Trends in Major Emerging Nuclear Country: China

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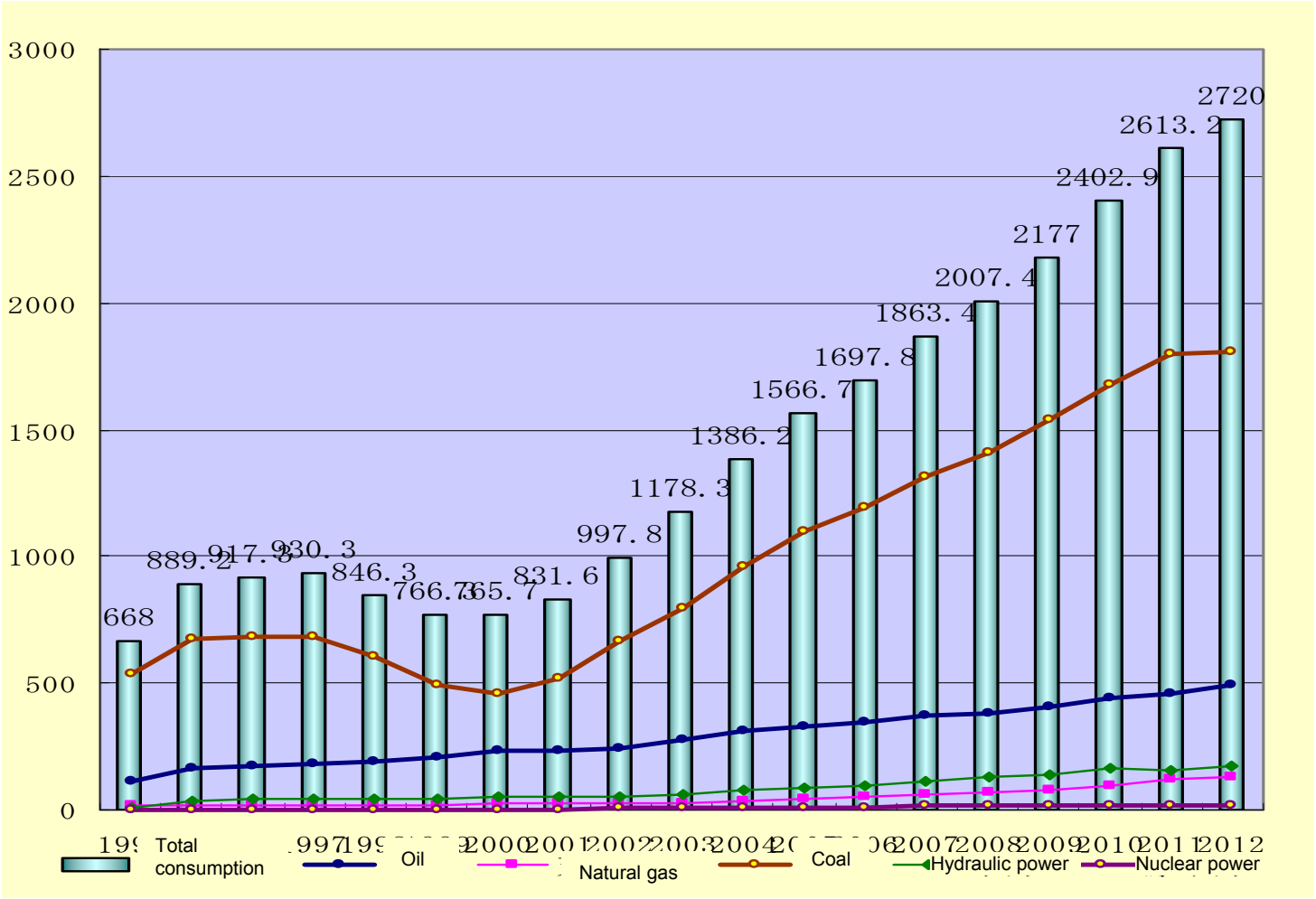
1. The position of nuclear power generation within the structure of primary energy consumption



At 0.8%, nuclear power generation only accounts for less than 1% of primary energy consumption (22 million tons of oil equivalent).

