

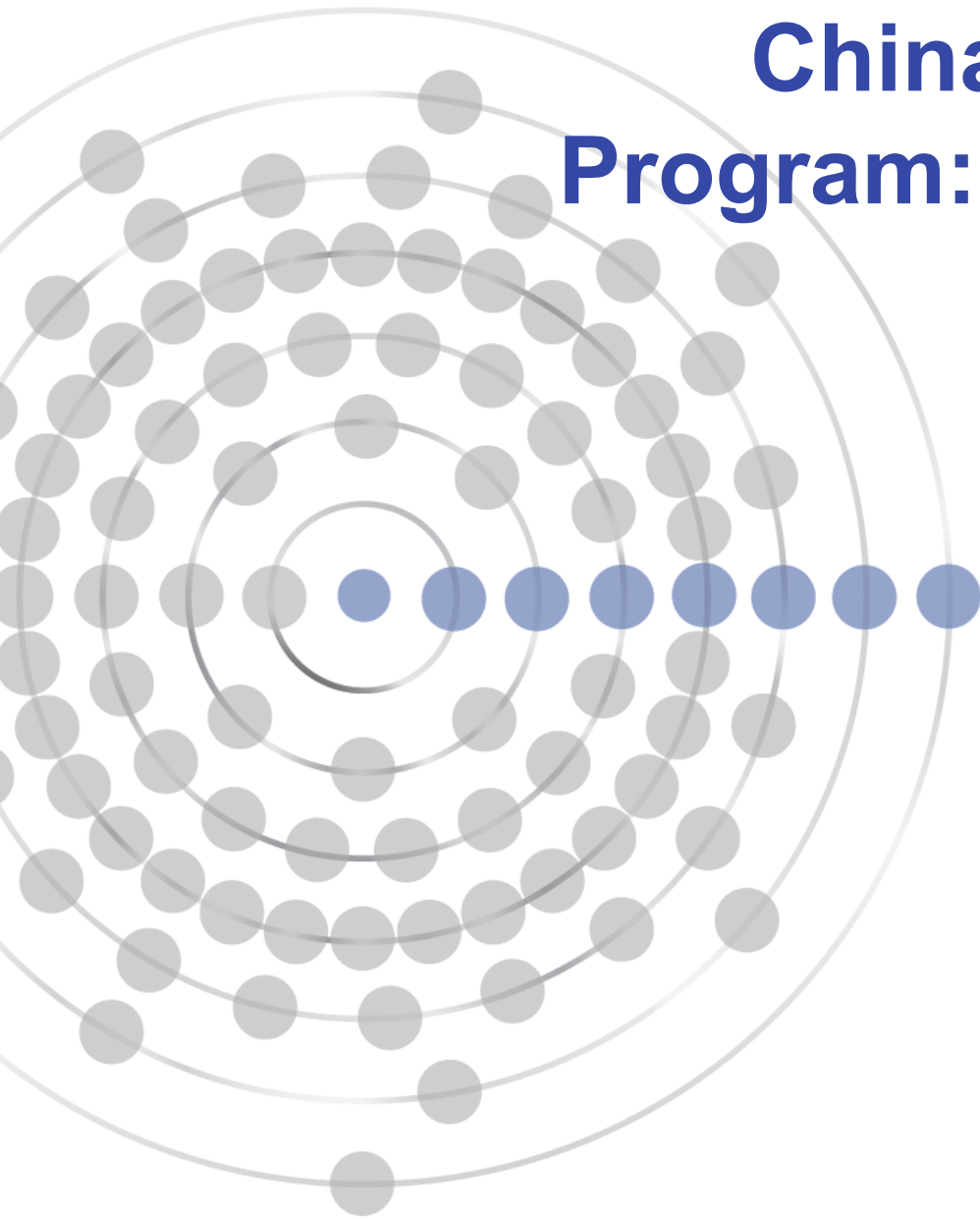
China's Nuclear Energy Program: Status and Future

IAEE Conference



Christhian Rengifo
Senior Consultant,
International Nuclear Policy

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Presentation Outline

- 1. Introduction to UxC**
- 2. UxC's global nuclear power forecasts**
- 3. China's electricity situation**
- 4. China's nuclear energy program**
- 5. China's electricity overcapacity**
- 6. Analysis**
- 7. Conclusions**





