August 22, 2014
Industry Report

Analysts: Research Team

China Nuclear Power Industry Outlook

Entering the fast-growth track in 2014-16

- The government's dispatch priority policy allows nuclear power producers enjoy better utilization rate than traditional thermal power
- Hydropower, wind power and solar power cannot displace nuclear power due to their unstable supplies
- Installed capacity of nuclear power will enter fast-growth track in 2014-15, leading to relative high output growth in coming years
- Government pricing policy reduces business uncertainty and avoids price war
- Local supply chain of nuclear power industry is well developed. Players in the industry are exploring the overseas market

High utilization hour – Utilization hour dictates the profitability of expensive power plants. Utilization hour of a nuclear generator was 7,893hrs/yr in 2013, which was1.57 times of thermal power, 2.38 times of hydro power, 3.79 times of wind power. The dispatch priority policy, together with the stable energy supply, allows nuclear power producers to maintain a higher utilization hour than other power sources.

Fast output growth – We estimate the installed capacity of the nuclear industry to grow by 65.5% p.a. from 2013-15 on completion of new plants. At end-June, total nuclear capacity in operation was 18,128 MW and 30,749 MW was under construction. The new capacity will commence operation in coming five years. The new installed capacity will enable the nuclear power output to grow faster than the national power output.

Favorable government policies - The slowdown in economy and the transformation of economic structure have dragged down the growth in power demand. Idle risk of new nuclear power capacity is lowered by dispatch priority and tariff risk is reduced by nuclear power tariff policy.

Nuclear power density to rise – Nuclear power in China accounted for 2.1% of total national power output in 2013, far below developed countries such as US (19.4%), UK (18.3%), France (26.7%), or neighboring countries such as Russia (17.5%), South Korea (27.6%), and India (3.5%). We expect China to diversify the energy sources by reducing reliance of thermal power and increasing the proportion of clean energy use.

Capitalize on the strength of local supply chain to explore overseas nuclear power market – Local nuclear plant owners team up with EDF to bid for nuclear project in UK. A HK-listed equipment supplier unveils local players are exploring nuclear business opportunities in Turkey and Romania.

Financial highlights of major China nuclear power owners/contractor in FY2013

(RMB bn)	China General Nuclear Power Corporation (CGNPC)	China National Nuclear Corporation (CNNC)	China Power Investment Corporation (CPIC)6	China Nuclear Engineering Group Co. (CNEG)
Major businesses	Nuclear power, wind power production	Nuclear power production	Diversified power production	Nuclear power plant construction contractor
Total assets	315.62	334.64	681.05	45.29
Total equity	86.17	89.51	95.92	7.05
Net profit to group	6.70	6.95	7.49	0.72
Net profit to owners	5.62	4.11	2.86	0.44
Chg (%YoY)	60.9	9.6	349.0	14.7
ROAA (%)	2.29	2.22	1.26	1.79
ROAE (%)	**10.95**	**6.84**	**7.36**	**10.19**
Equity/Assets (%)	27.30	26.75	14.08	15.57

Source(s): Annual reports of CGNPC, CNNC, CPIC, CNEG, ABCI Securities

Global nuclear sector key data

Nuclear power reactors in operation	436
Total net installed capacity (MW)	373,504
Nuclear power reactors under construction	71

Source(s): IAEA PRIS, 8/2014

Types of operating reactors

Types	No.	(MW)
Pressurized Light-Water-Moderated and Cooled Reactor (PWR)	274	254,110
Boiling Light-Water-Cooled & Moderated Reactor (BWR)	81	75,958
Pressurized Heavy-Water-Moderated and Cooled Reactor (PHWR)	49	24,592
Light-Water-Cooled, Graphite-Moderated Reactor (LWGR)	15	10,219
Gas-Cooled, Graphite-Moderated Reactor (GCR)	15	8,045
Fast Breeder Reactor (FBR)	2	580

Source(s): IAEA PRIS, 8/2014

Geographical location of operating reactors

Area	No.	(MW)
N America	119	112,581
W Europe	117	113,505
FE Asia	98	85,197
C&E Europe	68	48,607
ME & S Asia	25	6,913
Latin Am	7	4,841
Africa	2	1,860

Source(s): IAEA PRIS, 8/2014

China nuclear sector key data

Nuclear power reactors in operation*	20
Total net installed capacity (MW)*	17,056
Nuclear power reactors under construction*	28
Nuclear power/national electricity output in 2013 (%)	2.1

Note*: Data not including 6 reactors in Taiwan, China
Source(s): IAEA PRIS, 8/2014

Demand for electricity increases on economic growth

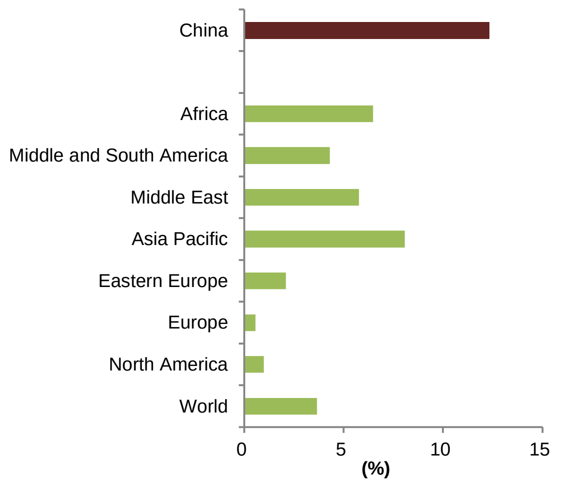
According to China Electricity Council (中国电力企业联合会), power consumption in China increased at a CAGR of 10.90% from 1,891 TWh in 2003 to 5,322 TWh in 2013. Growth of power consumption in China is outpacing the global average, thanks to the rapidly-expanding economy. According to U.S. Energy Information Administration (EIA), China's electricity consumption increased at 12.34% CAGR over 2001-11, higher than that in North America at 0.99%, Europe at 0.57%, Asia Pacific at 8.08%, and Africa at 6.47%.

Exhibit 1: Power consumption of China, 2003-1H14

Source(s): China Electricity Council, ABCI Securities

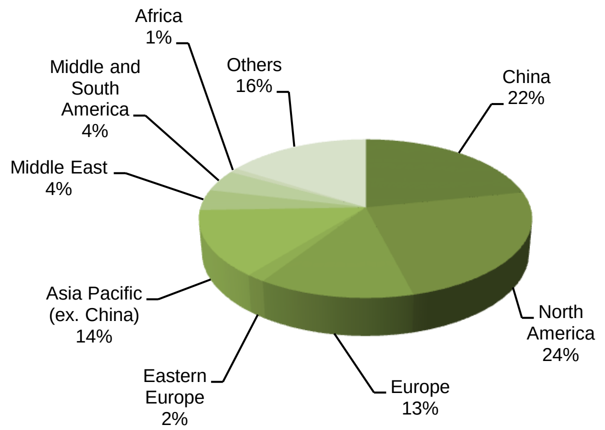
Electricity consumption in China accounted for 21.8% of the global total in 2011, up from 9.76% in 2001. Power industry in China is playing an increasingly important role in the world.

Exhibit 2: CAGR of electricity consumption over 2001-11



Source(s): EIA, ABCI Securities

Exhibit 3: Breakdown of electricity consumption, 2011



Source(s): EIA, ABCI Securities

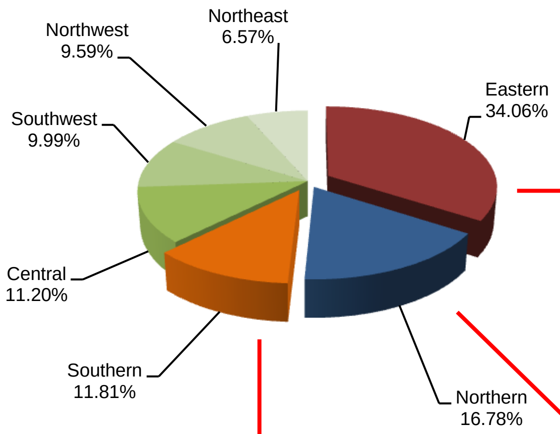
Power consumption in eastern, northern and southern China are higher than other parts of China, accounting for 34.1%, 16.8% and 11.8% of the country's total in 2013.

The eastern and southern areas are prone to power shortages in late spring/early summer as temperature and air-conditioning demand rise, while reservoir levels and hydro output fall before the arrival of summer rains in July and August.

To cope with the power shortfall, Guangdong and other southern provinces import substantial quantities of expensive fuel oil and diesel for the deployment of additional capacity.

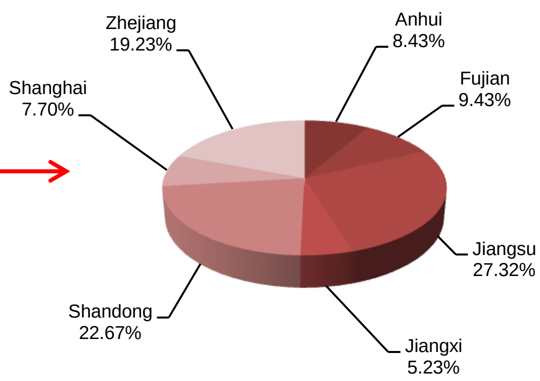
There is a need for the eastern and southern China to expand their capacities for power generation or develop alternative energy alternative energy sources with higher reliability, such as nuclear power.

