Challenges and Industries Electrification Impacts on Large Renewables Integration in China

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1 **Status of Energy Utilization in China**

2 **Opportunities and Challenges of Industries Electrification to RE integration**
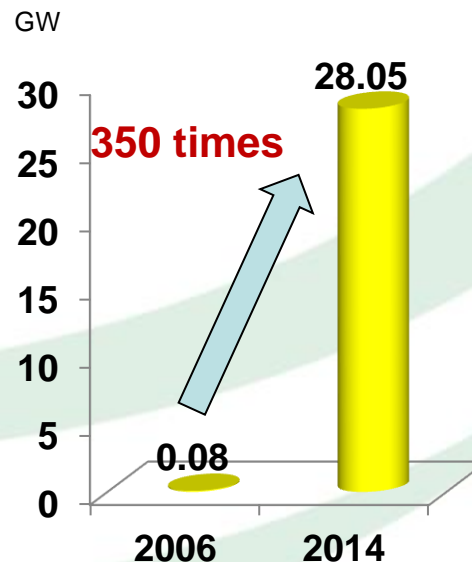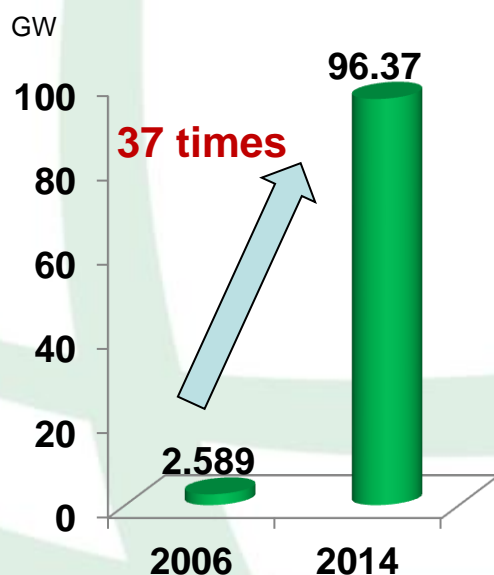
3 **Solutions and Practices for RE integration**

1.1 Large RE Development in China

By the end of 2014:

◆ **Hydro power**：302 GW, ranking **No.1** in the world;

◆ **Wind power**：96.37 GW, ranking **No.1** in the world;

◆ **Solar power (PV)**：28.05 GW, ranking **No.2** in the world;

GW

96.37

100

37 times

80

60

40

20

2.589

0

2006   **2014**

GW

28.05

30

350 times

25
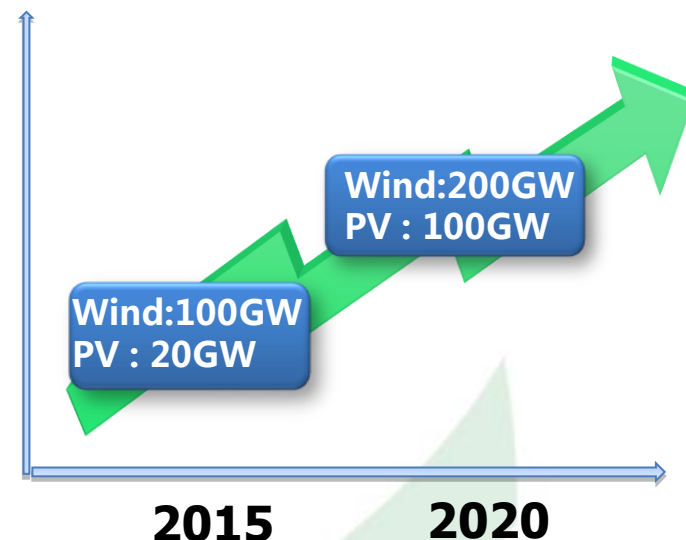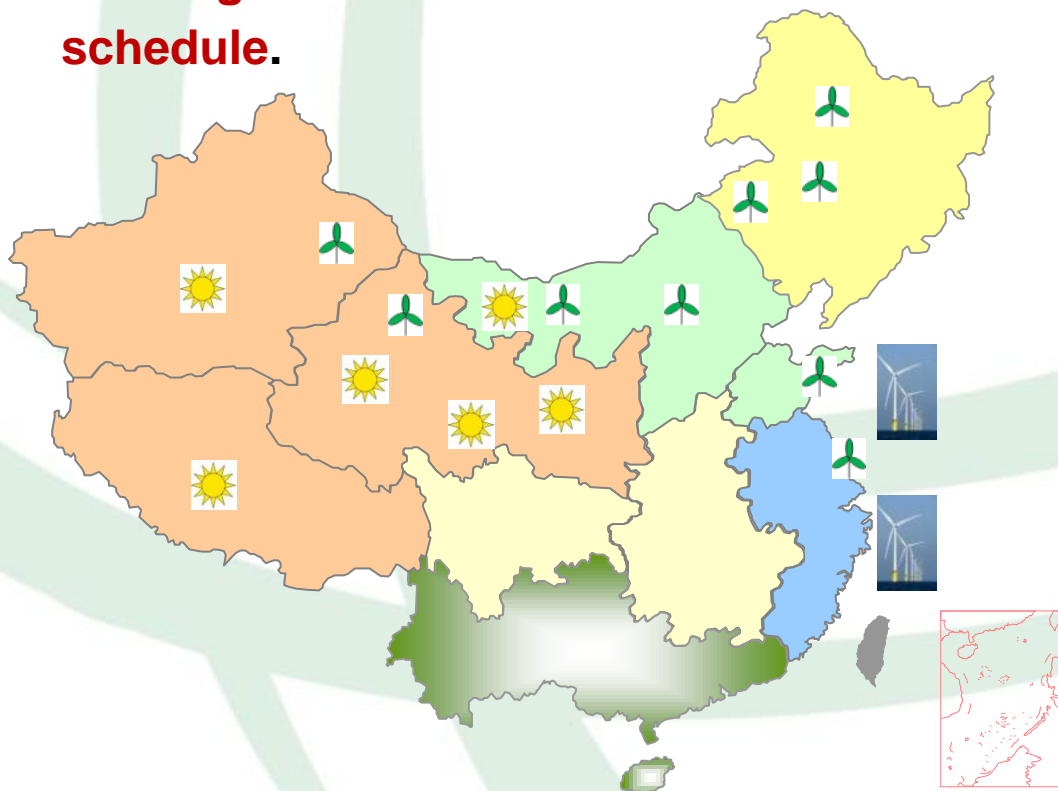
20