1. UxC – The Ux Consulting Company

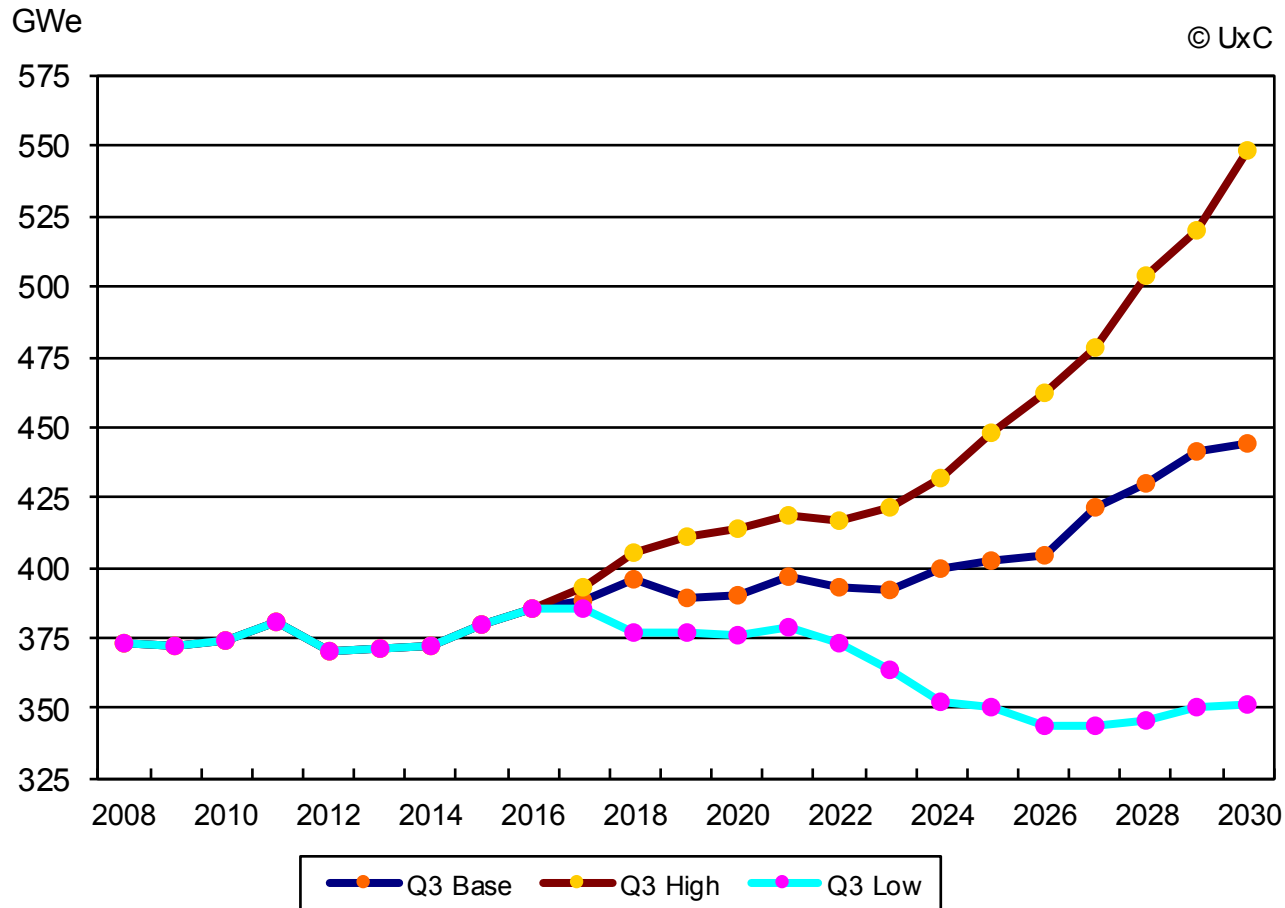
- ▶ **Provides nuclear consulting and market information services to suppliers, utilities, investors, and government agencies internationally**
 - Founded in March 1994
 - 15 professionals in company, plus consultant base
 - Offices/Staff Located in: Atlanta, Boston, Austin.

- ▶ **Three major lines of business**
 - Nuclear market consulting (fuel cycle & reactors)
 - Publishing industry market reports
 - Nuclear fuel price indicators and data services