Exhibit 4: Breakdown of power consumption in China by region, 2013



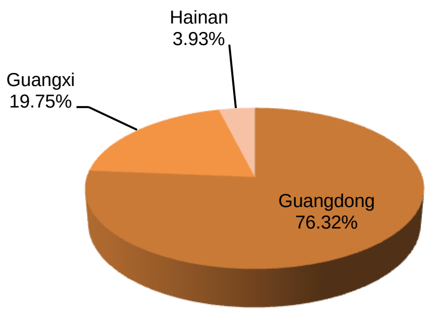
Source(s): NBSC, ABCI Securities

Exhibit 5: Breakdown of power consumption in eastern China by district, 2013



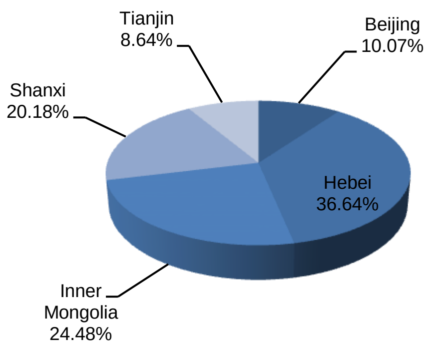
Source(s): NBSC, ABCI Securities

Exhibit 6: Breakdown of power consumption in southern China by district, 2013



Source(s): NBSC, ABCI Securities

Exhibit 7: Breakdown of power consumption in northern China by district, 2013



Source(s): NBSC, ABCI Securities

Exhibit 8: Breakdown of power consumption in the major area of China, 2008-1H14

Power generation (TWh)	2008	2009	2010	2011	2012	2013	1H13	1H14
Central China	**393**	**422**	**485**	**537**	**557**	**592**	**278**	**291**
Henan	196	208	235	266	274	290	137	144
Hubei	106	113	132	143	149	161	75	79
Hunan	91	101	118	129	134	141	66	68
Eastern China	**1,176**	**1,253**	**1,431**	**1,587**	**1,667**	**1,799**	**835**	**880**
Anhui	85	95	107	121	135	152	69	76
Fujian	108	113	131	151	158	170	79	85
Jiangsu	311	329	383	425	454	492	227	241
Jiangxi	54	61	70	83	86	94	43	47
Shandong	272	293	329	363	379	408	195	203
Shanghai	114	114	128	132	133	139	64	65
Zhejiang	232	247	283	312	322	346	157	163
Northern China	**581**	**616**	**708**	**794**	**837**	**886**	**433**	**448**
Beijing	69	74	80	80	85	89	45	45
Hebei	209	235	269	298	307	325	158	161
Inner Mongolia	121	128	151	185	201	217	104	114
Shanxi	131	125	143	161	172	179	89	90
Tianjin	51	55	64	69	71	77	37	37
Northeast China	**257**	**268**	**302**	**326**	**333**	**347**	**172**	**176**
Heilongjiang	67	68	73	77	80	82	42	43
Jilin	50	51	57	62	63	65	32	33
Liaoning	141	149	171	186	190	201	98	100
Northwest China	**262**	**278**	**330**	**396**	**441**	**507**	**238**	**259**
Gansu	68	70	80	91	98	106	52	52
Ningxia	44	46	54	72	74	80	39	41
Qinghai	31	34	46	56	60	67	33	36
Shaanxi	71	74	85	96	104	113	55	59
Xinjiang	48	55	64	81	105	140	60	72
Southern China	**439**	**456**	**517**	**565**	**593**	**624**	**292**	**312**
Guangdong	352	360	405	439	461	482	222	238
Guangxi	75	83	96	108	112	120	58	62
Hainan	12	13	16	18	21	23	11	12
Southwest China	**318**	**348**	**399**	**456**	**485**	**528**	**248**	**263**
Chongqing	48	52	61	70	71	79	37	41
Guizhou	69	77	85	96	107	114	53	57
Sichuan	121	131	153	172	180	192	93	96
Yunnan	80	89	99	117	128	142	65	69

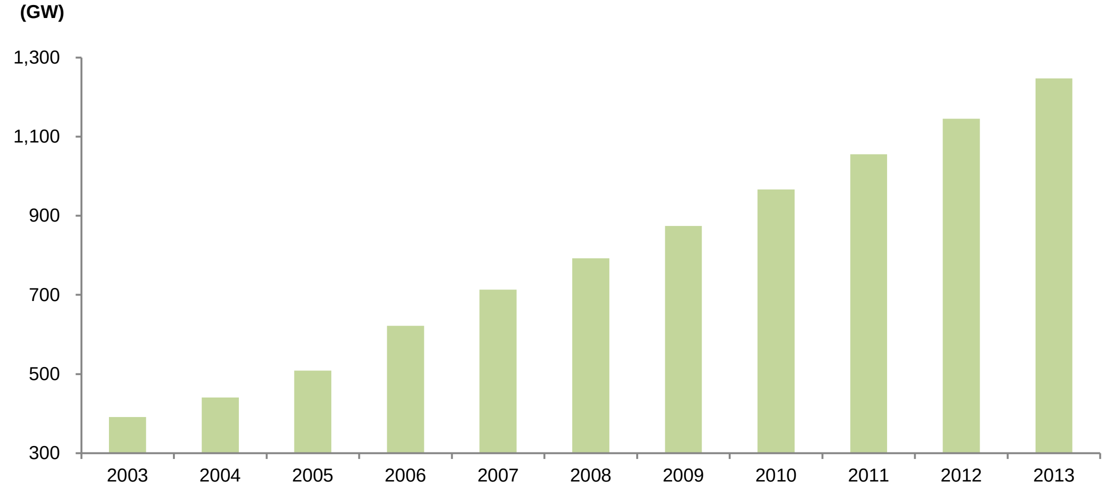
Source(s): NBSC, ABCI Securities

China's nuclear reactors in operation are located in Guangdong, Fujian, Liaoning, Jiangsu and Zhejiang provinces. Some new nuclear reactors under construction are located in Guangdong, Fujian, Hainan, Liaoning, Guangxi Jiangsu, Zhejiang and Shandong provinces. The total power generation from the 8 provinces (Guangdong, Guangxi, Hainan, Fujian, Jiangsu, Zhejiang, Shandong and Liaoning) accounted for ~42% of the total power generation in China in 2013.

Expansion of installed capacity for power generation

According to China Electricity Council (中国电力企业联合会), total installed capacity for power generation by power generation facilities with an annual production capacity over 6,000 kW increased at a CAGR of 12.29% from 391 GW in 2003 to 1,247 GW in 2013.

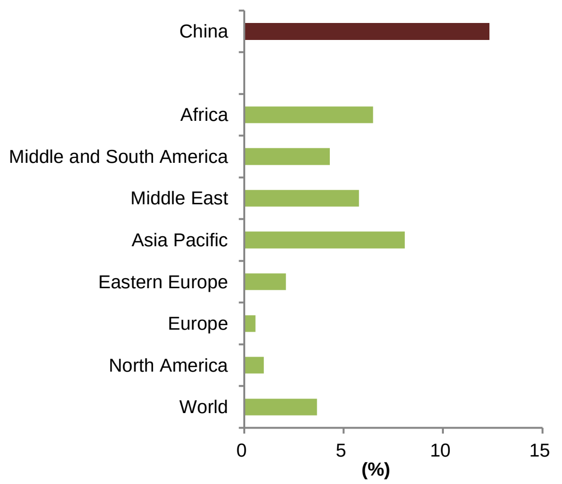
Exhibit 9: Total installed capacity for power generation by power generators with a capacity higher than 6,000 kW in China, 2003-13



Source(s): China Electricity Council, ABCI Securities

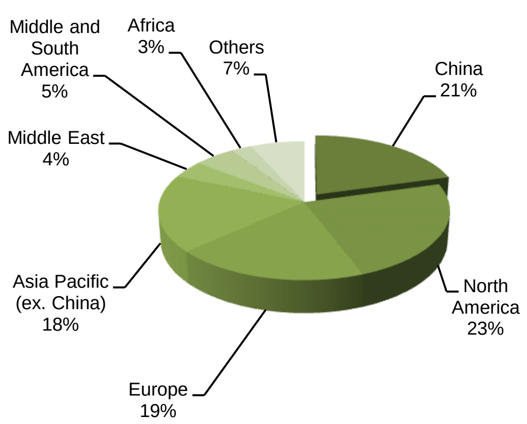
According to U.S. Energy Information Administration (EIA), China's electricity installed capacity increased at a 12.32% CAGR over 2001-11, higher than that of North America at 2.25%, Europe at 2.65%, Asia Pacific (ex. China) at 3.57% and Africa at 2.71%. The installed capacity of China accounted for 21% of the global total in 2011.

Exhibit 10: CAGR of electricity installed capacity over 2001-11



Source(s): EIA, ABCI Securities

Exhibit 11: Breakdown of global electricity installed capacity, 2011



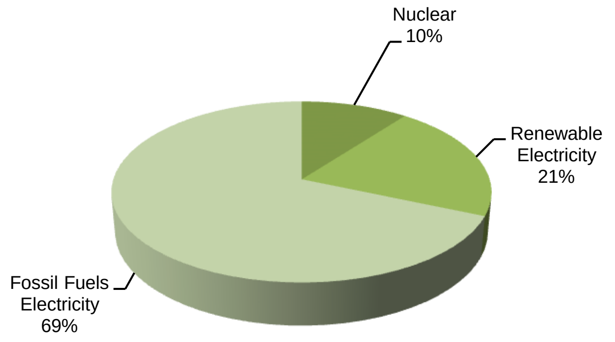
Source(s): EIA, ABCI Securities

Replacing traditional fossil fuels with renewable energy

Increased environmental concern has prompted developing countries to develop alternative energy sources to replace the conventional ones. Renewable energy technologies are cleaner energy sources that have a much lower environmental impact than conventional energy technologies.

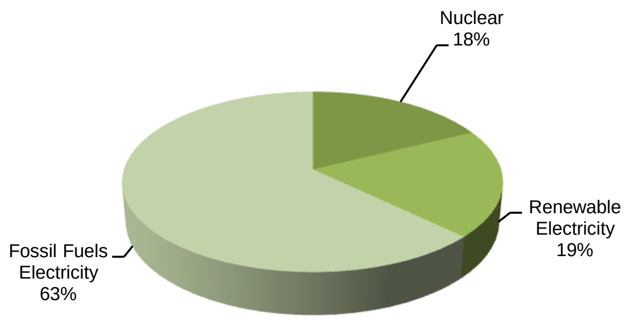
According to EIA and BP World Energy Statistics, electricity generated by fossil fuels accounted for 68.59% of the global total in 2012. The figures in North America and Europe (in 2011) were 62.90% and 48.99%. In China, fossil fuels are responsible for 80.32% in 2011 of the electricity generated, which was higher than other developing regions. This ratio stayed high in 2013 at ~80%, according to NBSC. To lower carbon emissions resulted from fossil- fuel burning, China is in urgent need to develop alternative energy sources.

Exhibit 12: Breakdown of global power generation breakdown by technology, 2012



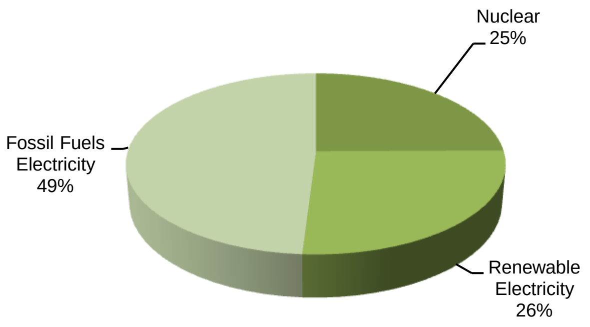
Source(s): EIA, BP World Energy Statistics, ABCI Securities