15

10

5

0.08

0

2006   **2014**

Wind and PV capacity growth from 2006 to 2014 in China

1.1 Large RE Development in China

◆ **9** large-scale wind power bases are in plan and under construction, **each of them** is over **10GW**.

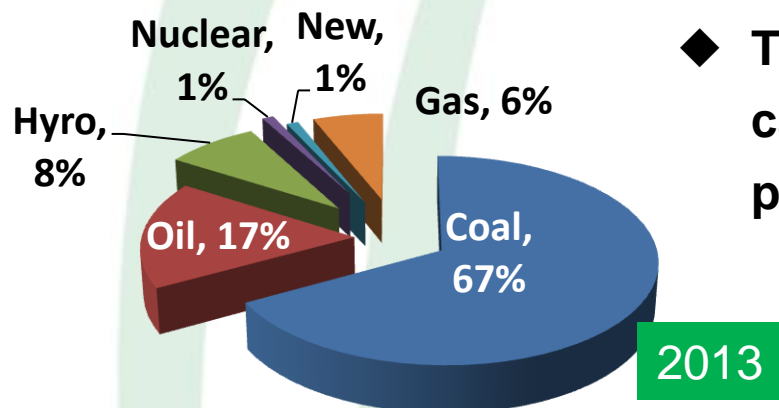◆ **Some goals** have been achieved **ahead of schedule**.

Wind:200GW
PV : 100GW

Wind:100GW
PV : 20GW

2015   2020

◆ **2015**

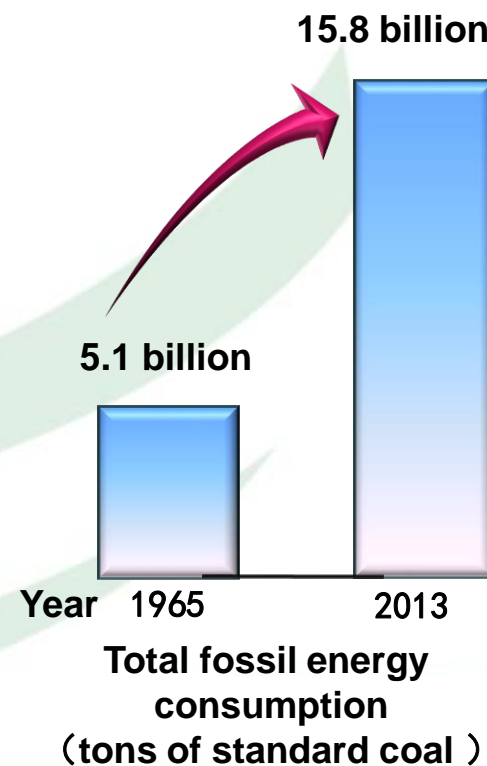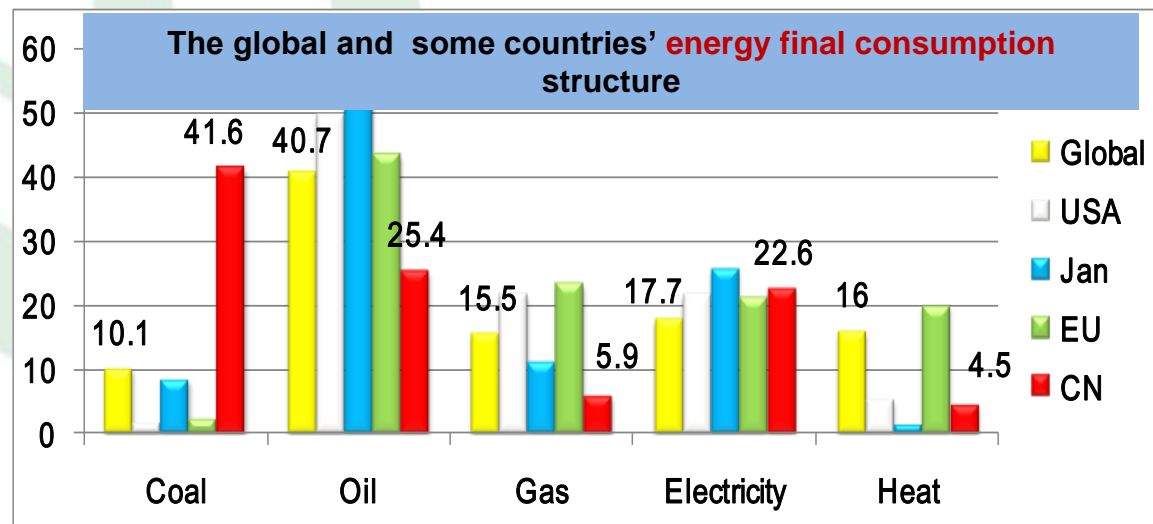Large PV station   10GW (**31.38GW**)

