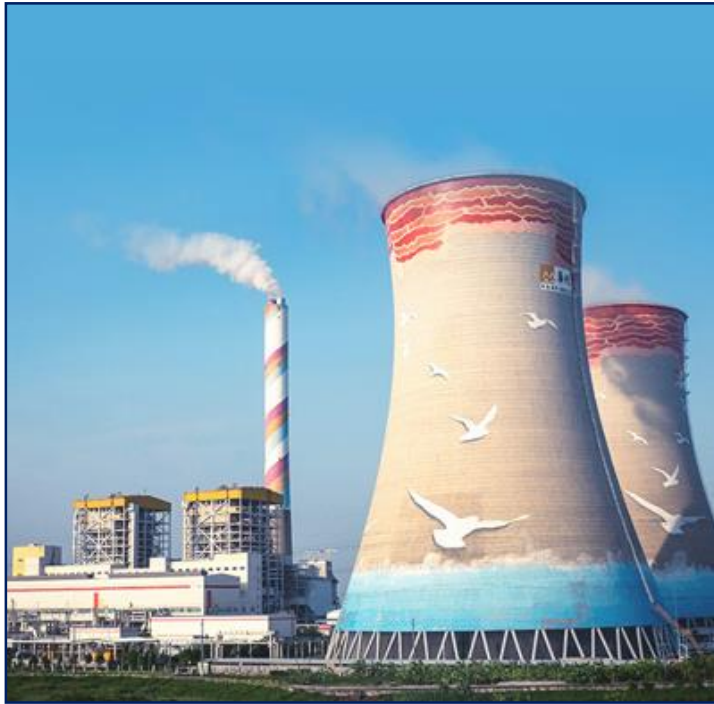
2. CR Power: Efforts on Carbon Reduction



2. CR Power: Efforts on Carbon Reduction



China Resources Power: A Brief Introduction



Coal-fired power



Wind farms/photovoltaic power



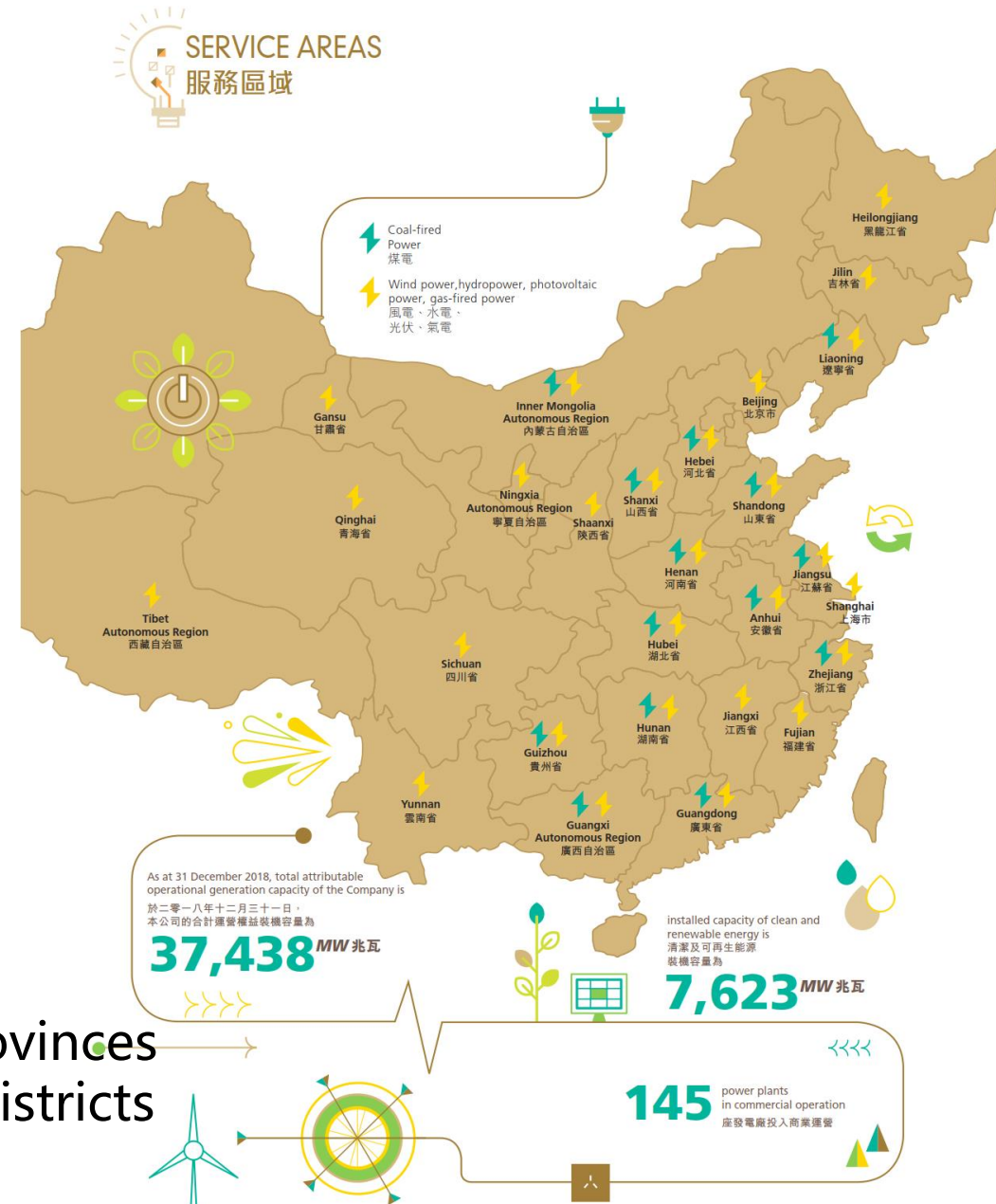
Comprehensive energy service

2. CR Power: Efforts on Carbon Reduction

CR Power: A Brief Introduction

- 38 coal-fired power plants
- 83 wind farms
- 20 photovoltaic power plants
- 2 hydroelectric plants
- 2 gas-fired plant

28 Provinces / Districts



2. CR Power: Efforts on Carbon Reduction

Ways to lower carbon emission

First, the social demand for energy is real and has to be fulfilled, then carbon reduction can happen by the ways of achieving higher efficiency and technological innovation.

Higher equipment utilization

Less power plants is needed to meet the social energy demand.



Higher production efficiency

produces demanded power with less carbon emission.



Build more green power facilities

Wind farm, photovoltaic power plant, comprehensive energy services, etc.