Capacity of Chinese power generation facilities

Units: MW; % (as of the end of 2013)

Power source	Facility capacity	Ratio
Thermal power	862, 380	69.1
Hydraulic power	280, 020	22.5
Nuclear power	14, 610	1.2
Solar power	14, 790	1.2
Wind power	75, 480	6.1
Total	1, 247, 280	100.0

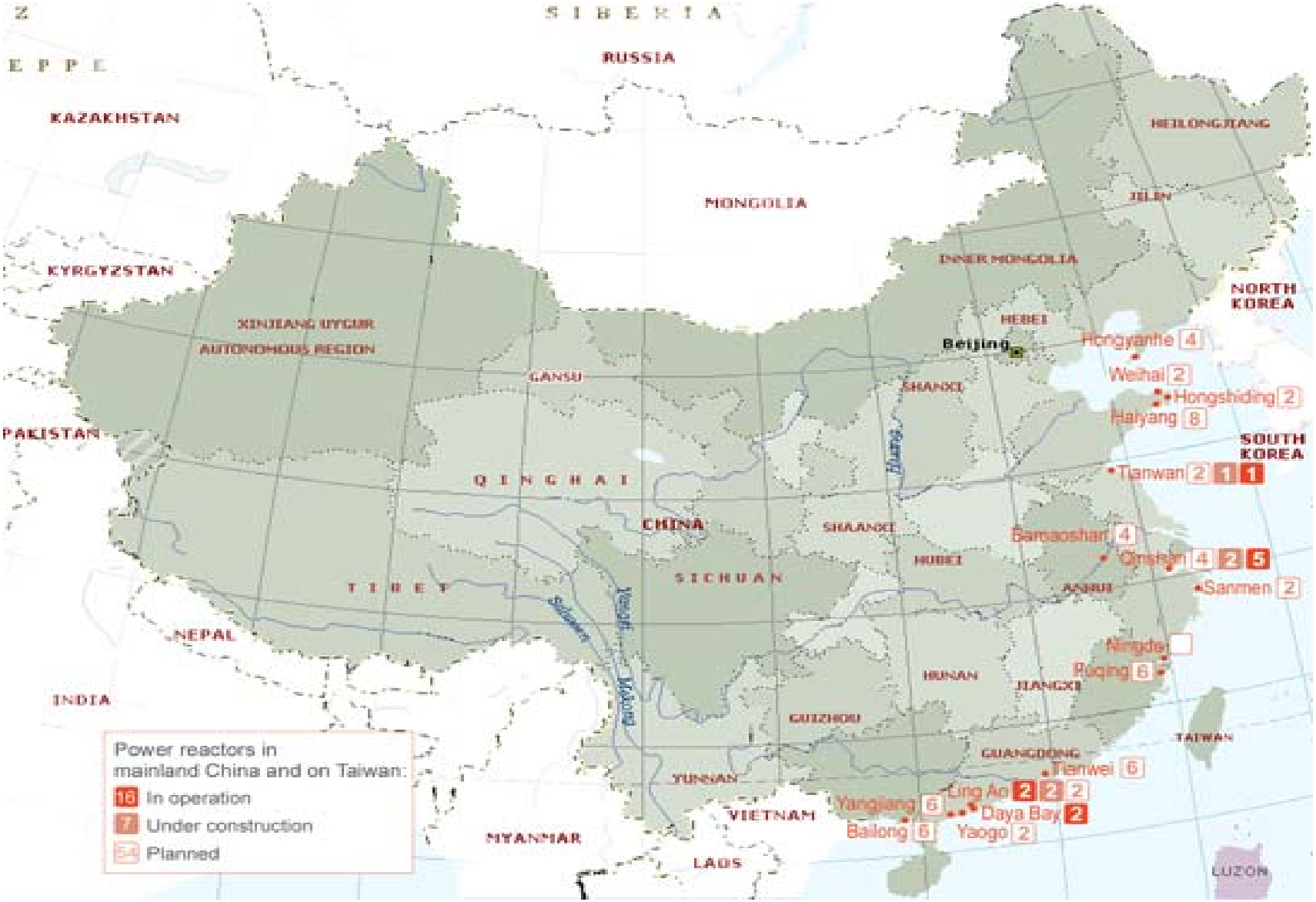
China is dependent on thermal power, and particularly on coal-fired thermal power. Nuclear power only accounts for 1.2%.