Exhibit 13: Breakdown of power generation by technology in North America, 2011



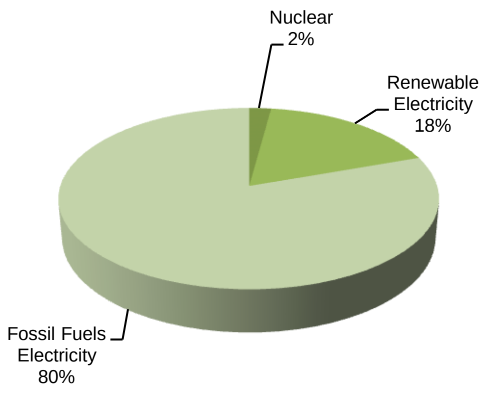
Source(s): EIA, ABCI Securities

Exhibit 14: Breakdown of power generation by technology in Europe, 2011



Source(s): EIA, ABCI Securities

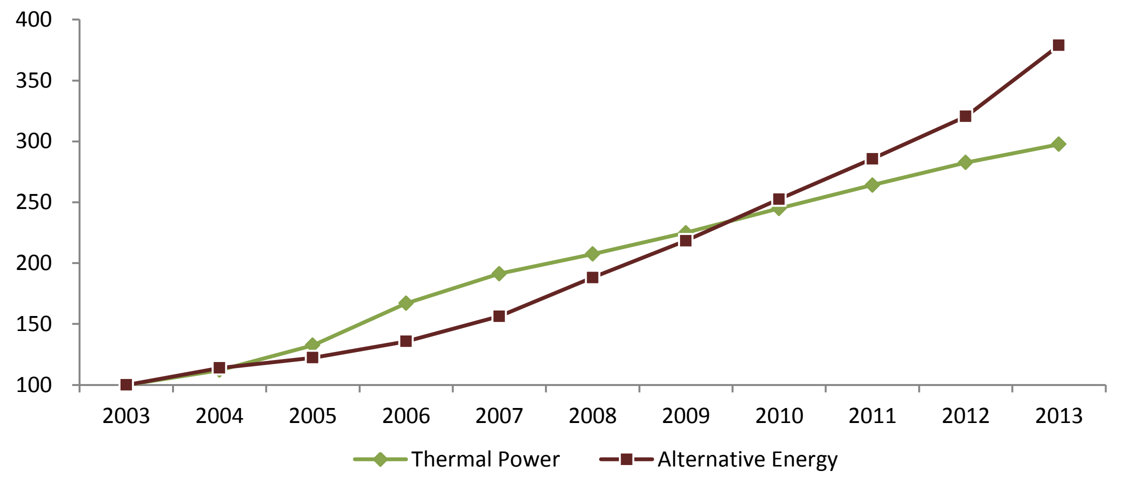
Exhibit 15: Breakdown of power generation by technology in China, 2013



Source(s): NBSC, ABCI Securities

According to China Electricity Council (中国电力企业联合会), the total installed capacity of thermal power grew at a CAGR of 11.52% over 2003-13, lower than that of alternative energy at 14.25% over the same period. The installed capacity of thermal power in 2013 was 2.98 times the capacity in 2003, while the installed capacity of alternative energy was 3.79 times the capacity in 2003.

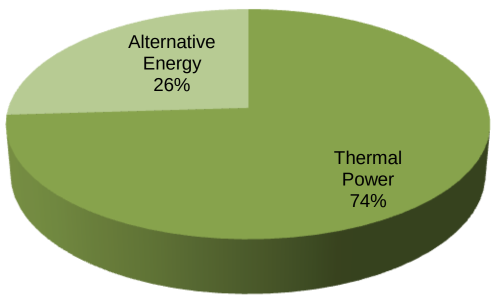
Exhibit 16: Comparison of installed capacity growth rates of thermal power and alternative energy in China, 2003-13



*: Assume the installed capacity at end-2013 was 100 for both thermal and alternative energy
Source(s): China Electricity Council, ABCI Securities

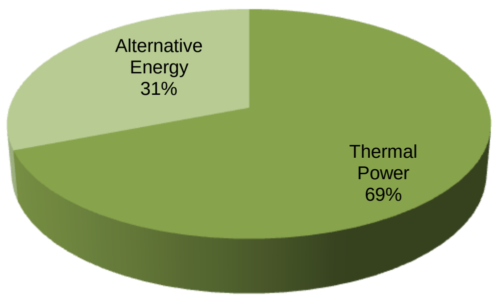
In terms of electricity capacity, the proportion of alternative energy increased from 26% in 2003 to 31% in 2013 in China under the active development of green energy in the country.

Exhibit 17: Proportion of capacity from alternative energy and thermal power sources in China in 2003



Source(s): China Electricity Council, ABCI Securities

Exhibit 18: Proportion of capacity from alternative energy and thermal power sources in China in 2013



Source(s): China Electricity Council, ABCI Securities

Surging demand for nuclear power

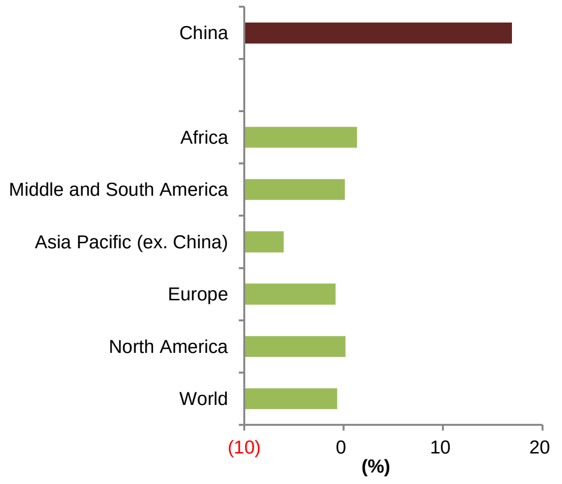
Because of the higher reliability of nuclear power compared to other alternative energy sources, the growth of nuclear power has been accelerating since 2011. The electricity generated by nuclear power grew at a CAGR of 14.41% over 2010-13, faster than that of thermal and hydro powers at 8.23% and 6.02%.

Exhibit 19: Nuclear power generation in China, 2003-13

Source(s): NBSC, ABCI Securities

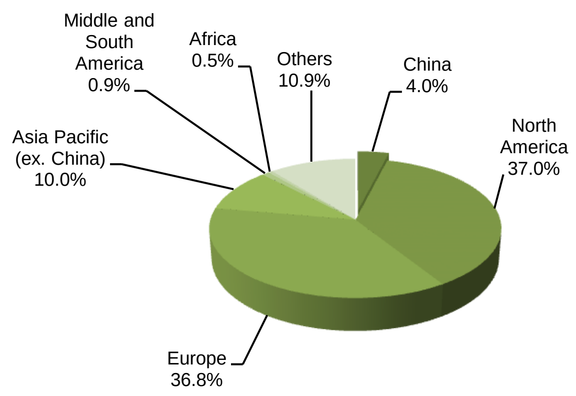
Growth in nuclear power generation in China outpaces that of the global average. According to EIA, electricity generated by nuclear power declined at a CAGR of 0.64% over 2001-12 globally, while nuclear power electricity in China increased at a CAGR of 16.92% over the same period.