Distributed PV   10GW (**11.67GW**)

1.2 Primary Energy Consumption

◆ **The global reserve of fossil energy is limited;**

◆ **The large-scale utilization of fossil energy have caused more serious CO_2 Emission and pollutions to air, water, and soil.**

Nuclear, 1%
New, 1%
Hyro, 8%
Gas, 6%
Oil, 17%
Coal, 67%

2013

15.8 billion

5.1 billion

The global and some countries' energy final consumption structure

	Coal	Oil	Gas	Electricity	Heat
Global	10.1	40.7	15.5	17.7	16
Jan					
CN	41.6	25.4	5.9	22.6	4.5

- Global (yellow)
- USA (white)
- Jan (blue)
- EU (green)
- CN (red)

Year   1965   2013

Total fossil energy consumption（tons of standard coal）

◆ **Path**：**replace fossil energy with clean energy**, **replace coal and oil by electricity** in consumption;

◆ **Target**： **Optimizing energy structure; increasing energy efficiency; achieve the transition from fossil energy dominant to clean energy dominant, increase the share of electric energy in end consumption.**

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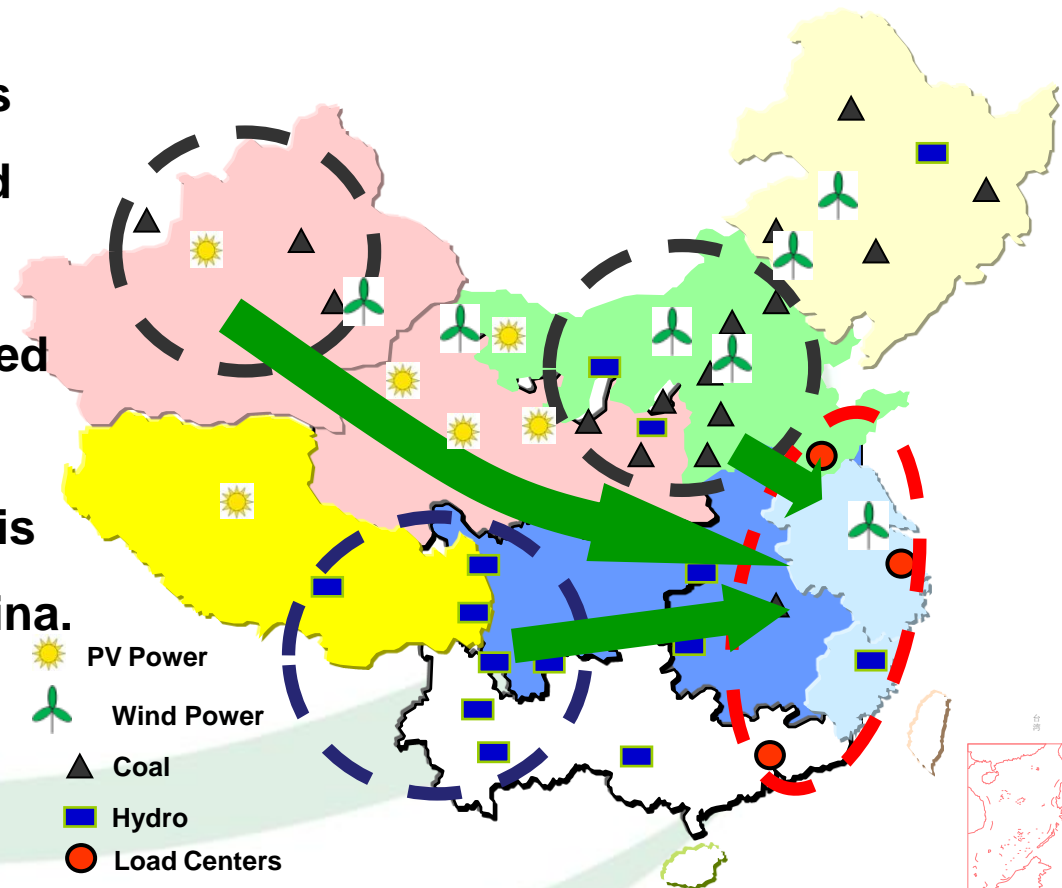
3 | **Solutions and Practices for RE integration**

2.1 Challenges of RE Integration

- **80% of wind/solar resources**, is located in North, Northeast and Northwest, **80% of the hydropower** resources is located in Southwest.

- **Over 2/3 of the power demand** is located in East and Central China.