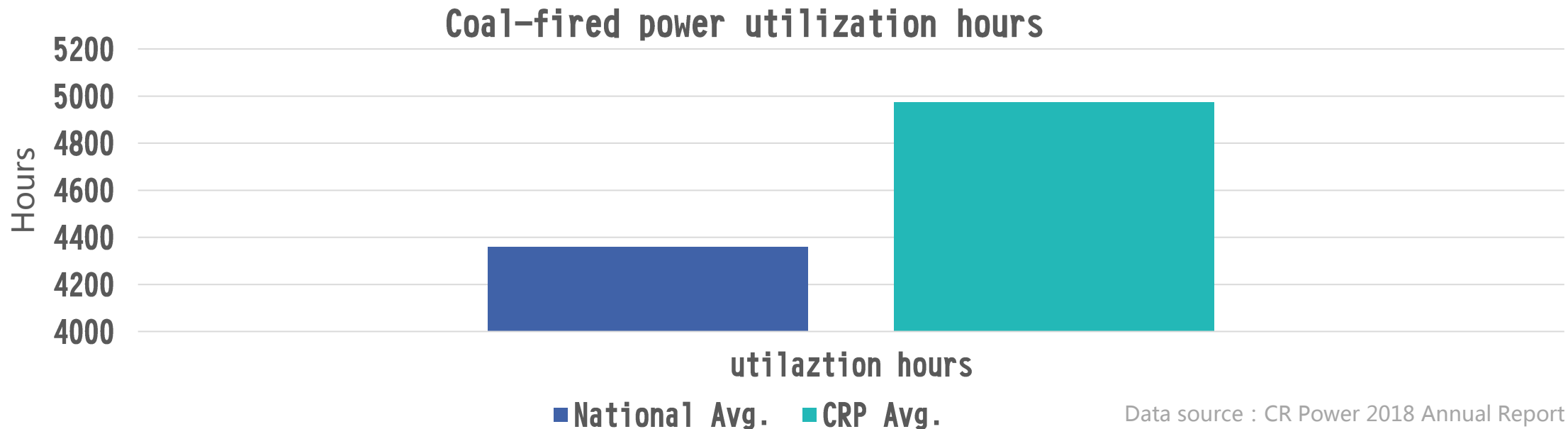


2. CR Power: Efforts on Carbon Reduction

Coal-fired: Higher equipment utilization

The average utilization hours of thermal generation units in 2018:

-  Nation-wide average reached **4,361** hours.
-  CR Power average reached **4,976** hours, 615 hours higher