Exhibit 20: CAGR of electricity generated by nuclear power in 2001-12



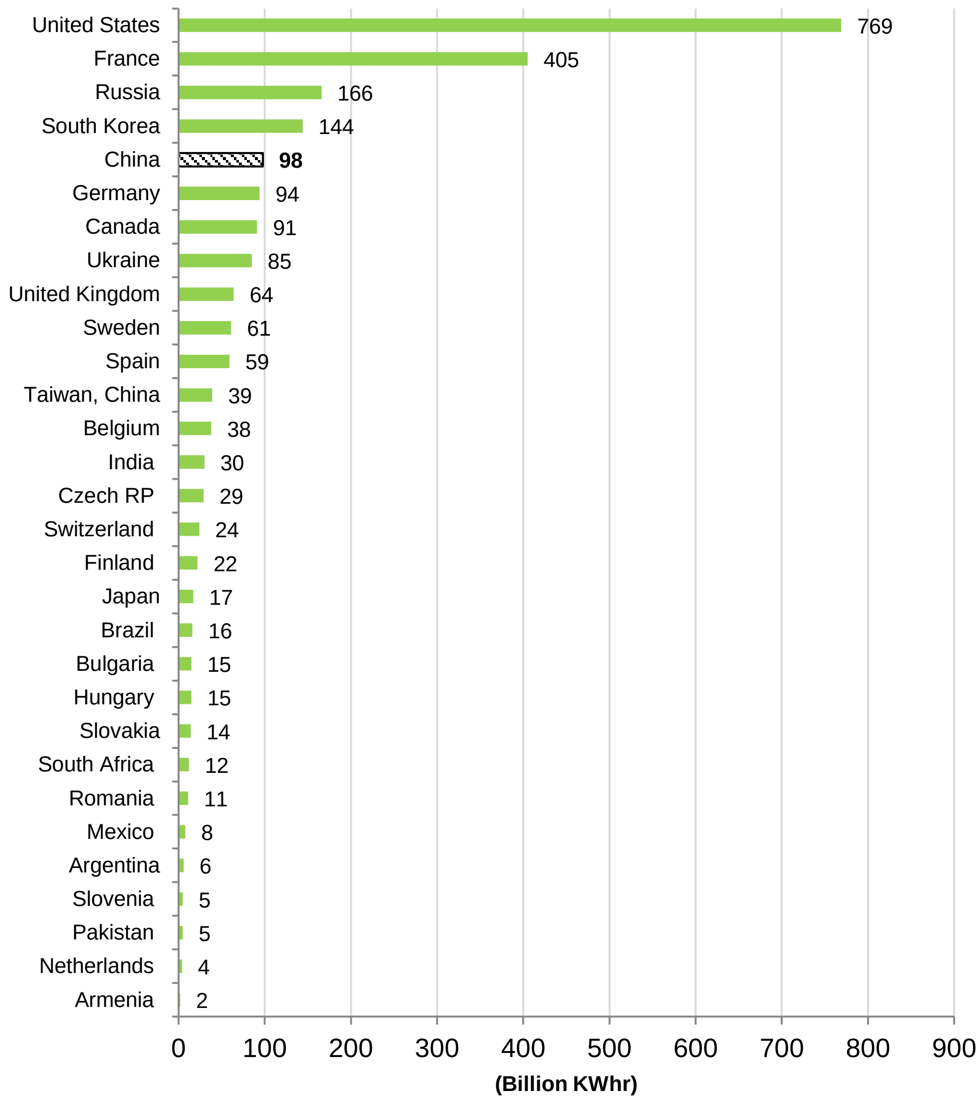
Source(s): EIA, ABCI Securities

Exhibit 21: Electricity generated by nuclear power by region, 2012



Source(s): EIA, ABCI Securities

Exhibit 22: Nuclear power output in different countries, 2012

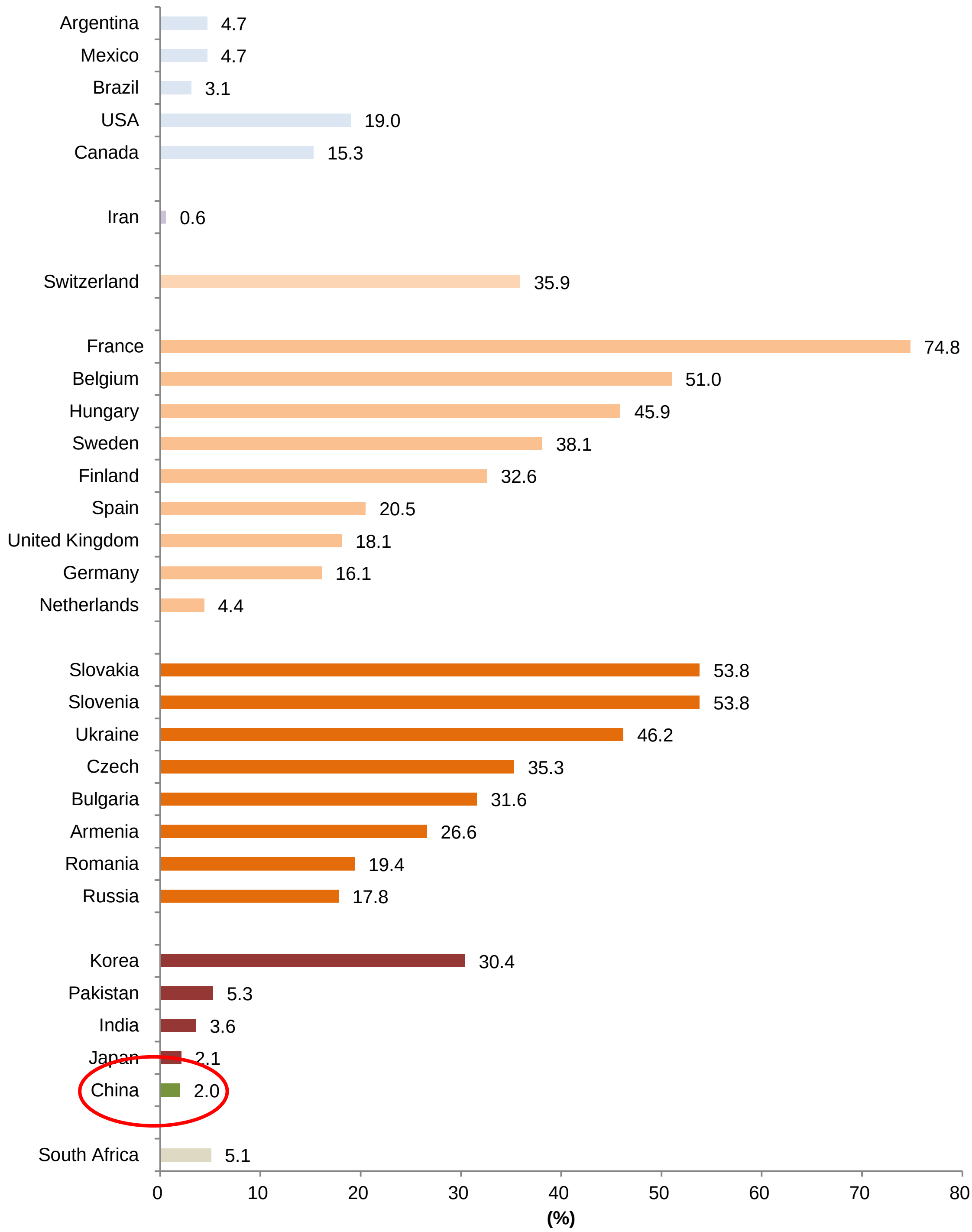


Source(s): EIA, ABCI Securities

In terms of electricity output, the U.S. was ranked top in nuclear power in 2012. Although China was ranked 5th according to EIA, share of nuclear power in China is far lower than other countries.

According to World Nuclear Association (WNA, 世界核协会), there were 14 countries where nuclear power accounted for 20% or higher of total electricity generation in 2012. Thirteen out of the 14 countries were in Europe. The contribution ratio of nuclear power in China was ~2% in 2012, according to WNA, thus we believe room for China to develop nuclear power is still ample.

Exhibit 23: Contribution of nuclear power to total electricity generation of the countries in 2012



Source(s): World Nuclear Association, ABCI Securities

Working principle of nuclear power

Nuclear power uses exothermic nuclear processes to generate useful heat and electricity. Nuclear power station with pressurized water reactor is basically divided into the "**nuclear island**" where steam is produced in the steam generator by nuclear power generated from a reactor. A "**conventional island**" where steam supplied from the nuclear island is used to drive the turbine-generator to produce electricity.

In the "nuclear island", heat is produced by nuclear fission in the reactor and delivered by pressurized water (or carbon dioxide, liquid sodium, etc.) in the primary coolant circuit to the steam generator, which converts the feed water in the secondary circuit to high-pressure steam and delivers it to the "conventional island" via steam pipe for driving the turbine and generator.

In the "conventional island", the steam passes through the multi-stage turbines and is discharged into the condensers where the steam is condensed to liquid water (condensate). This condensate discharge from the condensers (feed water) is pumped back to the steam generator in the nuclear island to be converted into steam again. Cooling water for the condensers is taken from the sea via the seawater pumps in the pump house. During the process, the steam spins the turbine generator at high speed, which then generates electricity to complete the energy conversion process.

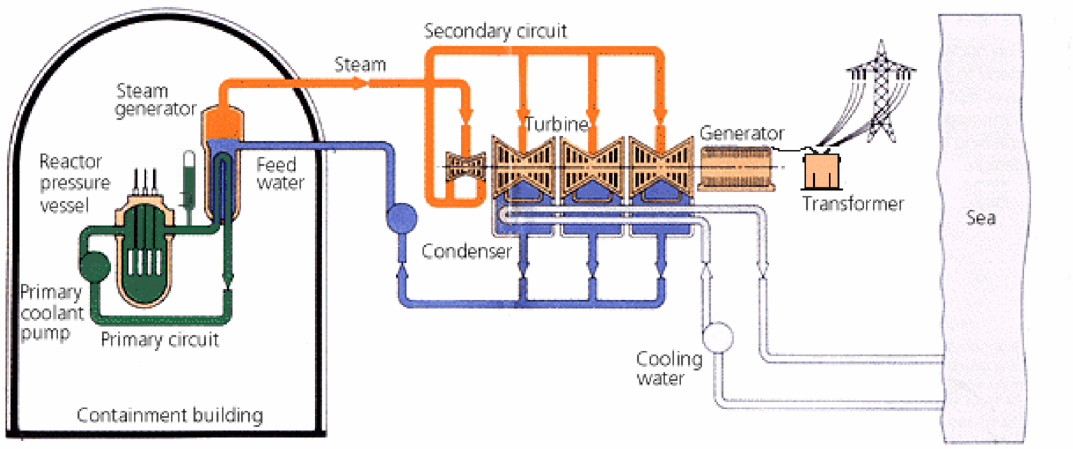
There are mainly 7 methods of nuclear power generation as distinguished by the coolant agent and the neutron moderator. Pressurized water reactor is the most common method adopted in China as well as the world.

Exhibit 24: Comparison of different nuclear power generation methods

	Coolant	Neutron moderator
Pressurized water reactor (PWR)	Water	Water
Boiling water reactor (BWR)	Water	Water
Pressurized heavy water reactor (PHWR)	Heavy water	Heavy water
Gas cooled reactor (GCR)	Carbon dioxide	Graphite
High temperature gas-cooled reactor (HTGR)	Helium	Graphite
Light-water cooled graphite moderated reactor (LWGR)	Water	Graphite
Fast breeder reactor (FBR)	Liquid Sodium	N/A

Source(s): ABCI Securities

Exhibit 25: Nuclear power station using pressurised water reactor



Source(s): Hong Kong Observatory

China Nuclear Power Industry

Our analysis indicates that China's nuclear power industry has the following competitive advantages against other types of power. The nuclear power industry, however, faces various challenges arising on the macro, micro, regulatory, and technological fronts. As China is aiming to diversify energy sources from traditional fossil fuels, such as coal and gas, to clean energy sources such as hydro, nuclear, wind and solar powers, we believe the Chinese government will help tackle these challenges.

Competitive advantages of nuclear power in China's power Industry

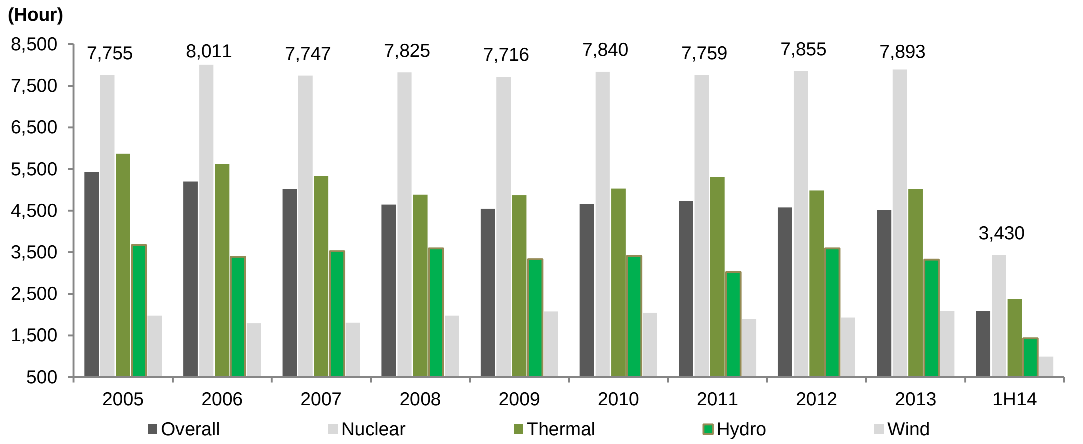
1. Dispatch priority leads to higher plant utilization hour and better asset utilization rate
2. High installed capacity growth to drive momentum in the future
3. Growth in nuclear power output is higher than that of national electricity output
4. Trend of fuel cost is favorable to nuclear power generators
5. New nuclear power plants with better fuel cost efficiency and safety standard
6. Nuclear plants are strategically located in fast-growing economic areas heavily reliant on fossil fuel energy
7. Nuclear power offers a huge and more stable supply of energy source than hydro, wind and solar power plants
8. Favorable tax policies to nuclear power producers
9. Capitalize on strength of the China's nuclear power supply chain to develop overseas markets

Industry challenges

- Favorable government policies are subject to change
- Slowdown in economic growth
- Change of economic structure leads to slower growth in power demand
- Reliance on uranium import
- Reliance on uranium fuel-processing technologies
- Spent fuel treatment technical knowhow and related costs
- Decommissioning costs

Dispatch priority leads to higher nuclear plant utilization hour and better asset utilization

Exhibit 26: Average utilization hours of power plant by types (Capacity≥6,000 KW), 2005-1H14



Source(s): NEA

Dispatch priority policy favors nuclear power

Nuclear power plants in general have a higher utilization hour than thermal power, hydropower, and wind power. Utilization hour of hydropower and wind power is more sensitive to the natural environment than that of nuclear and thermal powers. We believe nuclear power plants in general have a higher utilization hour because of the government's policy to provide dispatch priority of such power over the thermal one. The dispatch priority policy aims to encourage the use of clean energy sources that produce little or no carbon dioxide.

High annual utilization hour leads to better asset return rate

According to NEA, utilization hour of a nuclear power plant was 7,893hrs on average in 2013, which were 1.57 times of thermal power, 2.38 times of hydropower, or 3.79 times of wind power. From 2005-13, we estimate that average annual utilization hour of a nuclear power plant was 7,822hrs, which was 1.50 times of thermal power, 2.28 times of hydropower, or 4.01 times of wind power. The average utilization hour of a nuclear plant represented 90.11% of the annual total hours in 2013. The average utilization hour of a thermal power plant, a hydropower plant, and a wind power plant represented 57.2%, 37.9% and 23.8% of total annual hours in 2013, respectively. In another words, the 3 latter types of power generation plants are idle most of the time during the year. High utilization hour of the nuclear power plants implies better asset utilization and return rates for the nuclear power plant operator.

Stable annual utilization hour lowers business uncertainty

Moreover, annual utilization hour of a nuclear power plant is much less volatile than the thermal, hydro, and wind power ones. From 2005-13, standard deviation of the average annual utilization hour of a nuclear power was 92 hours or 1.2% of mean. A stable utilization hour can reduce business uncertainties for nuclear power operators in projecting their business development.