- Distance from energy bases to load centers:**800 km~ 3000 km**

☀ PV Power
🌲 Wind Power
▲ Coal
■ Hydro
● Load Centers

- China needs to **develop large power transmission** capacity to deliver the power to load center and optimize the power allocation nationwide.
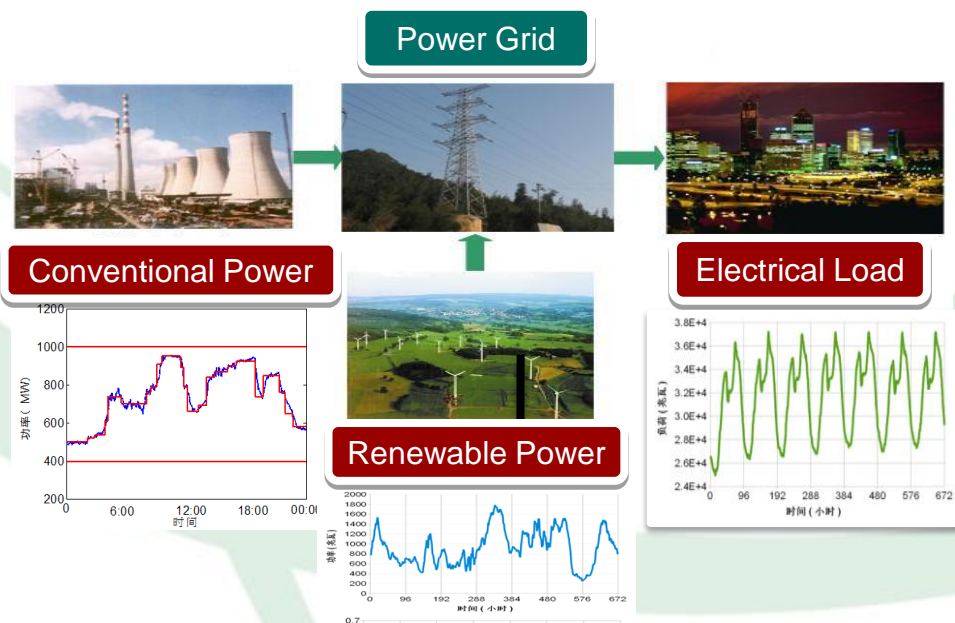
◆ **Large power fluctuation** of RE and **lack of flexible power sources** has brought great challenges to the power balancing capability of power system.

◆ By the end of 2014，the total installed generation capacity in China was 1360GW, including **67.32% thermal power**, 22.19% hydro power, 7.04% wind power, 1.46% nuclear power and PV power of 1.95%.

Power Grid

Conventional Power

Renewable Power

Electrical Load

Fluctuation characteristics
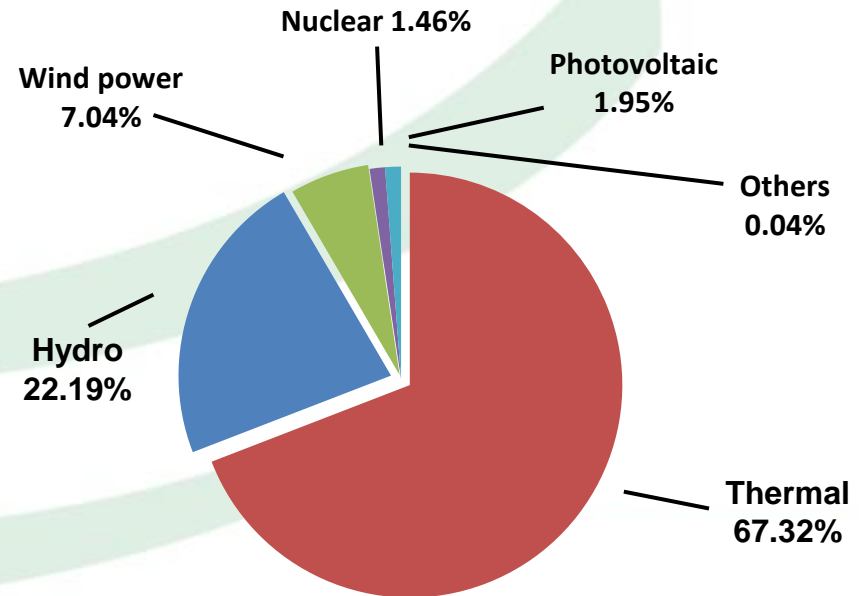
Nuclear 1.46%

Wind power 7.04%

Photovoltaic 1.95%

Others 0.04%

Hydro 22.19%

Thermal 67.32%

◆ **Industries electrification will result in the growth of electricity demand which brings opportunities for RE grid integration.**

    ◆ **Growth of industrial electricity provide a large market for RE;**

    ◆ **Increase of the share of industrial load changes the load profile and decrease the peak-valley ratio (peak-valley difference/ total load) of load.**

peak-valley ratio: 31.70%

peak-valley ratio: 20.13%
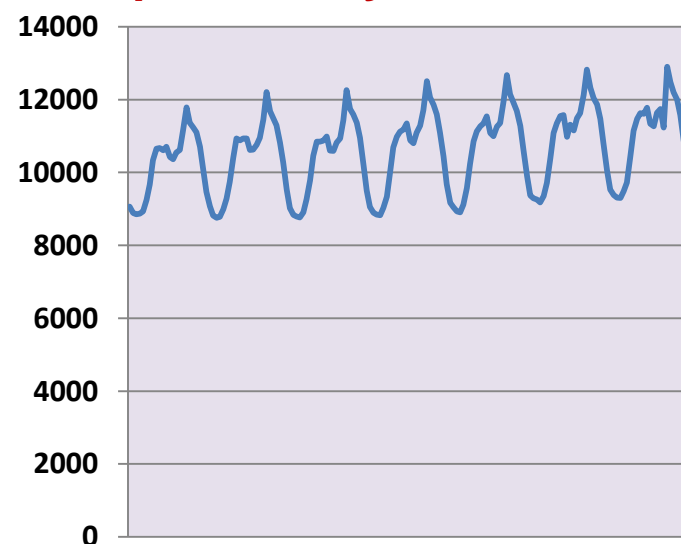
Residential load grow