Data source : CR Power 2018 Annual Report

2. CR Power: Efforts on Carbon Reduction

Coal-fired: Higher production efficiency

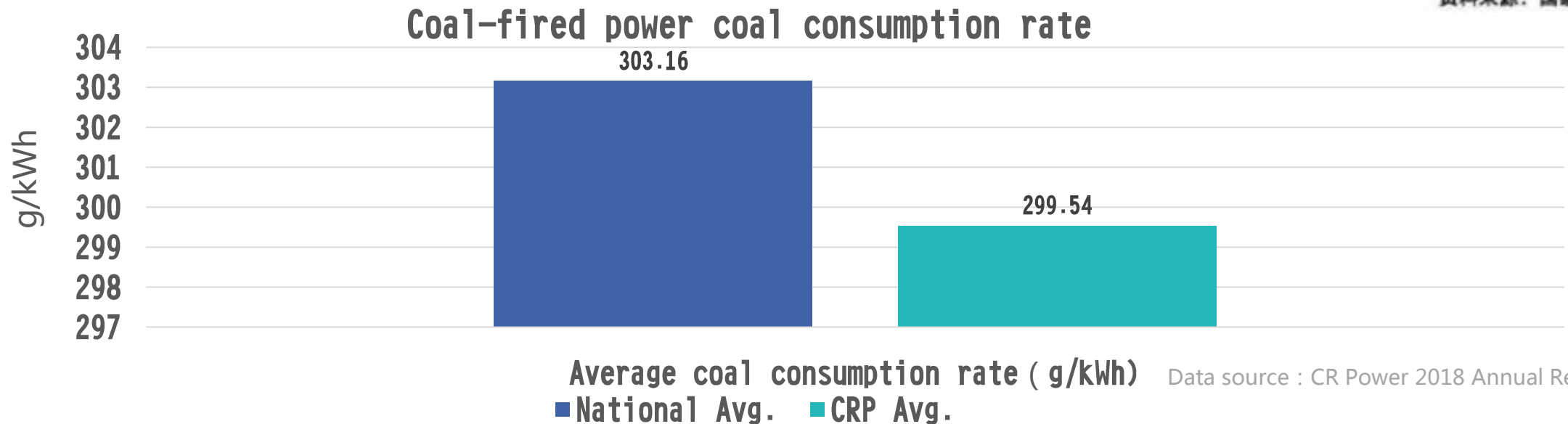


The average coal consumption rate

average coal consumption rate for power generation

Year 2018: **299.54 g/kWh**, down by 1.2%


Year 2017: **303.16 g/kWh**




2. CR Power: Efforts on Carbon Reduction

Coal-fired: Higher production efficiency

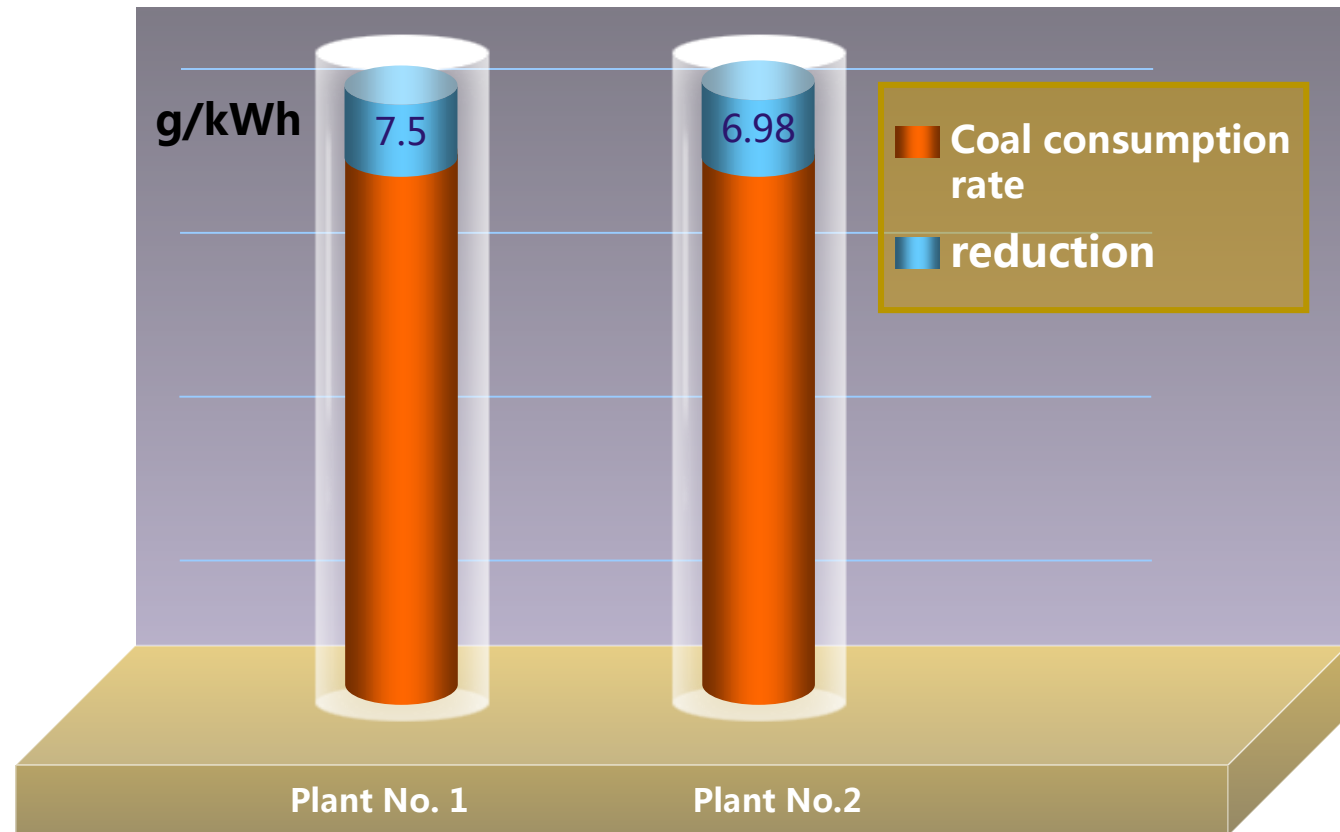
Typical examples

 Renovation on plant No.1 achieved a reduction by

7.5g/kWh ;

 Renovation on plant No.1 achieved a reduction by

6.98g/kWh.



2. CR Power: Efforts on Carbon Reduction

Coal-fired: Higher production efficiency

Typical examples

-  Newly built Caofeidian coal-fired plant in Tangshan, HeBei Province, achieved **global lowest coal consumption rate: 263g/kWh.**



2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

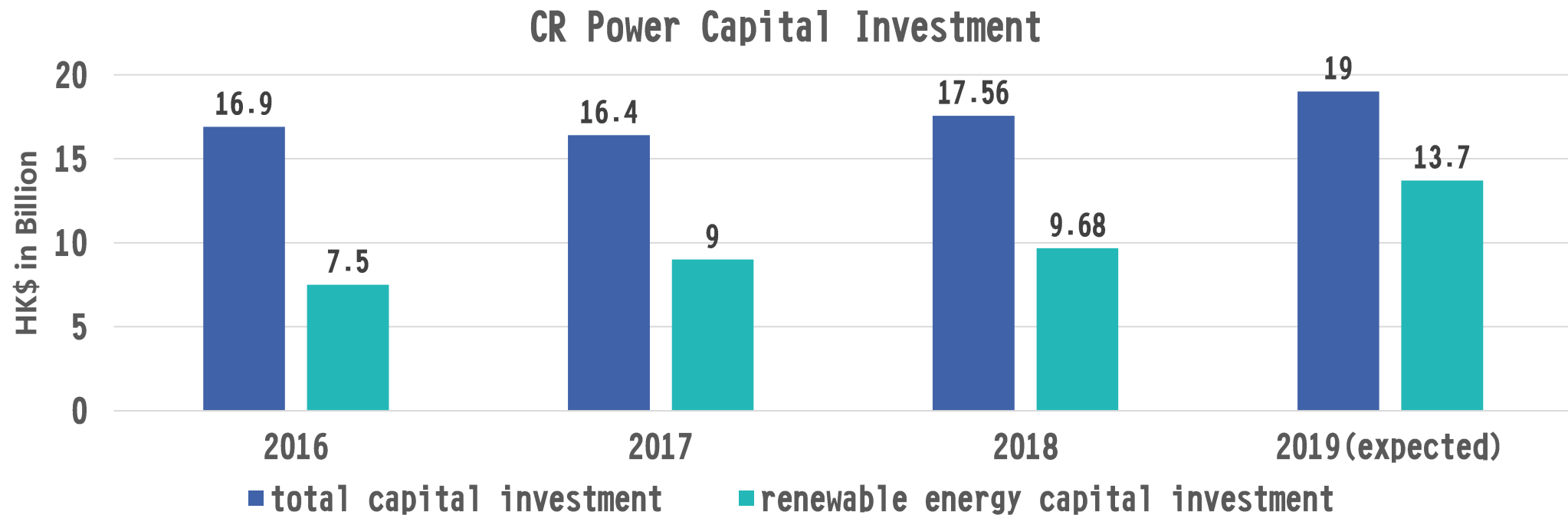
Investment

Capacity

Utilization hours

Energy service

- Capital investment of green and renewable energy acquires higher share year by year.
- In 2018 the share is over **55%**, while in 2019 it is expected to exceed **72%**.



2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

Investment

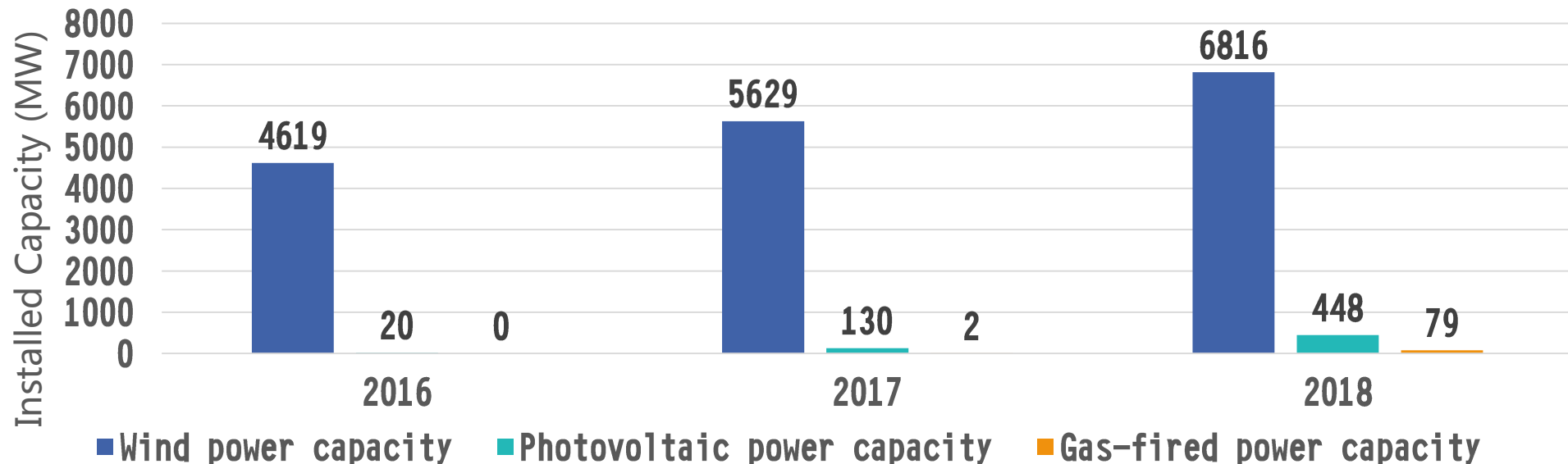
Capacity

Utilization hours

Energy service

- In 2018, green and renewable energy capacity reached **7623MW**, accounting for **20.4%**, expected to reach approximately **28%** by 2020.
- In 2018, Wind power: **6816MW**; Photovoltaic power: **448MW**; Gas-fired Power: **79MW**.