Exhibit 27：Average utilization hour of nationwide power plant equipment (Capacity≥6,000KW) in 2005-2013

	Overall	Nuclear	Thermal	Hydro	Wind
Avg. annual hours (2005-13)	4,811	**7,822**	5,211	3,425	1,952
Standard deviation. (hrs/yr)	324	**92**	347	196	109
St. dev./avg.	6.70%	**1.20%**	6.70%	5.70%	5.60%
Avg. annual hours/1 yr hours	54.90%	**89.30%**	59.50%	39.10%	22.30%

Source(s): NEA, ABCI Securities

High installed capacity growth of nuclear power industry to drive momentum

Strong nuclear power capacity expansion underway to sustain high output growth in 2014-15

According to China's 12th five-year power development plan, the government aims to increase installed capacity of nuclear power industry from 10.82mn kW in 2010 to 40.00mn kW in 2015, representing a CAGR of 29.9%.

By 2015, the government aims to have 18mn kW of nuclear power capacity under construction. Hence, nuclear power capacity under construction in 2015 will represent 45% of the expected installed capacity of the same year, thus providing further support to capacity growth beyond 2015.

By 2020, the government aims to have 58mn kW of installed capacity in operation and 30mn kW under construction.

At end-2013, total installed capacity of nuclear power was 14.61mn kW. To achieve the government's goal by 2015, the installed capacity of nuclear power has to grow at a CAGR of 65.5% from 2013-15. The relative high growth of installed capacity in 2014-15 will propel output expansion in nuclear power industry.

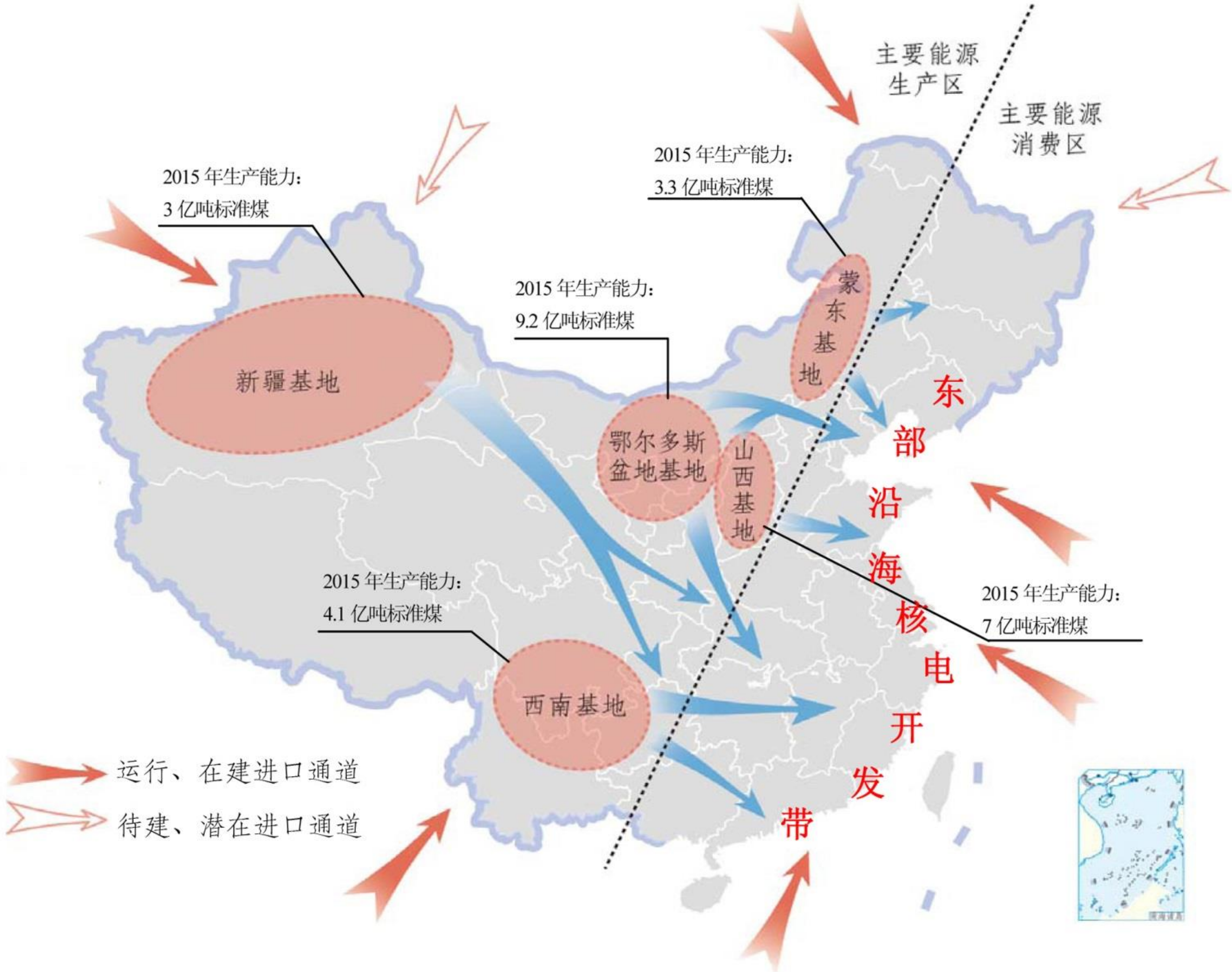
By end-June 2014, the total nuclear capacity in operation was 18,128 MW while 30,749 MW of capacity was under construction. Total installed capacity will reach 48,877 MW (or 48.877mn kW) as construction for all plants is completed. As the construction cycle of a nuclear reactor lasts for 5-6 years on average, most of the plants currently under construction are expected to be completed in the next 3-4 years. To achieve the target of a 58mn kW installed capacity at 2020, the government has to grant approval to construct additional new plants with a total capacity of 9.2mn kW (or approx. 8-9 new reactors) in 2014-15.

Exhibit 28：China's 12th five-Year power development plan

At year-end	2010A (mn kW)	2013A (mn kW)	2015 Target (mn kW)	2010-15 CAGR (%)	2013-15 CAGR (%)
Total Installed Capacity	**970**	**1,247.38**	**1,490**	**9.0%**	**9.3%**
Of which:					
Coal-fired Power	660	862.38	960	7.8%	8.5%
Gas-fired Power	26.4		56	16.2%	
Hydropower	220	280.02	290	5.7%	1.8%
Wind Power	31	75.48	100	26.4%	15.1%
Nuclear Power	**10.8**	**14.61**	**40**	**29.9%**	**65.5%**
Solar Power	0.9	n/a	21	89.5%	n/a
(1,000 bn kWhr)	**2010A**	**2013A**	**2015E**		
National electricity consumption	4.2	5.32	6.15	7.9%	7.5%

Source(s): NDRC

Exhibit 29: Overview of China's power generation



Source(s): National Energy Administration

Growth in nuclear power output is higher than national electricity output

Nuclear power output growth outpaces the power industry average

In 2009-13, nuclear power output grew at a CAGR of 12.1%. Meanwhile, the nationwide electricity output grew by a CAGR of 9.0%. In 1H14, nuclear power output grew by 16.4%YoY, higher than that of national electricity output at 5.8% YoY. We believe the faster output growth in nuclear is driven by 3 major factors:

1. The relatively fast installed capacity growth in the nuclear power industry
2. Dispatch priority of nuclear power over thermal power
3. Unstable supply of hydropower and wind power due to natural environment factors

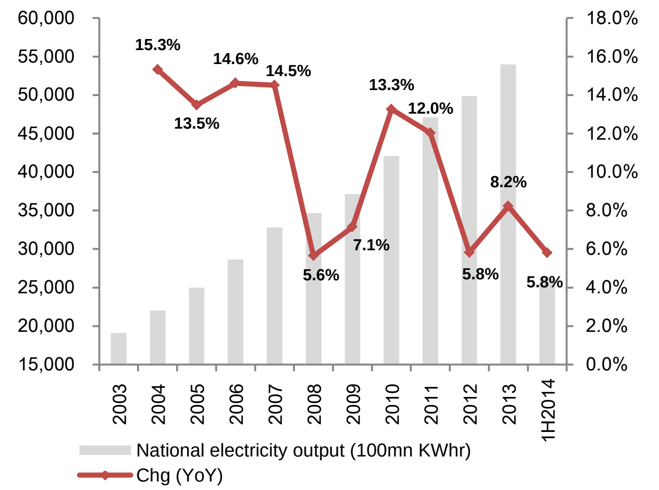
We believe these factors will continue to enable nuclear power output to grow at a rate above the power industry average in the next few years.

Exhibit 30: Nuclear power output

Year (Billion KWhr)	2009	2010	2011	2012	2013	2009-13 CAGR	1H14
Nationwide Nuclear Power Output	70.13	74.74	87.20	98.32	110.71		56.08
Chg (YoY)	-	**6.6%**	**16.7%**	**12.7%**	**12.6%**	**12.1%**	**16.4%**
Nuclear Power On-Grid	66.10	70.43	82.20	92.61	104.09		52.73
Chg (YoY)	-	**6.5%**	**16.7%**	**12.7%**	**12.4%**	**12.0%**	**16.1%**
Nationwide electricity output growth	**7.0%**	**13.3%**	**12.0%**	**4.7%**	**7.6%**	**9.0%**	**5.8%**

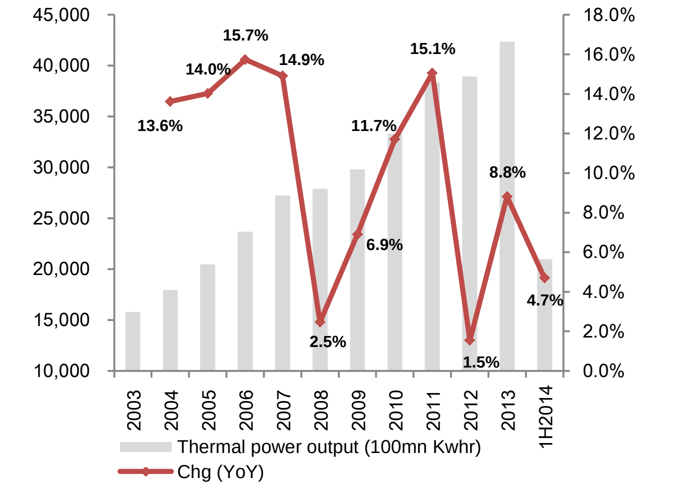
Source(s): NBSC, China Nuclear Energy Association