Industrial load grow

Peak-valley ratio decrease
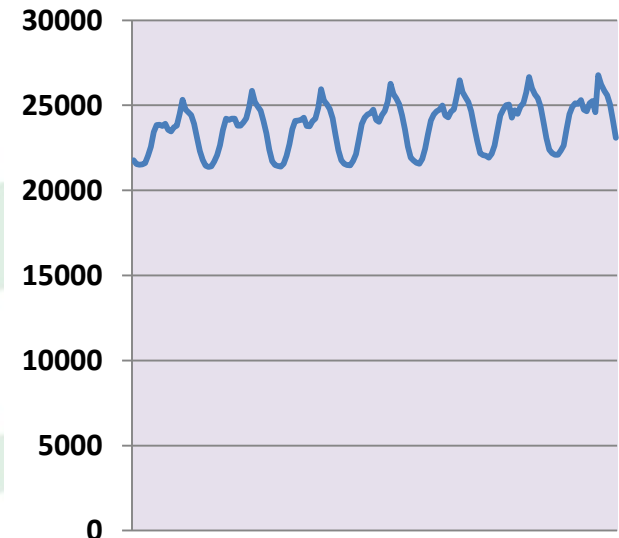
2.3 Challenges Caused by Industries Electrification

◆ **Distribution grid upgrade required by industries electrification**

　　◆ **Impacts of DER and EV to distribution grid**

　　◆ **Demand for expansion of LV-Grid**

　　◆ **More smart control performance**

◆ **Interaction with industrial users**

　　◆ **Change of load characteristic**

　　◆ **User resource dispatching**

　　◆ **Information exchange between grid and industrial users**

　　◆ **Policy and business**
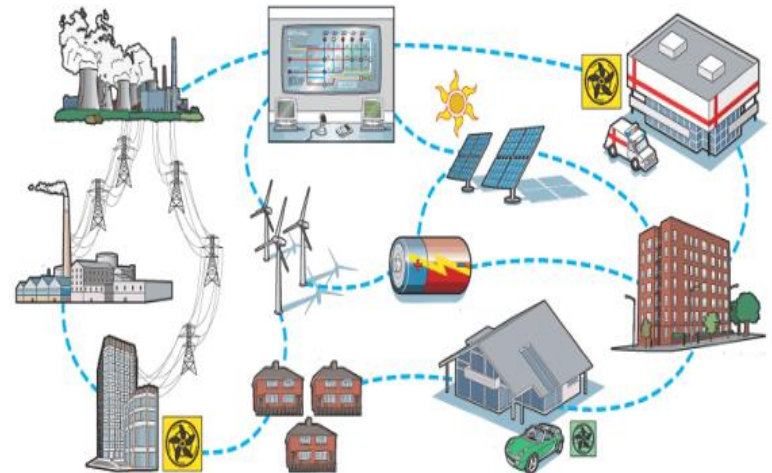
2.4 Electricity replacement of SGCC

2014

◆ **Electricity replacement projects: 13000**

◆ **Number of related policies：121**

Fired coal Reduction 23.8 Million tons

CO_2 Reduction 42.38 Million Tons

SO_2, NO_x, Dust 0.91 Million tons

Unit: TWH

Category	Value
Electric boiler	87
Kiln	197
Heat pump	122
Electric storage-cooling	44
Port electricity	10
EV	19
Rail taansit	212
Agricultural irrigation	52
Scattered electric heating	52
Domestic electrification	135
clean energy replacement	39
others	52
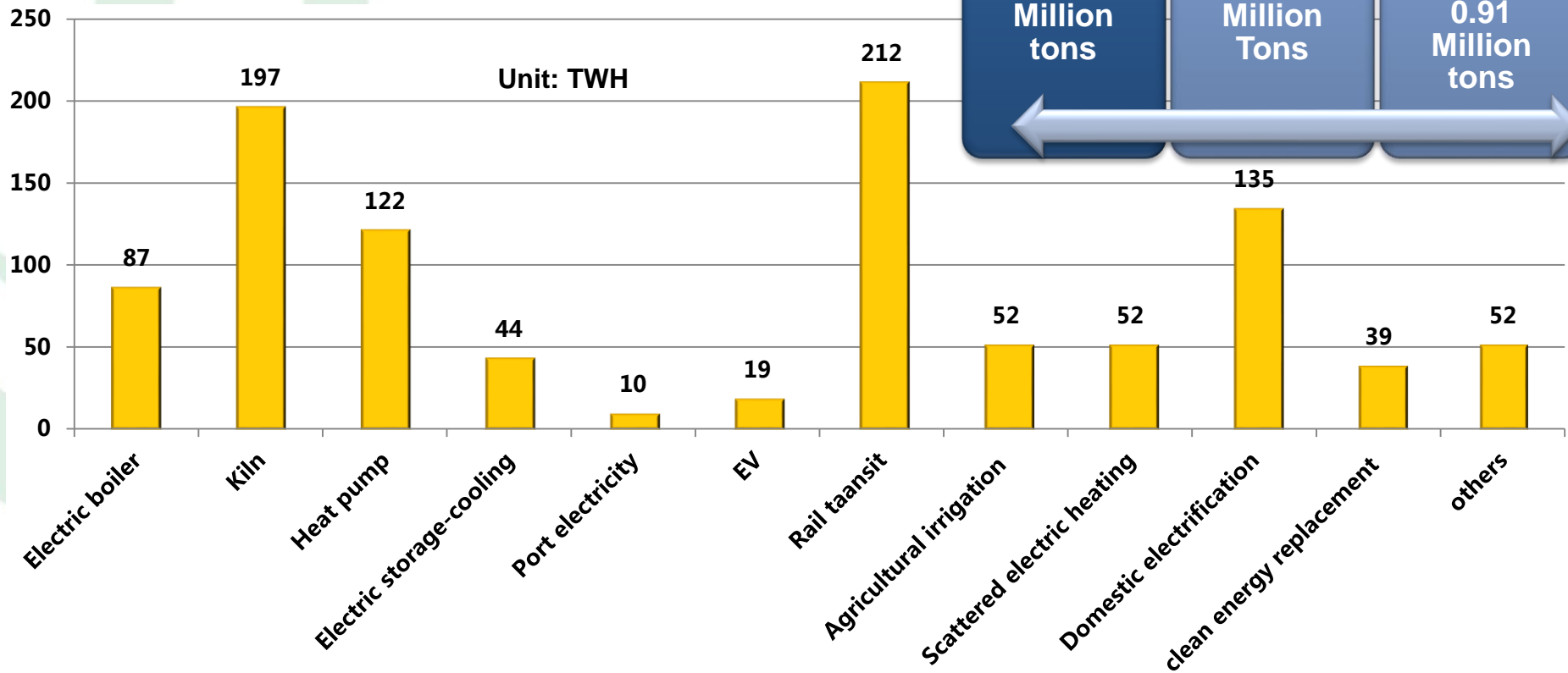
2.4 Electricity replacement of SGCC