2. Trends in nuclear power generation

- Current state of nuclear power plant operation (as of April 2014): 20 reactors currently in operation (17,055 MW)
- 28 are under construction. This accounts for 40% of nuclear power generation units under construction worldwide.
- Future targets: 40,000MW in 2015; 70,000 to 80,000 MW in 2020; (130,000MW in 2025 and 200,000MW in 2030 according to the Chinese Academy of Engineering)
- Nuclear power generation policy: since March 11, a greater emphasis on safety has led to the suspension of construction in the inland (until 2015), but the policy of pushing forward with the construction of nuclear power plants has remained unchanged.

- Latest trends:
- Schedule for nuclear power plant sites under planning in the inland: commence in 2014, preparations complete by 2015 and works start by 2016
- The construction of nuclear power plants in the inland will resume in 2016.
- The period covered by the 13th Five-year Plan (from 2016 to 2020) will see an expansion in the construction of nuclear power plants.

Nuclear power reactors in mainland China



Source: World Nuclear Association

Operating nuclear reactors

Units	Province	Net capacity (each)	Type	Operator	Commercial operation
Daya Bay 1&2	Guangdong	944 MWe	PWR (French M310)	CGN	1994
Qinshan Phase I	Zhejiang	298 MWe	PWR (CNP-300)	CNNC	April 1994
Qinshan Phase II, 1&2	Zhejiang	610 MWe	PWR (CNP-600)	CNNC	2002, 2004
Qinshan Phase II, 3&4	Zhejiang	620 MWe	PWR (CNP-600)	CNNC	2010, 2012
Qinshan Phase III, 1&2	Zhejiang	678 MWe	PHWR (Candu 6)	CNNC	2002, 2003
Ling Ao Phase I, 1&2	Guangdong	938 MWe	PWR (French M310)	CGN	2002, 2003
Ling Ao Phase II, 1&2	Guangdong	1026 MWe	PWR (M310 - CPR-1000)	CGN	Sept 2010, Aug 2011
Tianwan 1&2	Jiangsu	990 MWe	PWR (VVER-1000)	CNNC	2007, 2007
Ningde 1&2	Fujian	1020 MWe	PWR (CPR-1000)	CGN	April 2013, (2014)
Hongyanhe 1&2	Liaoning	1024 MWe	PWR (CPR-1000)	CGN-CPI	June 2013, Feb 2014
Yangjiang 1	Guangdong	1021 MWe	PWR (CPR-1000)	CGN	March 2014
Total: 20		**17,055 MWe**			

Source: World Nuclear Association (updated April 2014)

Nuclear power plants currently under construction in China

(as of April 2014)