Exhibit 31: National electricity output



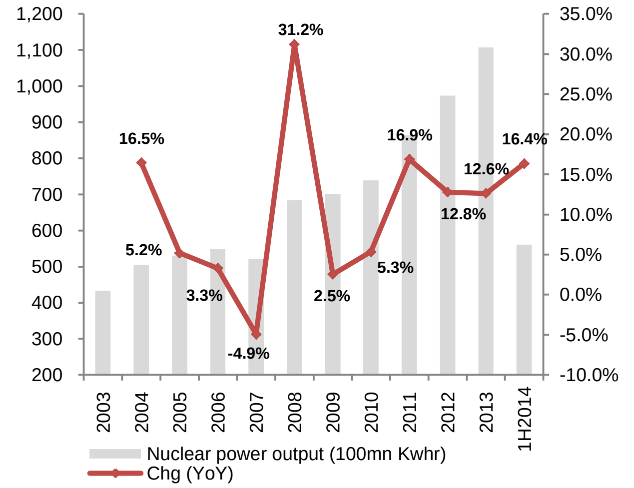
Source(s): NBSC, ABCI Securities

Exhibit 32: Thermal power output



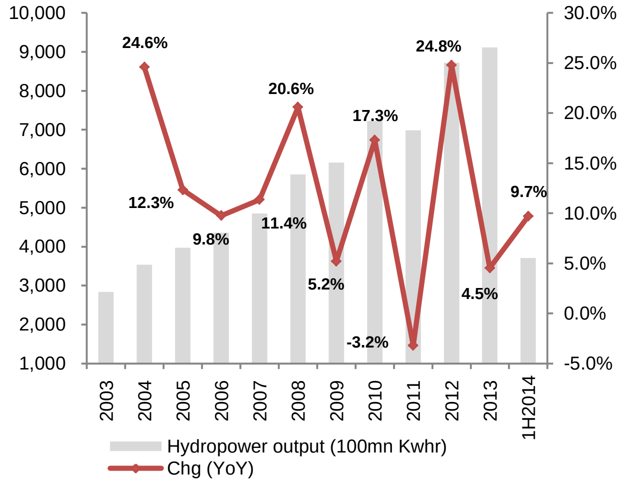
Source(s): NBSC, ABCI Securities

Exhibit 33: Nuclear power output



Source(s): NBSC, ABCI Securities

Exhibit 34: Hydropower output

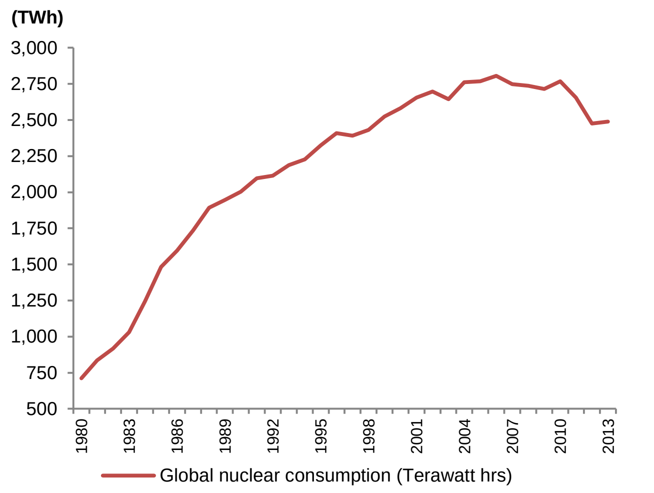


Source(s): NBSC, ABCI Securities

Trend of fuel cost is favorable to nuclear power generators

After the Fukushima nuclear crisis in Japan in 2011, Japan has shut down its nuclear plants while Germany has also determined to reduce the country's reliance on nuclear power. China has postponed approval for construction of new nuclear power plants in the inner provinces. According to BP Statistical Review of World Energy June 2014, global nuclear power consumption declined by 4.1% YoY in 2011 and slid down further by 6.8%YoY in 2012, followed by a slight rebound of 0.9% YoY in 2013. The weakening growth in nuclear power consumption has resulted in lower demand for nuclear fuel in the past several years. Global demand for uranium fuel, along with uranium price, has been reducing.

Exhibit 35: Global nuclear power consumption



Source(s): BP Statistical Review of World Energy June 2014

Exhibit 36: Uranium-308 physical spot price (US$/lb)

Source(s): Bloomberg

According to BP, China's nuclear power consumption accounted for 4.4% of global total in 2013. Hence, the increase of nuclear power consumption in China expected for the coming years will stimulate global demand for nuclear fuel. The impact, however, should not be exaggerated as China's nuclear power consumption is accounting for a tiny portion of the global total despite the rapid expansion of the country's nuclear market.

New nuclear power plants with better fuel cost efficiency and safety standard

According to International Energy Outlook 2013 issued by U.S. Energy Information Administration, EIA predicts global nuclear installed capacity to grow by a CAGR of 2.1% from 2010-40. Nuclear power installed capacity will grow at a CAGR of 0.86% from 2010-15 and escalate to a CAGR of 4.27% from 2015-20. Beyond 2020, the growth will slow down.

The global growth of nuclear power installed capacity is expected to be driven by the capacity growth in non-OECD countries such as China. Hence, growth in global demand for nuclear power equipment, nuclear fuel, and power plant construction services will be mainly led by non-OECD countries.

Exhibit 37: CAGR of nuclear power installed capacity

Period from To	2010 2015	2015 2020	2020 2025	2025 2030	2030 2035	2035 2040	2010 2040
OECD	-1.69%	1.89%	1.65%	0.68%	-0.15%	0.38%	0.45%
Non-OECD	10.21%	9.67%	5.26%	4.11%	3.18%	2.21%	5.73%
Global	0.86%	4.27%	2.99%	2.09%	1.35%	1.27%	2.13%

Source(s): International Energy Outlook 2013 issued by U.S. Energy Information Administration

Based on the nuclear plants under construction, we have identified some features favorable to the nuclear power industry:

- Third-generation power plants have larger installed capacity than previous ones, resulting in lower fixed cost per capacity unit.
- Nuclear fuel efficiency is improved. Less nuclear fuel is consumed per unit of generation. Subsequently, spent fuel treatment cost per unit of generation will reduce.
- After the nuclear crisis in Japan in 2011, more safety standards or features are incorporated into the design of new nuclear power plants.
- Design life of new nuclear power plant is lengthened to as long as 60 years from the conventional 40 years.

These factors will strengthen the competitiveness of the nuclear industry against the conventional thermal power industry and enhance the investment returns of new nuclear power plant investors.

Nuclear plants are strategically located at fast-growing economic areas heavily reliance on fossil fuel energy

At end-June 2014, there are 20 nuclear reactors operating in China with a total installed capacity of 18,128 MW. These nuclear reactors are located in Guangdong, Fujian, Liaoning, Jiangsu and Zhejiang provinces. Moreover, there are 28 nuclear reactors under construction with a total capacity of 30,749 MW. These new nuclear reactors under construction are located in Guangdong, Guangxi, Hainan, Fujian, Jiangsu, Zhejiang, Shandong and Liaoning provinces. Approval for construction of new nuclear plants in inner provinces is suspended after Japan's nuclear crisis in 2010. Thus, the existing nuclear plants in operation or new nuclear plants under construction are located in coastal provinces that are more economically significant to the country.

Exhibit 38: Economies of provinces with existing or new nuclear plants

Provinces	2010	2011	2012	2013	1H2014
Guangdong	12.2%	10.0%	8.2%	8.5%	7.5%
Fujian	13.8%	12.2%	11.4%	11.0%	9.7%
Liaoning	14.1%	12.1%	9.5%	8.7%	7.2%
Guangxi	14.2%	12.3%	11.3%	10.2%	8.5%
Jiangsu	12.6%	11.0%	10.1%	9.6%	8.9%
Zhejiang	11.8%	9.0%	8.0%	8.2%	7.2%
Hainan	15.8%	12.0%	9.1%	9.9%	8.0%
Shandong	12.5%	10.9%	9.8%	9.6%	8.8%
National	**10.3%**	**9.2%**	**7.8%**	**7.7%**	**7.4%**

Source(s): NBSC

Exhibit 39: Nuclear reactors in operation up to June 2014

Nuclear plants	Reactors	Reactor Type, Model	Capacity (MW)	Commercial Operation since	Main Owners	Plant Location
Daya Bay Nuclear Power Plant (大亚湾核电站)	No.1	PWR, M310	984	21994	CGNPC	Guangdong
	No.2	PWR, M310	984	5/1994	CGNPC	Guangdong
Ling Ao Nuclear Power Plant (岭澳核电站)	No.1	PWR, M310	990	5/2002	CGNPC	Guangdong
	No.2	PWR, M310	990	1/2003	CGNPC	Guangdong
	No.3	PWR, CPR1000	1,086	9/2010	CGNPC	Guangdong
	No.4	PWR, CPR1000	1,086	8/2011	CGNPC	Guangdong
Yangjiang Nuclear Power Plant (阳江核电站)	No.1	PWR, CPR1000	1,086	3/2014	CGNPC	Guangdong
Hongyanhe nuclear power Plant (红沿河核电站)	No.1	PWR, CPR1000	1,119	6/2013	CGNPC	Liaoning
	No.2	PWR, CPR1000	1,119	6/2014	CGNPC	Liaoning
Ningde nuclear power Plant (宁德核电站)	No.1	PWR, CPR1000	1,089	4/2013	CGNPC	Fujian
	No.2	PWR, CPR1000	1,089	5/2014	CGNPC	Fujian
Qinshan Nuclear Power Plant (秦山一核)	No.1	PWR, CNP300	310	4/1994	CNNC	Zhejiang
Qinshan Nuclear Power Plant 2 (秦山二核)	No.1	PWR, CNP600	650	4/2002	CNNC	Zhejiang
	No.2	PWR, CNP600	650	4/2004	CNNC	Zhejiang
	No.3	PWR, CNP600	660	10/2010	CNNC	Zhejiang
	No.4	PWR, CNP600	660	12/2011	CNNC	Zhejiang
Qinshan Nuclear Power Plant 3 (秦山三核)	No.1	PHWR, CANDU6	728	12/2002	CNNC	Zhejiang
	No.2	PHWR, CANDU6	728	7/2003	CNNC	Zhejiang
Tianwan Nuclear Power Plant (田湾核电站)	No.1	PWR, VVER V428	1,060	5/2007	CNNC	Jiangsu
	No.2	PWR, VVER V428	1,060	8/2007	CNNC	Jiangsu
Total			**18,128**			
Of which, owned by CGNPC			**11,622**			
owned by CNNC			**6,506**			

Source(s): CGNPC, CNNC, China Nuclear Energy Association

Exhibit 40: Nuclear plants under construction up to June 2014 by CNNC

Nuclear plants	Reactors	Reactor Type, Model	Capacity (MW)	Expected Operation	Main Owners	Location
Fang Shan Nuclear Power	No.1	PWR, CPR1000	1,080	2014	CNNC	Zhejiang
(方家山核电)	No.2	PWR, CPR1000	1,080	-	CNNC	Zhejiang
Tianwan Nuclear Power	No.3	PWR, VVER V428	1,126	2018	CNNC	Jiangsu
Plant（田湾核电站）	No.4	PWR, VVER V428	1,126	-	CNNC	Jiangsu
Sanmen Nuclear Power	No.1	PWR, AP1000	1,250	2015	CNNC	Zhejiang
(三门核电)	No.2	PWR, AP1000	1,250	-	CNNC	Zhejiang
Fuqing Nuclear Power	No.1	PWR, CPR1000	1,080	2014	CNNC	Fujian
(福清核电)	No.2	PWR, CPR1000	1,080	-	CNNC	Fujian
	No.3	PWR, CPR1000	1,080	-	CNNC	Fujian
	No.4	PWR, CPR1000	1,080	-	CNNC	Fujian
Hainan Nuclear Power	No.1	PWR, CNP600	650	2015	CNNC	Hainan
(海南昌江核电)	No.2	PWR, CNP600	650	-	CNNC	Hainan
Total			**12,532**			