Future

◆ **Potential electricity replacement** is about **1.8 trillion kWh**.

◆ **Target of 2015: 65,000 GWH(base), 75,000 GWH(challenge)**

NO.	Alternative energy	Alternative technology	Potential quantity（TWh）	Ratio
Total			17939	100%
1	Replace coal by electricity	Electric heat-storage boiler	6480	36.12%
2		Heat pump	1814	10.11%
3		Electric heat-storage boiler	1800	10.03%
4		Electric cooking appliance	1000	5.57%
5	Replace oil by electricity	EV	176	0.98%
6		Electric railway	242	1.35%
7		Urban railway system	125	0.70%
8		Kiln	40	0.22%
9		Electric pump	280	1.56%
10	Replace gas by electricity	Electric cooking appliance	1806	10.07%
11		Electric water heater	798	4.45%
12		Electric heater for house	106	0.59%
13		Electric heat-storage boiler	672	3.75%
14		Electric heat-storage boiler	2600	14.49%

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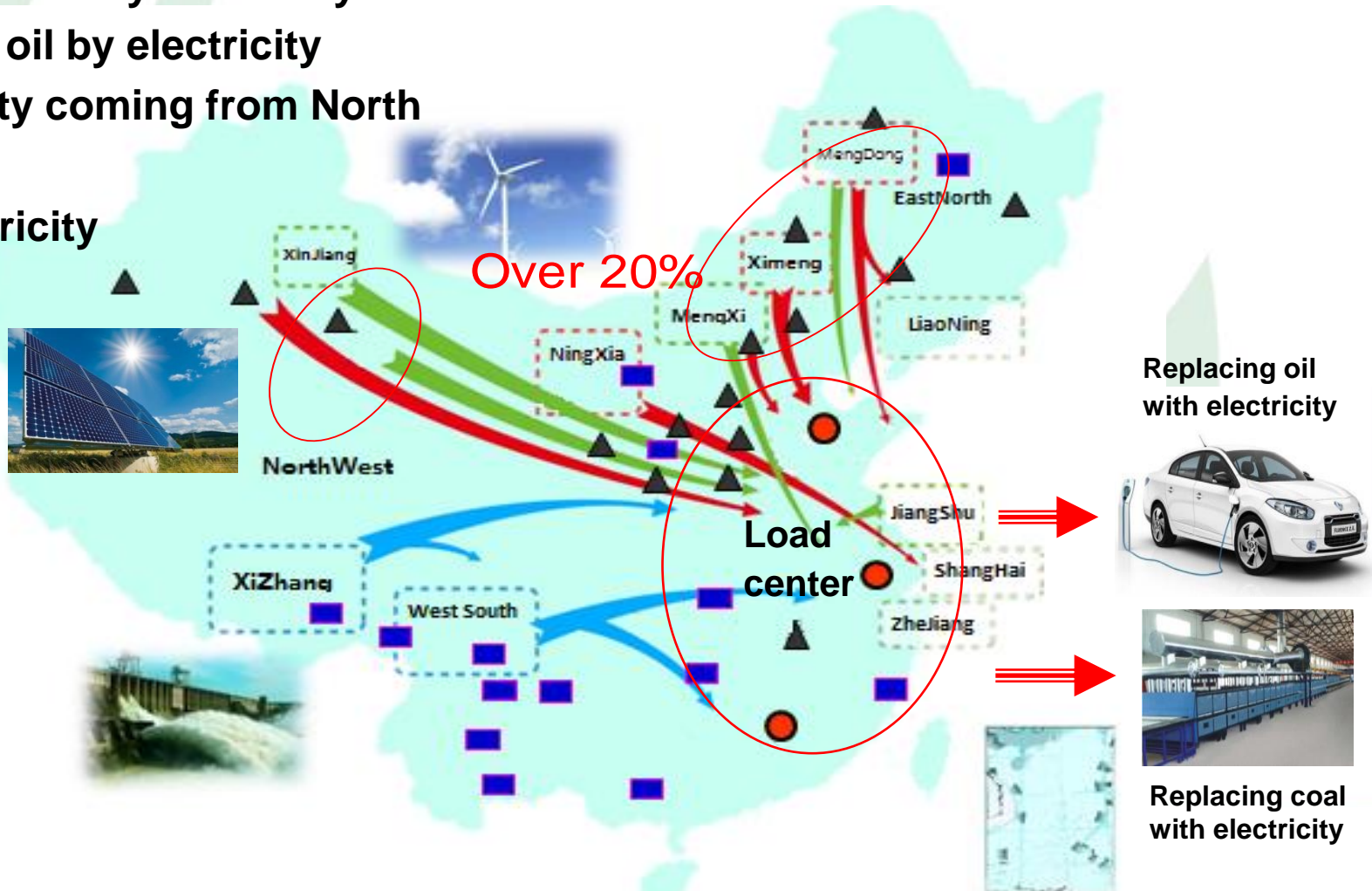
◆ **Replace coal by electricity**