Green energy capacity of CR Power



2. CR Power: Efforts on Carbon Reduction

Build more green power facilities

Investment

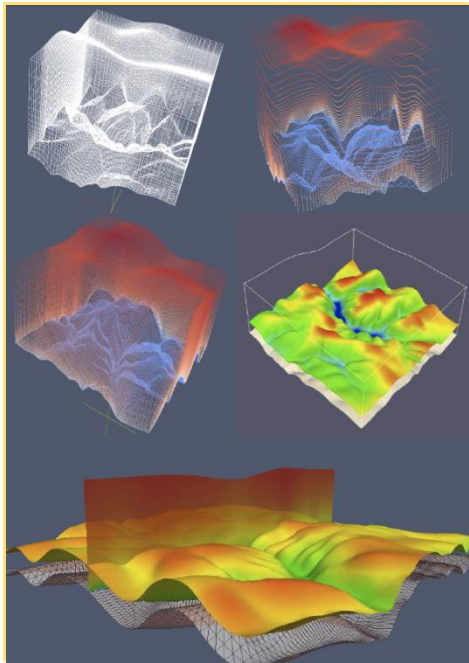
Capacity

Utilization hours

Energy service

-  More wind power capacity comes from the precise grasp of renewable policies;
-  And more comes from the wind resource assessment techniques and research.

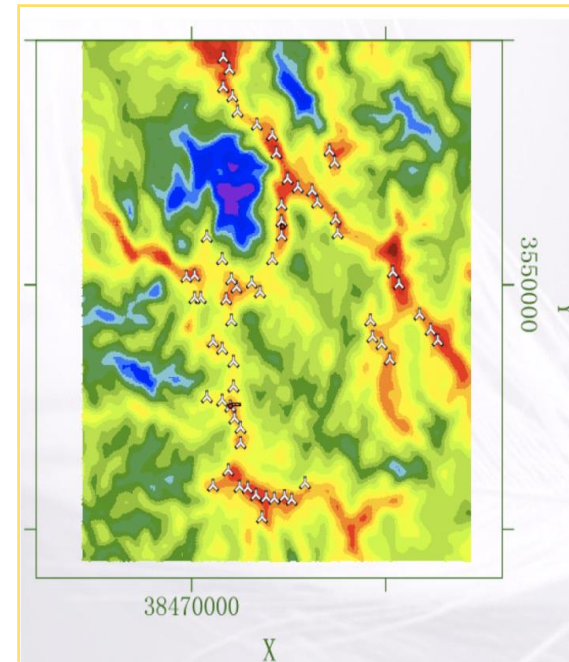
Meteorology / Fluid Dynamics Models



Site Measurement



Wind resource assessment and Micro-siting



More capacity
More utility hours

2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

Investment

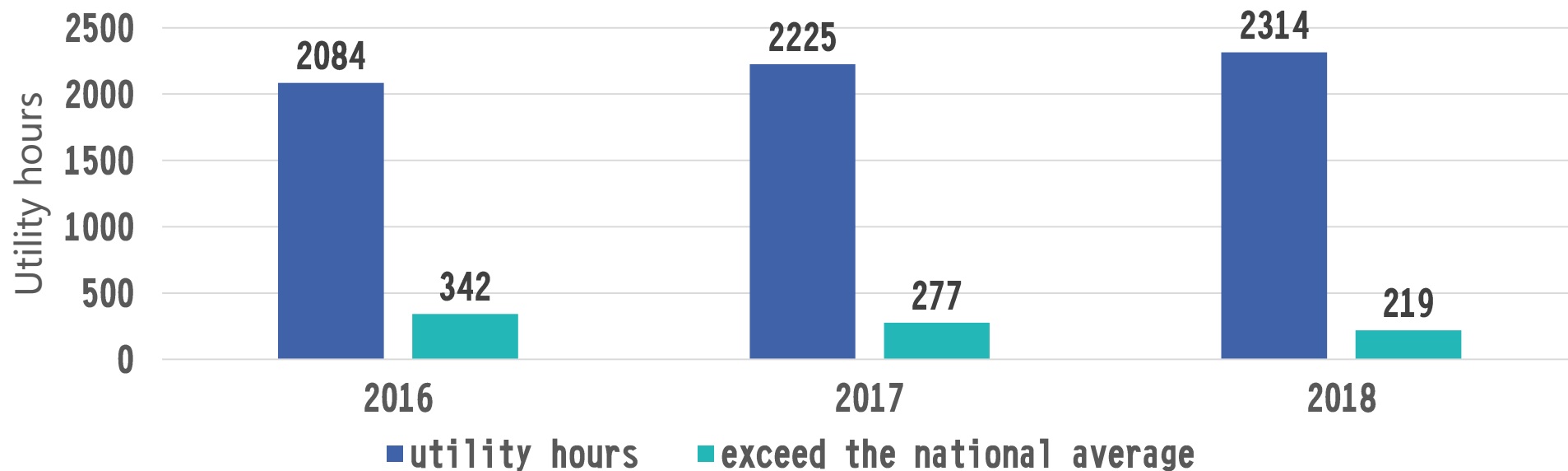
Capacity

Utilization hours

Energy service

- In 2018, green and renewable energy capacity reached **7623MW**, accounting for **20.4%**.
- Wind power: **6816MW**; Photovoltaic power: **448MW**; Gas-fired Power: **79MW**.

Green energy utility hours of CR Power



2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

Investment	Capacity	Utilization hours	Energy service
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3rd party project design utilization hours: **2360h**