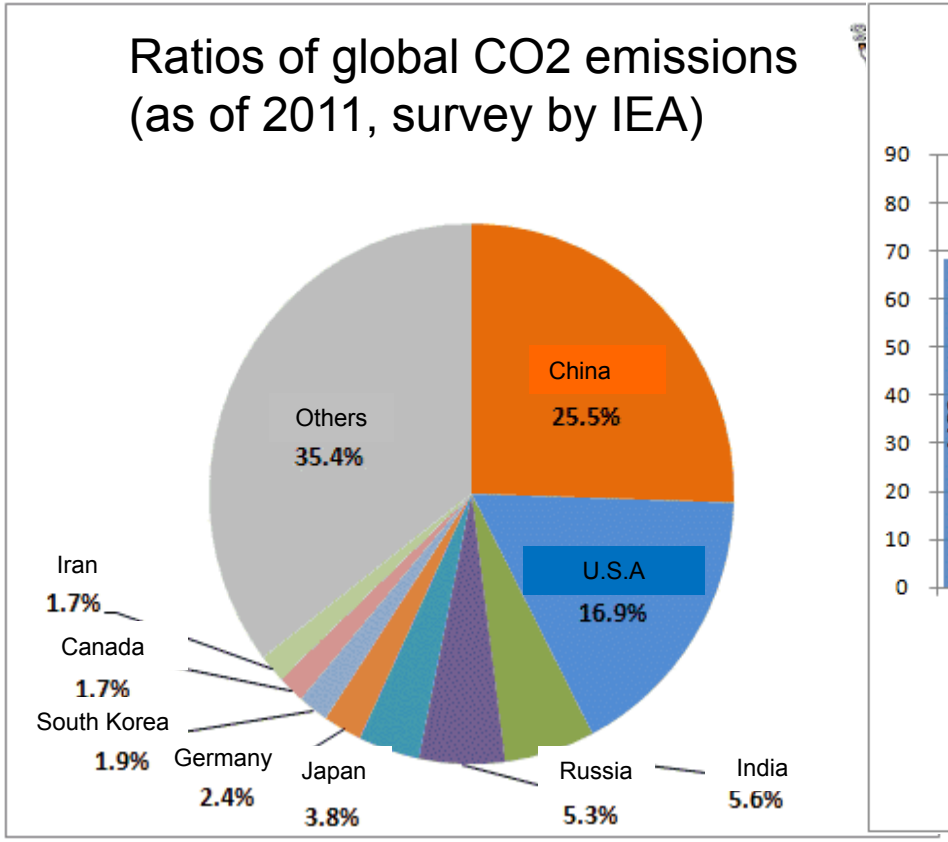
Source: survey conducted by the author

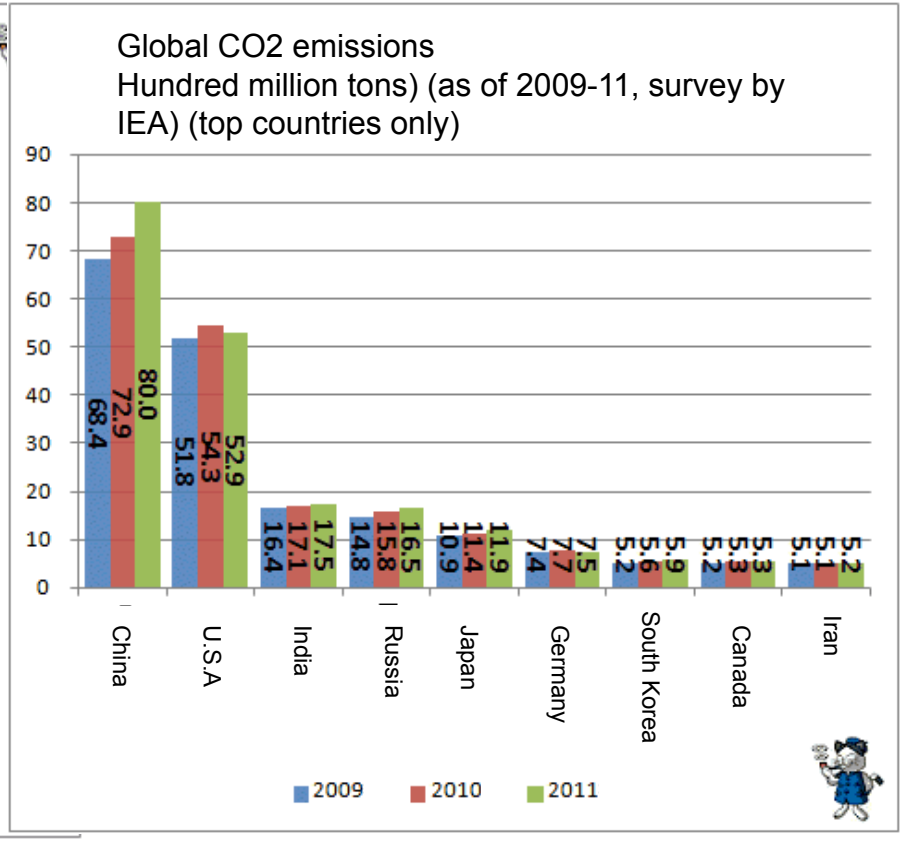
By area Province/autonomous region	Location/unit	Reactors 28	Beginning of construction	Expected completion	Capacity (10,000 kW) (total: 3063.5)	Reactor type
Liaoning	Hongyanhe Units 3 and 4	2	2009	2014	2×111.9	China・CPR1000
Shandong	Haiyang Units 1 and 2 Shidao	2 1	2009.；2010. 2012	2014；2015 2016	2×125 1×21	U.S.・AP1000 HTR-PM
Jiangsu	Tianwan Units 3 and 4	2	2012~2013	2018	2×106	Russia・VVER1000
Zhejiang	Sanmen Units 1 and 2 Fangjiashan Units 1 and 2	2 2	2009 2008～2009	2015 2014	2×125 2×108.7	U.S.・ AP1000 China・CPR1000
Fujian	Fuqing Units 1 to 4 Ningde Units 3 and 4	4 2	2008～2009 2010	2014~2016 2014~2015	2(108.7+108) 2×108.9	China ・CPR1000 China ・CPR1000
Guangdong	Yangjiang Units 1 to 4 Taishan Units 1 to 2	5 2	2009~2012 2009 ~2010	2014~2017 2016~2017	108.7+2(108.7+108) 2×175	China CPR1000 France・EPR
Guangxi	Fangchenggang Units 1 and 2	2	2010.~2011	2015~2016	2×108	China ・CPR1000
Hainan	Changjiang Units 1 and 2	2	2010.	2015	2×65	China ・CNP 600

Background of the promotion of nuclear power generation:

- Addressing the issue of structural dependence on coal-fired thermal power (by adjusting the energy supply/demand structure)
- Worsening of air pollution (such as PM 2.5) and environmental problems
- Expanding demand for power
- Increased economic profit and revenue of local public finances
- Development of a technology-intensive industry → foster economic growth
- Entry into the international nuclear power generation market and share expansion