◆ **Replace oil by electricity**

◆ **Electricity coming from North West**

◆ **RE electricity**

Over 20%

Load center

Replacing oil with electricity

Replacing coal with electricity

3.2 Reinforcement of Power Grid
--- UHV Power Transmission

◆ **Build national UHV power grids:** form a UHV AC backbone network and UHV DC transmission channels connecting large energy bases and load centers.

◆ **Engineering construction:**

  ➢ **3 AC and 4 DC UHV projects have been completed**

  ➢ **Delivered over 200TWh electricity**

China's plan for UHV grids by 2020

图例

1000kV AC

±800kV DC

±1100kV DC
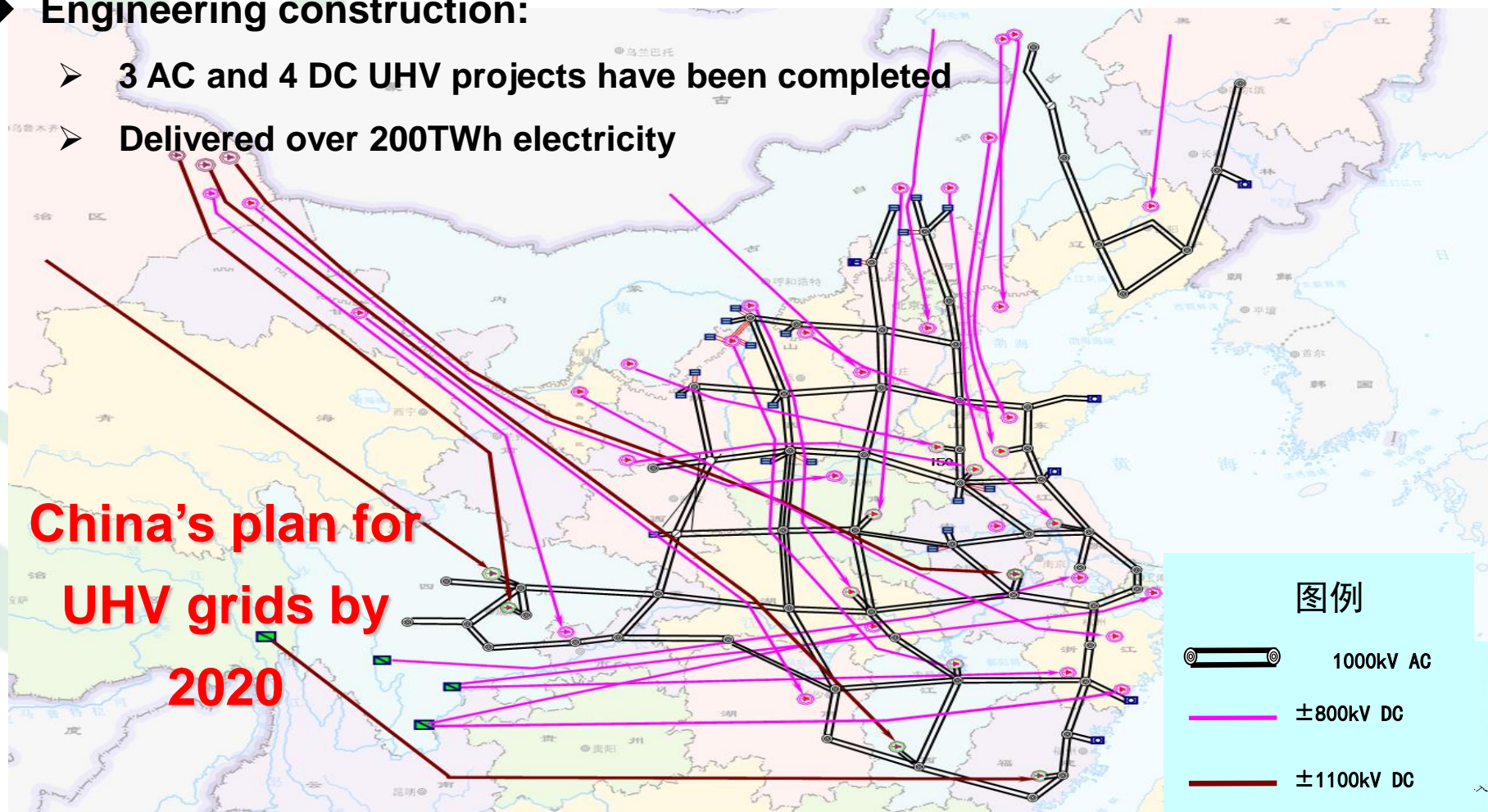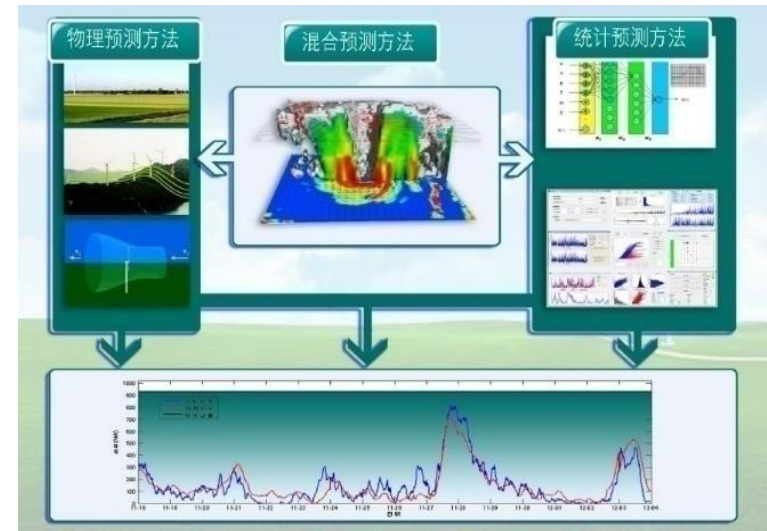
3.3 Improved Generation Flexibility
--- RE power prediction