Wind resource and micro-siting optimization

Loc. Siting

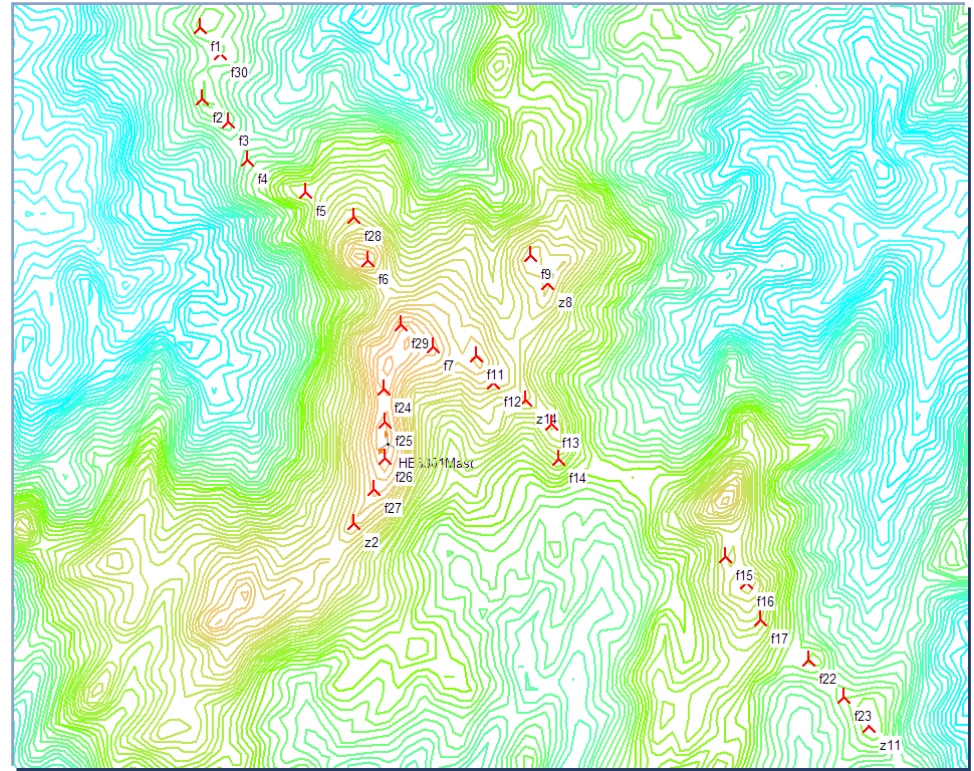
Submit Report

Manufacturer Check

Approval

Approved Report: **2560h**

Total **More utilization hours: Wind resource and micro-siting**



↑ **8.4% : 200 hours : 10GWh/year/50MW: same equipment, more carbon reduction**

2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

Investment

Capacity

Utilization hours

Energy service

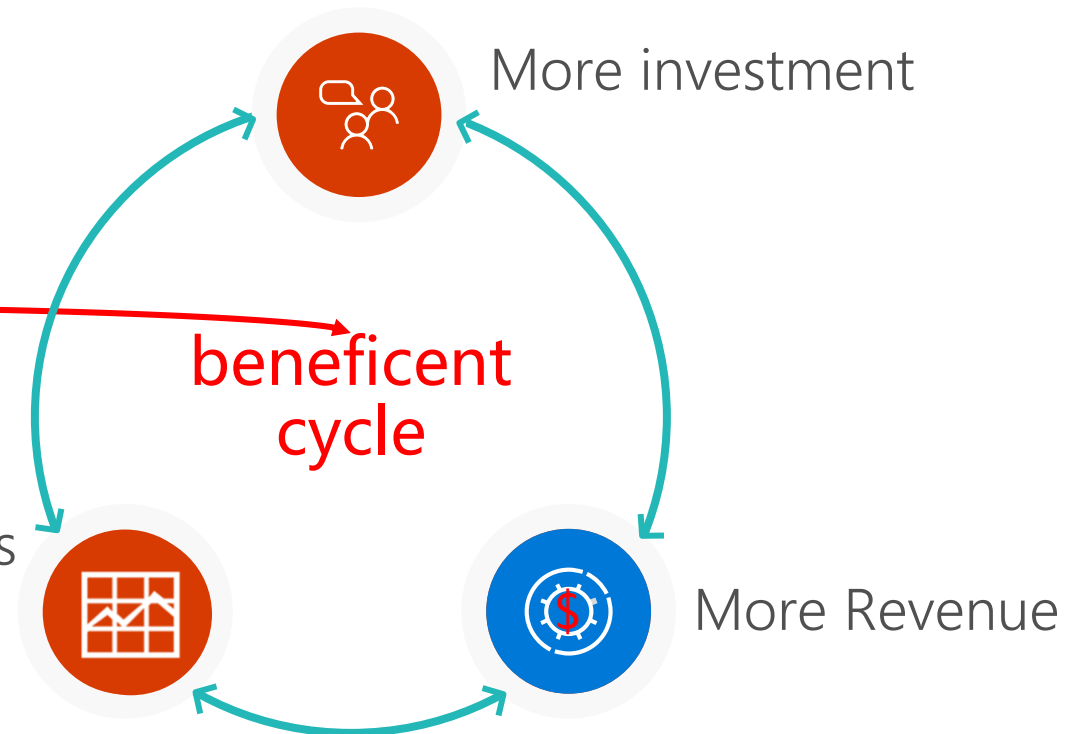
More utility hours shape the beneficent cycle:

- Wind resource research platform
- Smart wind farm platform

Siting and smart operation technologies



More utility hours
More carbon
reduction



2. CR Power: Efforts on Carbon Reduction






Build more green power facilities

Investment

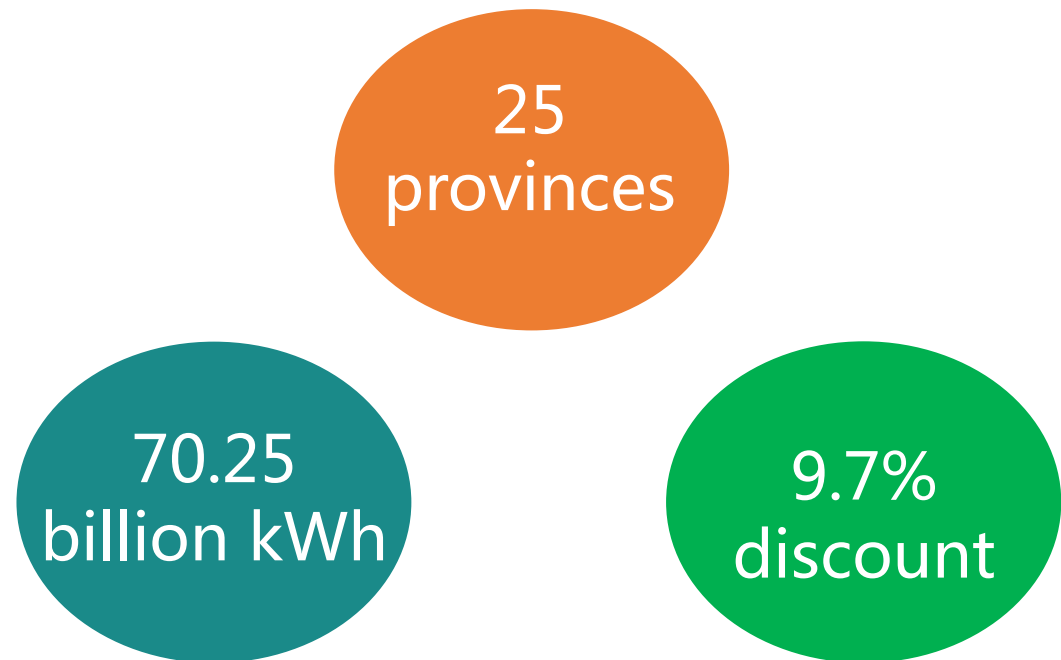
Capacity

Utilization hours

Energy service

-  **25** provincial power retail companies across China.
-  **70.25 billion kWh** of electricity sold through bilateral long-term agreements and on-grid competitive bidding.
-  **9.7% discount** approx. as compared with the average approved on-grid tariff.
-  **57 companies** in **14 business sectors** under CRH cooperating with us on energy service.
-  Cooperation with Foxconn, TCL, Country Garden and the Hyatt Group etc.