Source(s): CNNC, IAEA PRIS

Exhibit 41: Nuclear plants under construction up to June 2014 by CGNPC

Nuclear plants	Reactors	Reactor Type, Model	Capacity (MW)	Expected Operation	Main Owners	Location
Yangjiang Nuclear Power	No.2	PWR, CPR1000	1086	2014	CGNPC	Guangdong
(阳江核电站)	No.3	PWR, CPR1000	1086	-	CGNPC	Guangdong
	No.4	PWR, CPR1000	1086	-	CGNPC	Guangdong
	No.5	PWR, ACPR1000	1086	-	CGNPC	Guangdong
	No.6	PWR, ACPR1000	1086	-	CGNPC	Guangdong
Taishan Nuclear Power	No.1	PWR, EPR1750	1,750	2015	CGNPC	Guangdong
(台山核电)	No.2	PWR, EPR1750	1,750	-	CGNPC	Guangdong
Hongyanhe Nuclear Power	No.3	PWR, CPR1000	1119	2014	CGNPC	Liaoning
(红沿河核电站)	No.4	PWR, CPR1000	1119	-	CGNPC	Liaoning
Ningde Nuclear Power	No.3	PWR, CPR1000	1089	2014	CGNPC	Fujian
(宁德核电站)	No.4	PWR, CPR1000	1089	-	CGNPC	Fujian
Guangxi Nuclear Power	No.1	PWR, CPR1000	1080	2016	CGNPC	Guangxi
(防城港核电)	No.2	PWR, CPR1000	1080	-	CGNPC	Guangxi
Total			**15,506**			

Source(s): CGNPC, IAEA PRIS

Exhibit 42: Nuclear plants under construction up to June 2014 by other companies

Nuclear plants	Reactors	Reactor Type, Model	Capacity (MW)	Expected Operation	Main Owners	Location
Haiyang Nuclear Power	No.1	PWR, AP1000	1250	2015	CPIC	Shandong
(山东海阳核电站)	No.2	PWR, AP1000	1250	-	CPIC	Shandong
Shidao Bay Nuclear Power (石岛湾核电)	No.1	HTGR, HTR PM	211	2018	CHG	Shandong
Total			**2,711**			

Source(s): China Power Investment Corporation (CPIC), China Huaneng Group (CHG), IAEA PRIS

Nuclear power offers a huge and more stable supply of energy source than hydro, wind and solar powers

The supplies of renewable energy sources such as hydropower, wind power and solar power are subject to various unpredictable and fluctuating natural factors throughout the year. Although hydro, wind and solar powers were granted dispatch priority over the nuclear one, the annual utilization hour of the first three power sources are not high. The unstable supplies of these renewable energy sources will raise the economic risk of highly industrialized regions with huge electricity demand.

Exhibit 43: Utilization hour of power generation equipment (Capacity>6000KW) in 2013

Provinces (hrs)	Overall	Nuclear	Thermal	Hydro	Wind
Guangdong	4,650	**7,543**	4,577	2,645	2,514
Fujian	4,500	**8,471**	4,852	3,263	2,745
Liaoning	4,006	**8,438**	4,353	2,901	1,924
Guangxi	3,823	**Note ***	4,729	2,836	2,000
Jiangsu	5,545	**8,344**	5,690	998	1,902
Zhejiang	4,996	**7,869**	5,296	1,803	2,284
Hainan	4,676	**Note ***	5,184	2,893	1,969
Shandong	4,815	**Note ***	5,064	355	2,008
Nationwide	**4,511**	**7,893**	**5,012**	**3,318**	**2,080**

Note*: New nuclear plants under construction in Guangxi , Hainan & Shandong
Source(s): NEA

Exhibit 44: Utilization hour of power generation equipment (Capacity>6000KW) in 1H14

Provinces (hrs)	Overall	Nuclear	Thermal	Hydro	Wind
Guangdong	2,147	**3,506**	2,154	930	1,452
Fujian	2,056	**2,036**	2,235	1,660	1,279
Liaoning	1,925	**3,053**	2,169	970	853
Guangxi	1,845	**Note ***	2,862	1,486	1,110
Jiangsu	2,562	**3,722**	2,637	467	1,108
Zhejiang	2,198	**3,705**	2,299	832	975
Hainan	2,501	**Note ***	2,862	1,410	850
Shandong	2,328	**Note ***	2,461	236	1,048
Nationwide	**2,087**	**3,430**	**2,375**	**1,430**	**986**

Note*: New nuclear plants under construction in Guangxi, Hainan & Shandong
Source(s): NEA

Favorable tax policies for nuclear power producers

Owing to construction lead time and high capital expenditures in nuclear power generation, the government has provided various tax incentives to compensate for the risk of investing in and operating nuclear power generation businesses. The main tax incentives mainly include (1) rebate of VAT and (2) preferential tax treatment on enterprise income tax

The rebate of VAT will enhance the pre-tax profit margin of nuclear power producers. The preferential tax rate will enhance the net profit margin of nuclear power producers. Hence, these tax incentives will boost return of investment in nuclear power plant.

Capitalize on the strength of China's nuclear power supply chain to develop the overseas markets

During 2010-15, the installed capacity growth of nuclear power plants in major OECD countries would be constrained for various reasons. The expansion would be mainly powered by the non-OECD countries such as China. China has succeeded in raising the localization rate of the nuclear power plants to 70%-80% due to the development of supply chain in the domestic nuclear industry. We believe China's nuclear power producers, equipment suppliers, and turnkey project operators would be able to capitalize on their experience to explore the overseas market.

We believe business opportunities in the overseas market are emerging.

On Oct 21, 2013, EDF Group and the UK government agreed on the key commercial terms of the investment contract for the Hinkley Point C nuclear power station. The Contract for Difference (CfD), the strike price of which has been set at £92.5/MWh, (or £89.5/MWh if Sizewell C goes ahead) will last for 35 years from the date of commissioning. The project is eligible for the UK Guarantees scheme, the UK government's infrastructure guarantee program, under terms and conditions to be agreed upon. Agreement in principle on the scope of the UK Guarantees scheme and on the key terms of the investment contract allow EDF Group to move ahead to secure partners for the project, based on an expected rate of return (IRR) of around 10% for the project. The share of equity is expected to be 45%-50% for EDF, 10% for Areva, 30%-40% for China General Nuclear Corporation (CGN) and China National Nuclear Corporation (CNNC). Discussions are also taking place with a shortlist of other interested parties who could take up to 15%. Finalization of these agreements and construction of the plant are subject to a final investment decision, provided certain key steps are completed, including agreement of the full investment contract, finalization of agreements with industrial partners and a clearance decision from the European Commission under State aid rules.

According to a HK-listed nuclear power equipment supplier, the domestic nuclear power companies are seeking business opportunities in Turkey and Romania.

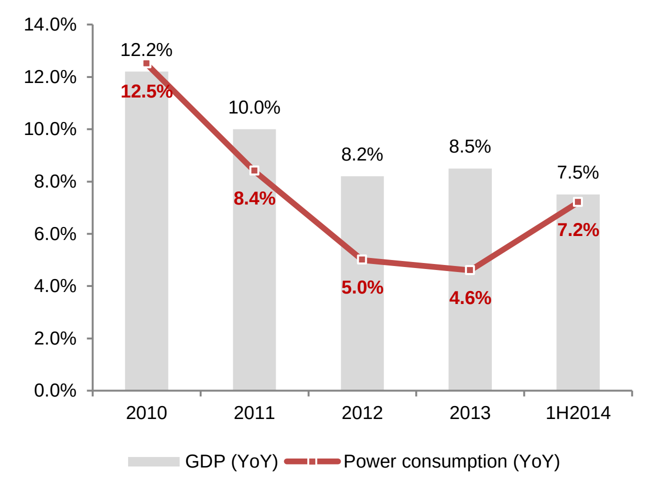
Industry challenges

Major Macro Risks

Economic slowdown in provinces with existing or under-constructing nuclear plants

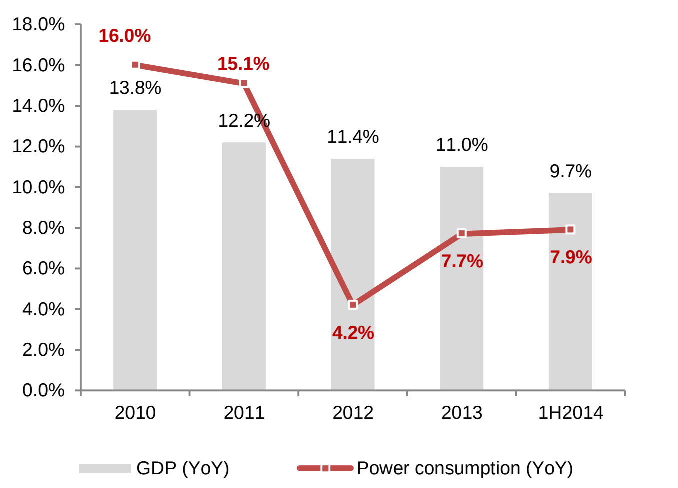
Demand growth for electricity is sensitive to economic growth, meaning that demand growth for electricity will slow upon a flagging economy. As the construction cycle of a new nuclear power plant would take ~5-6 years, the economic condition in which the plant commences operation may vary significantly from the expected one when it first starts construction. In recent years, GDP growth in Guangdong, Fujian, Liaoning, Jiangsu, and Zhejiang have slowed down due to various external or internal factors. In Guangxi and Hainan where new nuclear plants are under construction, the provincial GDP growth has been slowing too. Nonetheless, dispatch priority of nuclear power over thermal power would provide certain competitive advantages to nuclear power producers in these provinces.