RE power prediction

◆ Physical, statistical and hybrid prediction methods

◆ Numerical weather prediction operational center

3.4 Demand Side Management
--- EV and smart meters application

◆ **Built over 500 EV charging and battery swap stations, 20,000 charging poles, and many inter-city charging and battery swap service network;**

◆ **Installed 220 million smart meters, and realized automatic data collection of power use information for 230 million customers.**

Smart meters

220 million

EV charging stations

500

Automatic information Collection system

230 million customers

EV charging poles

20,000

环渤海

长三角

在环渤海、长三角地区形成了城际充换电服务网络

南海诸岛

3.4 Demand Side Management
--- Demand response

Demand response

539 households in 4 cities

	Type	Beijing	Shanghai	Yinchuan	Nanchang
Infor push	information push	35	48	34	50
AC controlling	information push and load control	48	36	38	50
baseline	data collection only	50	50	50	50

Information push group:
peak-valley difference :32kW

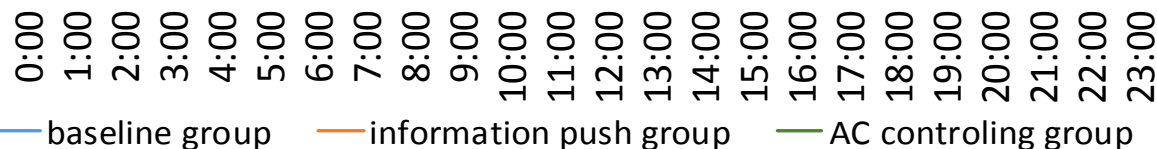**Baseline group:**
peak-valley difference :34.68kW

AC controlling group:
peak-valley difference : 19.42kW

Information push group:
Reduction rate of peak-valley difference :7.73%

AC controlling group :
Reduction rate of peak-valley difference :44%

Load/kW

baseline group — information push group — AC controling group

Renewable Energy Law

中华人民共和国
可再生能源法

<China Renewable Energy Law>

China Renewable Energy Law amended

2009

- **Strengthen planning**
- **Power utility's duty**
- **RE fund established**

China Renewable Energy Medium and Long term planning

2007

By 2020
- **Wind   30GW**
- **Solar power 1.8GW**
- **Biomass   30GW**

China Renewable Energy Law takes effect

2006

China Renewable Energy Law released

2005

No systematic RE policies before 2005

- **General targets**
- **Classified tariffs**
- **Cost share (RE surcharge 0.04 CNY/kWh)**
- **Compulsory grid-connected**

3.5 Policy and Related Incentives
--- Policy

Renewable energy electricity quotas

◆ Making a **mandatory RE quota** in each province, encourage each region actively develops and utilizes local RE resources;

◆ Will be issued this year or next.

Generation ➡ **Transmission** ➡ **Consumption**

RE generation enterprises   Power grid   Provincial government

Type of Regions	Given Ratio of RE Quotas	Including Regions
Type 1	10%	Inner Mongolia, Shaanxi, Ningxia, Gansu, Xinjiang, Tibet, Liaoning, Jilin, Heilongjiang
Type 2	7%	Beijing, Tianjin, Hebei, Qinghai, Yunnan, Shanxi, Shandong
Type 3	4%	Jiangsu, Shanghai, Guangdong, Hunan, Fujian, Henan, Anhui, Hubei, Guangxi and Hainan
Type 4	2%	Zhejiang, Guizhou, Sichuan, Jiangxi, Chongqing

Future Outlook

By 2022

◆ **National UHV grid will be formed with more than 20 UHV lines;**

◆ **Cross region power transmission: 450GW;**

◆ **Clean energy power transmission: 550GW;**

◆ **Annual clean energy consumption: 1.7 trillion kWh;**

◆ **Replacement of raw coal: 700 Million Tons**

◆ **CO_2 emission reduction: 1400 Million Tons**

◆ **SO_2 emission reduction: 3.9 Million Tons**

Thanks for your attention!

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