Power retail and comprehensive energy services



Data source : CR Power 2018 Annual Report

2. CR Power: Efforts on Carbon Reduction



Build more green power facilities

Investment

Capacity

Utilization hours

Energy service

-  Smart energy service: bringing more “low carbon” power with lower cost;
-  Both cost and carbon is lower : marginal effect of higher utilization hours and lower fuel consumption rate, resulting in carbon reduction.





3. Thoughts on Renewable Energy for Hong Kong







3. Thoughts on Renewable Energy for Hong Kong

Hong Kong's Climate Action Plan 2030+

-  Hong Kong aims at reducing carbon intensity by 65 to 70 percent by 2030 compared with the 2005 level
-  This target is equivalent to an absolute reduction of 26 to 36 percent and resulting in per capita emission of 3.3 to 3.8 tons




3. Thoughts on Renewable Energy for Hong Kong

Approaches

-  Thermal power substitution.
-  Renewable substitution.
-  Electricity substitution.
-  Greater Bay Area opportunities.

3. Thoughts on Renewable Energy for Hong Kong

Thermal power substitution: coal-fired to gas-fired

-  Burning efficiency increased.
-  Fuel logistics energy consumption decreased.
-  Thermal power can be essential because of flexible load adjustment-capability. With high renewable power penetration, thermal power is a basic stabilizer of the grid.

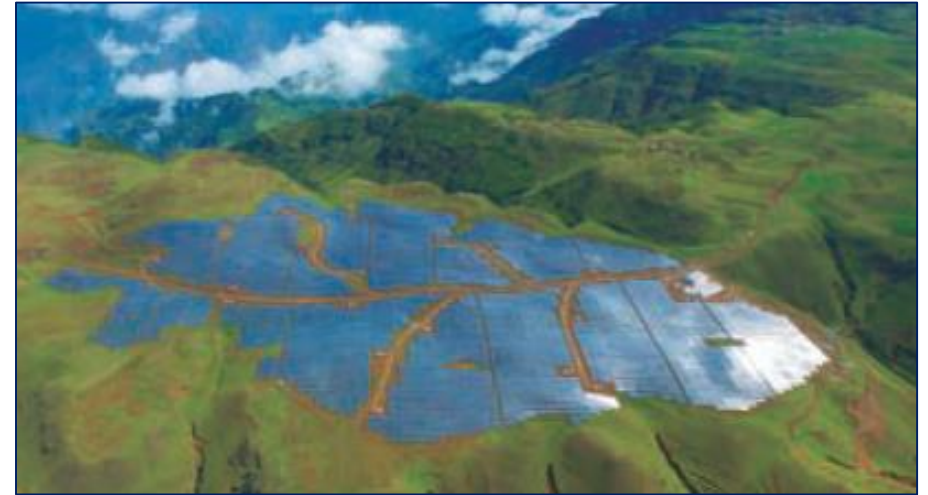


3. Thoughts on Renewable Energy for Hong Kong

Renewable substitution

Benefits of renewables

With the most mature wind and photovoltaic power, the carbon emission in power production goes **near zero**.



3. Thoughts on Renewable Energy for Hong Kong

Renewable substitution - inner strength of Hong Kong

Renewables	Technology development	Natural endowment for HK
Onshore wind	Good, advancing	Weak
Offshore wind	Good, advancing	Medium to rich
Photovoltaic plant	Good, advancing	Weak
Distributed photovoltaic	Good, advancing	Medium



3. Thoughts on Renewable Energy for Hong Kong

Renewable substitution - inner strength of Hong Kong

Offshore wind power planning:

CLP/HK Electric: Buying renewable electricity at a price between HK\$ 3-5, from 2015-2033.

Offshore wind power planning – mostly big players.

All about policies

Distributed photovoltaic power planning – individual players and contractors.

Policies for renewable energy encouragement - on investment and consumption.



3. Thoughts on Renewable Energy for Hong Kong

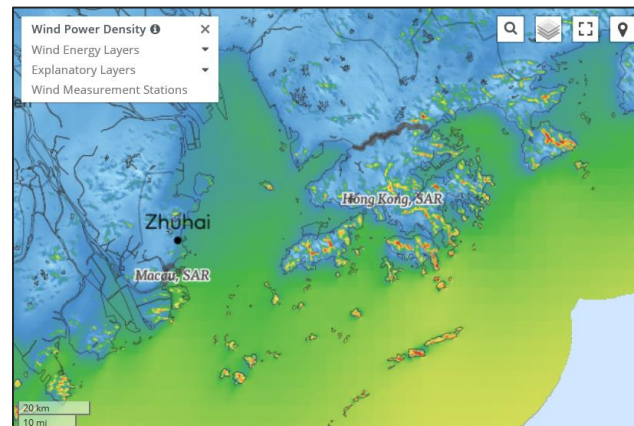
Renewable substitution - inner strength of Hong Kong

Offshore wind power planning:

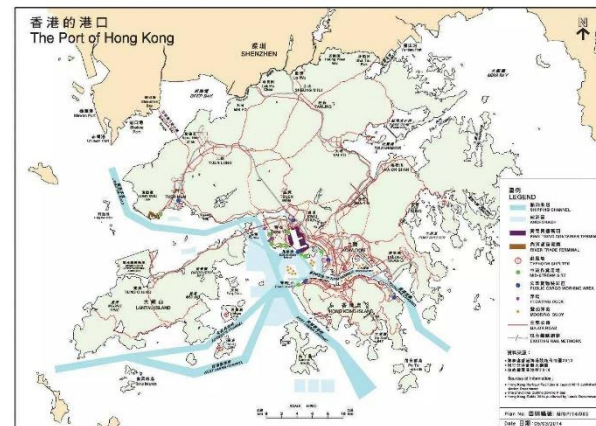
- Offshore wind measurement and resource assessment.
- Investigation for shipping lanes and environmental impacts etc.
- Geology and tidal measurement and assessment, investment budget estimation etc.