Exhibit 45: YoY growth in power consumption and GDP growth in Guangdong Province



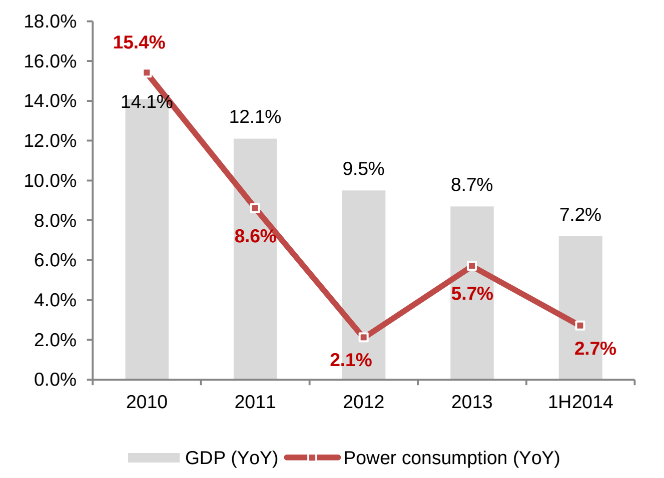
Source(s): NBSC, Bloomberg

Exhibit 46: YoY growth in power consumption and GDP growth in Fujian Province



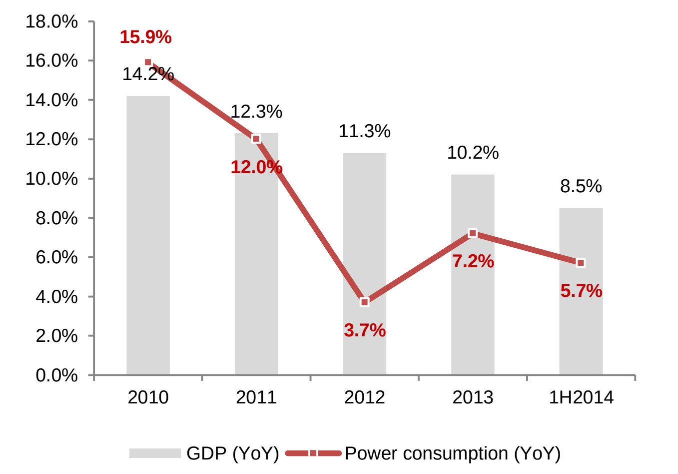
Source(s): NBSC, Bloomberg

Exhibit 47: YoY growth in power consumption and GDP growth in Liaoning Province



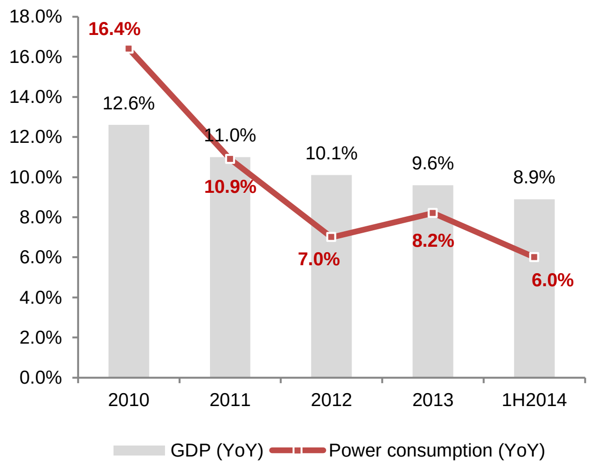
Source(s): NBSC, Bloomberg

Exhibit 48: YoY growth in power consumption and GDP growth in Guangxi Province



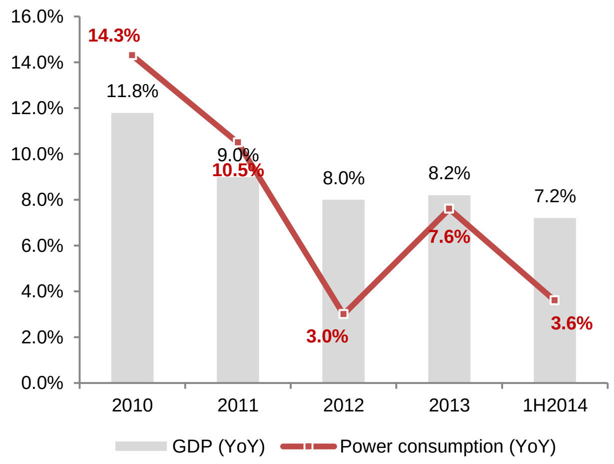
Source(s): NBSC, Bloomberg

Exhibit 49: YoY growth in power consumption and GDP growth in Jiangsu Province



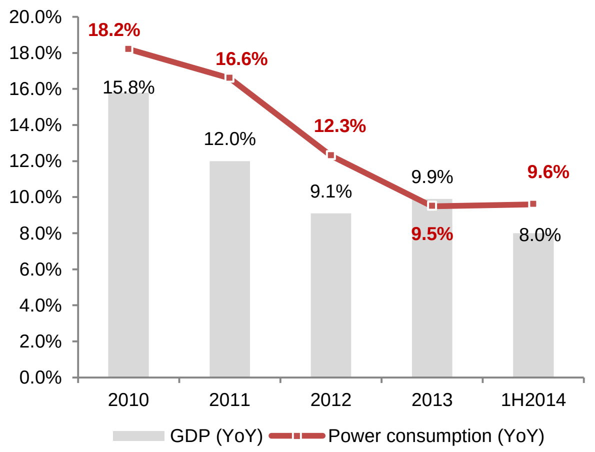
Source(s): NBSC, Bloomberg

Exhibit 50: YoY growth in power consumption and GDP growth in Zhejiang Province



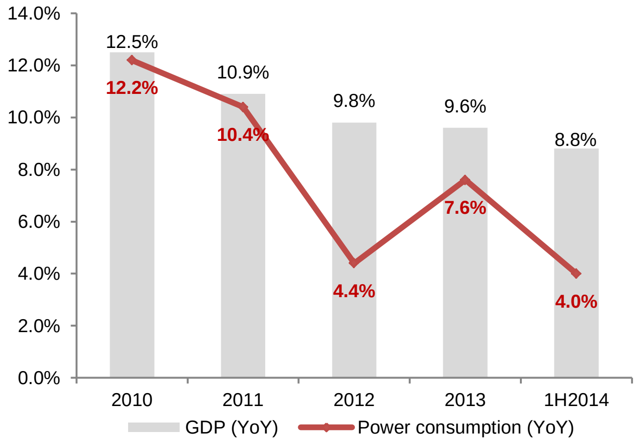
Source(s): NBSC, Bloomberg

Exhibit 51: YoY growth in power consumption and GDP growth in Hainan Province



Source(s): NBSC, Bloomberg

Exhibit 52: YoY growth in power consumption and GDP growth in Shandong Province



Source(s): NBSC, Bloomberg

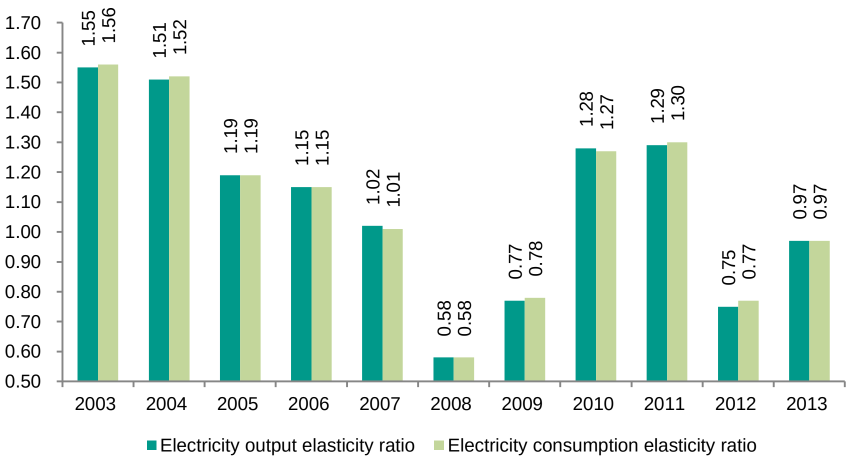
Elasticity ratio of electricity output and consumption fell below 1.0x

In 2012 and 2013, China's power output growth or power consumption growth was lower than the national economic growth. The electricity output elasticity ratio (average electricity output growth/average economic growth) was 0.75 and 0.97 for 2012 and 2013. The electricity consumption elasticity ratio (average electricity consumption growth/average economic growth) was 0.77 and 0.97 for 2012 and 2013. We believe the elasticity ratios, which fell below 1.0 in 2012-13, were driven down by:

1. Improved energy efficiency of power consumption industries
2. Transformation of economic structures from the more energy-intensive manufacturing industries to less intensive ones such as services industries

We believe the above-mentioned factors will continue to affect power demand in coming years. In particular, the government encourages reducing idle capacities on energy-intensive industries such as steel, cement, glass, and non-ferrous metals. The changes in economic structure will subsequently affect power demand.

Exhibit 53: Electricity Elasticity Ratios



Source(s): NBSC

Major Policy Risks

Dispatch priority of power generation sources are subject to change

In the 12th five-year Power Development Plan, total installed capacity of power generation is targeted to grow at CAGR of 9.0%, which is 1.5 ppt higher than the expected el electricity ectricity consumption growth. Competition in power supply industry is expected to intensify when the new installed capacities commenced operation. The current dispatch priority has provided some competitive advantages to clean energy suppliers, such as hydro, wind, solar, and nuclear powers. If the dispatch priority policy is suspended or altered in the future, the less cost-effective clean energy suppliers will be subject to keen market competition. The investment return of clean energy suppliers will also be adversely affected.

Pricing policy

The NDRC sets the on-grid pricing policy of nuclear power producers in 2013. The policy is favorable to nuclear power producers as it eliminates pricing competition between nuclear and thermal powers in a certain extent. The pricing policy limits the pricing power of nuclear power producers on one hand, but it reduces the business uncertainty of new nuclear power plants under construction on the other hand. If the pricing policy is amended in the future, business risks of existing or under-constructing nuclear power plants may increase.

Tax concession

Nuclear power producers enjoy tax concession from VAT rebate to preferential tax treatment. These tax incentives will help enhance investment returns of nuclear power producers. If these incentives are abolished, amended or expire, investment returns of nuclear power producers will be adversely affected.

Business risks

Intra-provincial competition

Our analysis indicates some of new nuclear plants under construction are located in the provinces such as Guangdong, Fujian, Jiangsu, and Zhejiang with existing nuclear power plants. Competition of nuclear power supply among different nuclear power plants within the same province will intensify.

Total fuel costs

Total nuclear fuel costs may be underestimated. We believe total nuclear fuel costs should include expenses related to pre-used nuclear fuel and post-used nuclear fuel (i.e. spent fuel). As total installed capacity of China's nuclear power plants is set to grow rapidly in coming years, the demand for nuclear fuel would rise. Subsequently, the volume of spent fuel would increase proportionally. Owners of nuclear power plants without the technologies to produce nuclear fuel or process spent fuel will need to bear the business risk of incurring high nuclear fuel costs.

Decommissioning costs

By regulation, nuclear plant owners are responsible for decommissioning the plants after their useful life is completed. The actual decommissioning costs are hard to estimate. The ultimate costs may be adversely deviated from the original expectations.

Disclosures

Analyst Certification

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Definition of equity rating

Rating	Definition
Buy	Stock return ≥ Market return rate
Hold	Market return – 6% ≤ Stock return < Market return rate
Sell	Stock return < Market return – 6%

Stock return is defined as the expected % change of share price plus gross dividend yield over the next 12 months

Market return: 5-year average market return rate from 2007-2011

Time horizon of share price target: 12-month

Definition of share price risk

Rating	Definition
Very high	2.6 ≤180 day volatility/180 day benchmark index volatility
High	1.5 ≤ 180 day volatility/180 day benchmark index volatility < 2.6
Medium	1.0 ≤180 day volatility/180 day benchmark index volatility < 1.5
Low	180 day volatility/180 day benchmark index volatility < 1.0

We measure share price risk by its volatility relative to volatility of benchmark index. Benchmark index: Hang Seng Index.

Volatility is calculated from the standard deviation of day to day logarithmic historic price change. The 180-day price volatility equals the annualized standard deviation of the relative price change for the 180 most recent trading days closing price.

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