Enormous CO2 emissions

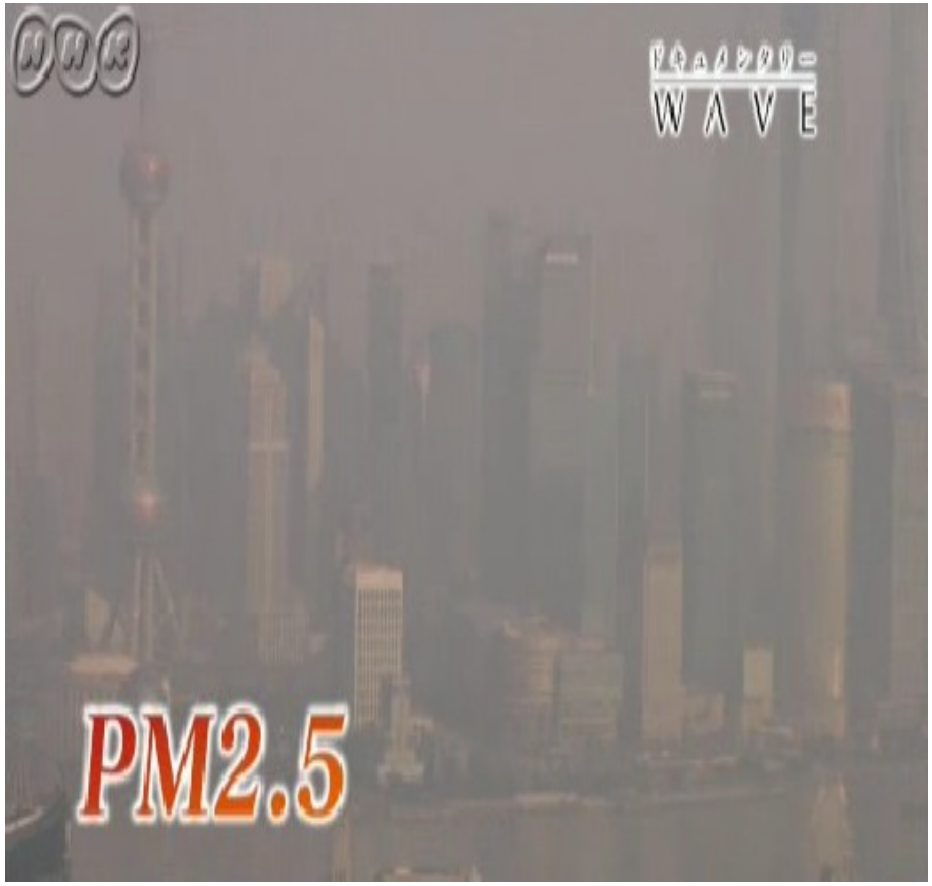




Source: IEA

(Garbagnews.com HP)

Worsening air pollution



(December 6, 2013 in Shanghai)

January 31, 2013 in Beijing (Kyodo News)

Harbin in Northeast China, where PM 2.5 concentration reached 1,000 micrograms

(Reuters, 10.21.2013)

Accelerating overseas expansion

- Nuclear power generation companies (the China National Nuclear Corporation and China Guangdong Nuclear Power Holding), manufacturers of equipment and facilities (Dongfang Electric and Harbin Power Equipment) and state-owned banks are partnering to venture into the overseas nuclear power generation market.
- Diplomacy on nuclear power generation by government leaders and top officials (President Xi's recent aggressive diplomatic efforts on nuclear power generation with the United Kingdom and France)
- Nuclear power generation market in emerging and developing countries → nuclear power generation market in developed countries (to the U.K. market after Pakistan, Romania, etc.)
- The Europrean Pressure Reactor (EPR) project at Hinkley Point entails the China General Nuclear Power Group (CGN) and the China National Nuclear Corporation (CNNC) providing 30% to 40% of total investment to a consortium led by Électricité de France (EDF).
- China is set to use its achievement in the U.K. as a foothold to expand the presence of its nuclear power generation industry in the global market.
- China will use its Hua Long 1 (main brand: China National Nuclear Corporation's ACP 1000 technology) as the pillar of its overseas expansion.
- Strategic areas for nuclear power generation overseas: Europe, Eastern Europe, Asia and South Africa.

3. Issues and challenges

1. Issues in negotiations with residents concerning the future siting and construction of nuclear power plants
2. Risks from earthquakes, etc.: nuclear power plant siting and seismic zones
3. Issues in securing coolant in conjunction with inland siting
4. Shortage of experienced personnel
5. China's difficulty in entering the nuclear power generation business overseas by itself, especially in developed countries (reasons: issues with the supply of main components and facilities, possibility of interference by the governments of the countries involved, lack of experience in overseas business)

Attention will focus on the way in which China will overcome the above issues.

4. Future developments: impact on the global nuclear power generation market

- Contribution to securing energy and protecting the environment, both internally and externally
- Expansion of opportunities for business with developed countries employing nuclear energy
- Intensified competition to secure uranium resources
- China will become a competitor of developed nuclear countries as a new player enjoying a “relative advantage” in the global nuclear power generation market.