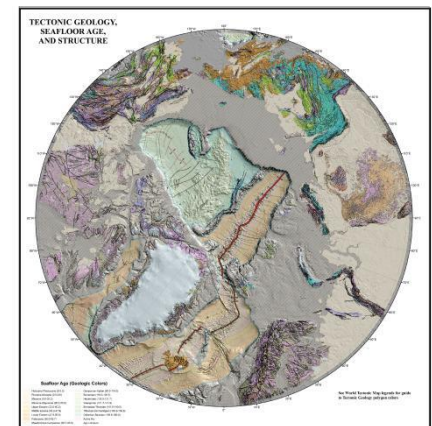
Measurement



Resource assessment



Shipping lanes investigation



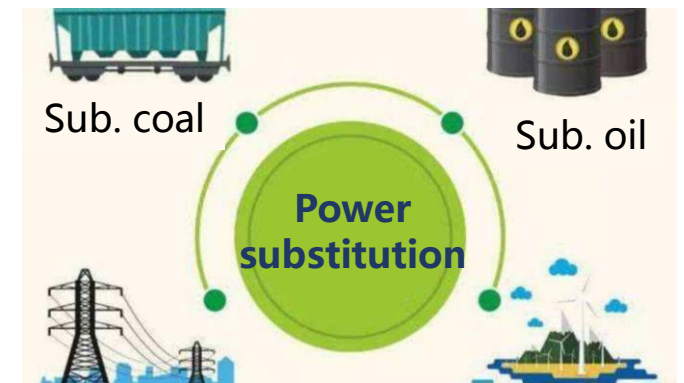
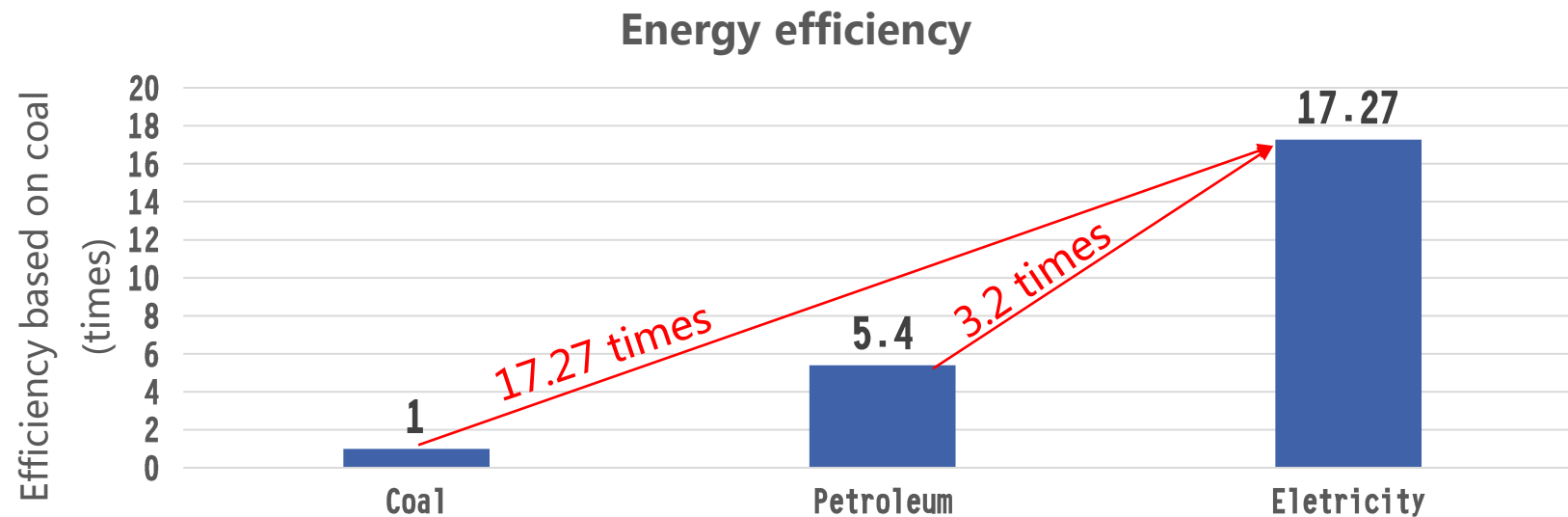
Geology and tide

3. Thoughts on Renewable Energy for Hong Kong

Electricity substitution

Why electricity substitution?

- Most of the renewables comes in the form of electricity.
- Utilization of power (large scale grid) proved to be the most efficient form of energy.
- Distribution of power is fastest and most flexible, also the cheapest.







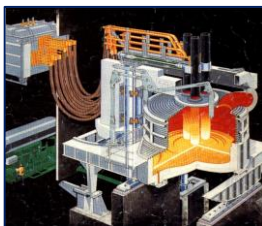
Data source: China Southern Grid report on Economic Daily

3. Thoughts on Renewable Energy for Hong Kong

Electricity substitution

How electricity substitution?

-  **Transportation:** E-Vehicle (EV/HEV/PHEV), E-train, E-bus, E-ship (shore power system)
-  **Production and manufacture:** E-manufacture, E-agriculture, etc.
-  **Construction:** E- Construction, lifting cranes, machines, etc.
-  **Residential and home:** E-home, heating, cooking, etc.

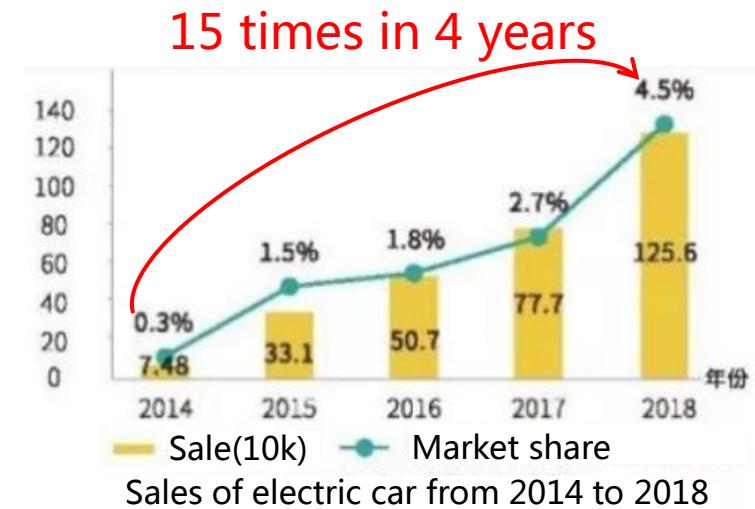
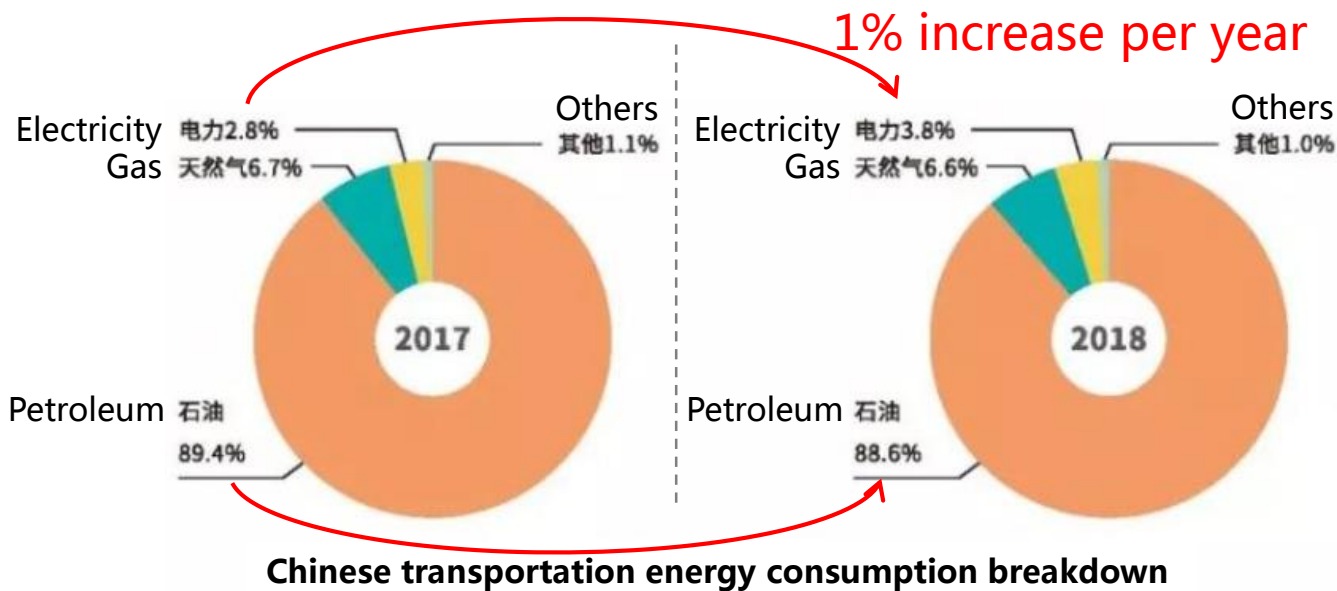


3. Thoughts on Renewable Energy for Hong Kong

Electricity substitution

How electricity substitution?

Transportation: a lesson from Chinese Mainland



3. Thoughts on Renewable Energy for Hong Kong

Greater Bay Area – infrastructure interconnection

Greater Bay Area planning framework:

- Speed up infrastructure interconnection.
- Optimize energy supply structure.

We have railways, water way, bridges, internet connections.

Yet maybe we need strong power grid interconnections.



railways



water way



bridges

3. Thoughts on Renewable Energy for Hong Kong

Greater Bay Area – infrastructure interconnection

Greater Bay Area planning framework:

- Speed up infrastructure interconnection.
- Optimize energy supply structure.

2019 Hong Kong residential power tariffs



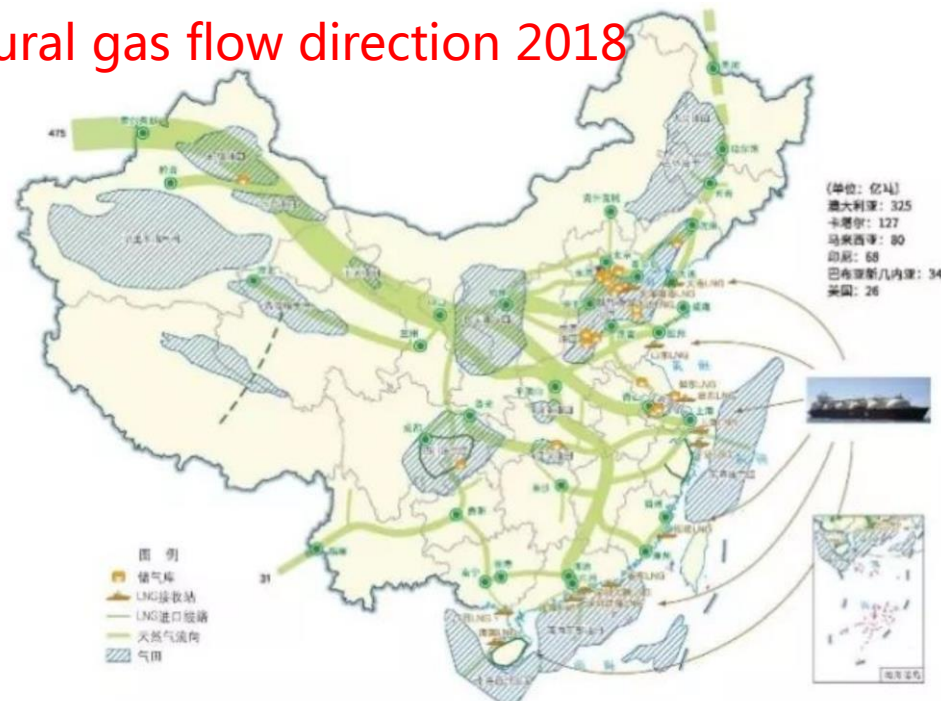
3. Thoughts on Renewable Energy for Hong Kong

Greater Bay Area – infrastructure interconnection

Final purpose of energy (power) system:

- Realize the carbon reduction goal.
- Supply enough electricity at an acceptable price.

Natural gas flow direction 2018



Source : CEPPEI

Facts: HK shifts from coal-fire to gas-fired

- Farthest end point of gas pipeline, higher fuel price.
- Carbon emission go down, power tariff push up.

3. Thoughts on Renewable Energy for Hong Kong

Greater Bay Area – infrastructure interconnection

Guangdong strength:

- Hydro power from Yunnan, Guizhou, Sichuan and Hubei province through UHV grid.
- Guangdong plans to have 6.5GW wind power, and 5GW photovoltaic power installed.



Source : CEPPEI

HK Opportunity: cooperate to achieve carbon and price goal

- Carbon reduction through renewable electricity purchase.
- Power tariff cut through mutual market penetration.
- Feasible to invest renewables in China and transmit it to HK, utilizing the natural endowment of Chinese mainland.

3. Thoughts on Renewable Energy for Hong Kong

Greater Bay Area – infrastructure interconnection

Cooperate and purchase through mutual market:

- Get an reasonable price.
- Lower carbon emission.
- Join the back bone grid.

Average market price
10 家大型发电集团各类电源
平均市场化交易电价

中国内地与港澳地区及邻国交换电量



- 煤电 0.326 元/千瓦时
- 水电 0.221 元/千瓦时 Hydro
- 风电 0.346 元/千瓦时 Wind
- 光伏 0.682 元/千瓦时 Solar PV
- 气电 0.660 元/千瓦时 Gas-fired
- 核电 0.361 元/千瓦时 Nuclear





Electricity transmitted to Hong Kong reached **13 billion kWh**.

Transmitted electricity **2018**

3. Thoughts on Renewable Energy for Hong Kong



Final conclusion

-  **Hong Kong:** substantial inner strength in renewable energy, e.g. wind and photovoltaic.
-  **Chinese mainland:** achieves carbon reduction and cost reduction simultaneously.
-  **CR Power:** achieves lowest carbon consumption rate;
achieves highest utilization hours for renewable power;
cut the tariff by near 10% through comprehensive energy service.
-  **Greater Bay Area opportunity:**
acquires back bone grid support;
power market penetration for lower cost;
transmit renewable electricity to HK to serve the carbon reduction goal;
cooperate on electricity substitution, improving energy efficiency;
new investment opportunity in renewable power in Chinese mainland.



THANK YOU!

YOUR COMMENT IS HIGHLY APPRECIATED



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