2. UxC Global Nuclear Power Forecasts

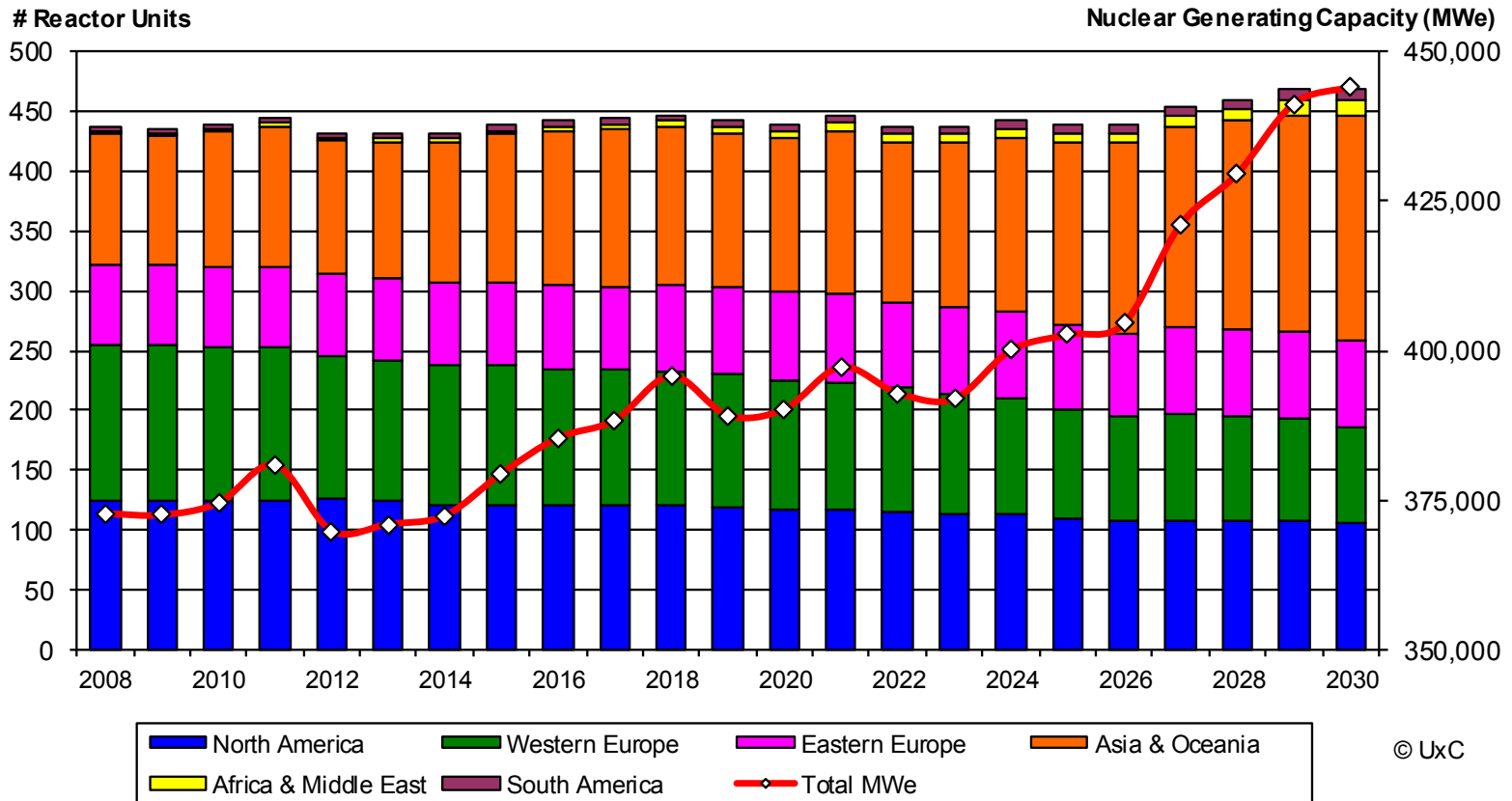


Source: UxC Nuclear Power Outlook, Q3 2017





2. UxC Base Case Regional Forecast



© UxC

Source: UxC Nuclear Power Outlook, Q3 2017



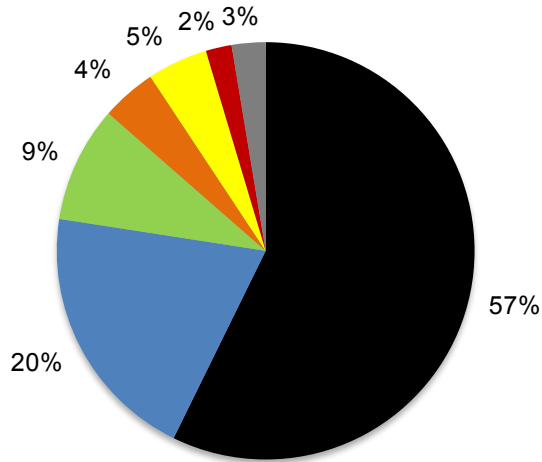


3. Electricity Situation in China (2016)

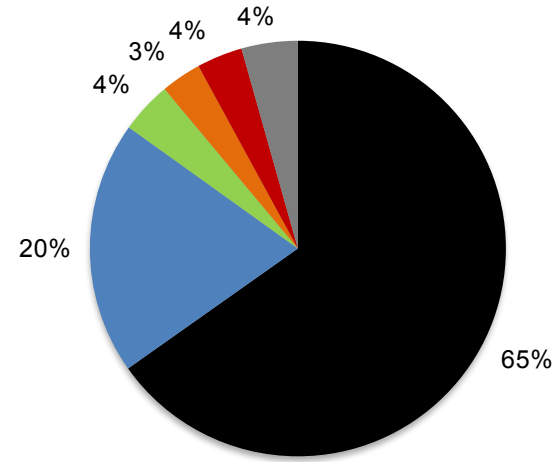
Capacity: 1,645 GWe

Generation: 5,989 TWh

■ Coal ■ Hydropower ■ Wind ■ Gas ■ Solar ■ Nuclear ■ Others



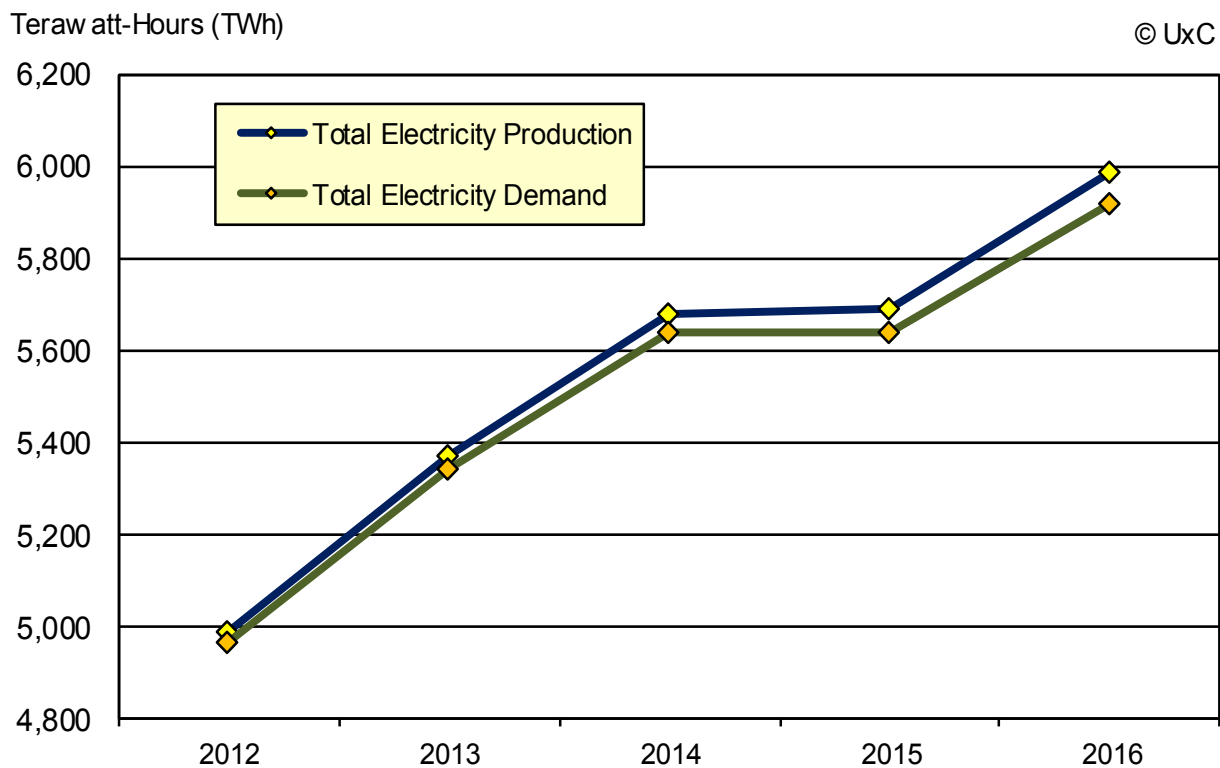
■ Coal ■ Hydropower ■ Wind ■ Gas ■ Nuclear ■ Others



Source: China Electricity Council



3. China Electricity Supply & Demand



Source: China Electricity Council





3. 13th Five Year Plan (2016-2020) for Power Development

China's Power Development Targets under the 13th FYP			
	2015	2020	Average Annual Increase
Total Generation Capacity (GWe)	1,530	2,000	5.5%
Total Electricity Demand (TWh)	5,690	6,800-7,200	3.6-4.8%
Generation Capacity by Fuel (GWe)			
Conventional hydro power	297	340	2.8%
Pumped-storage hydro	23	40	11.7%
Nuclear power	27	58	16.5%
Wind power	131	210	9.9%
Solar power	42	110	21.2%
Coal	900	< 1,100	4.1%
Gas	66	110	10.8%

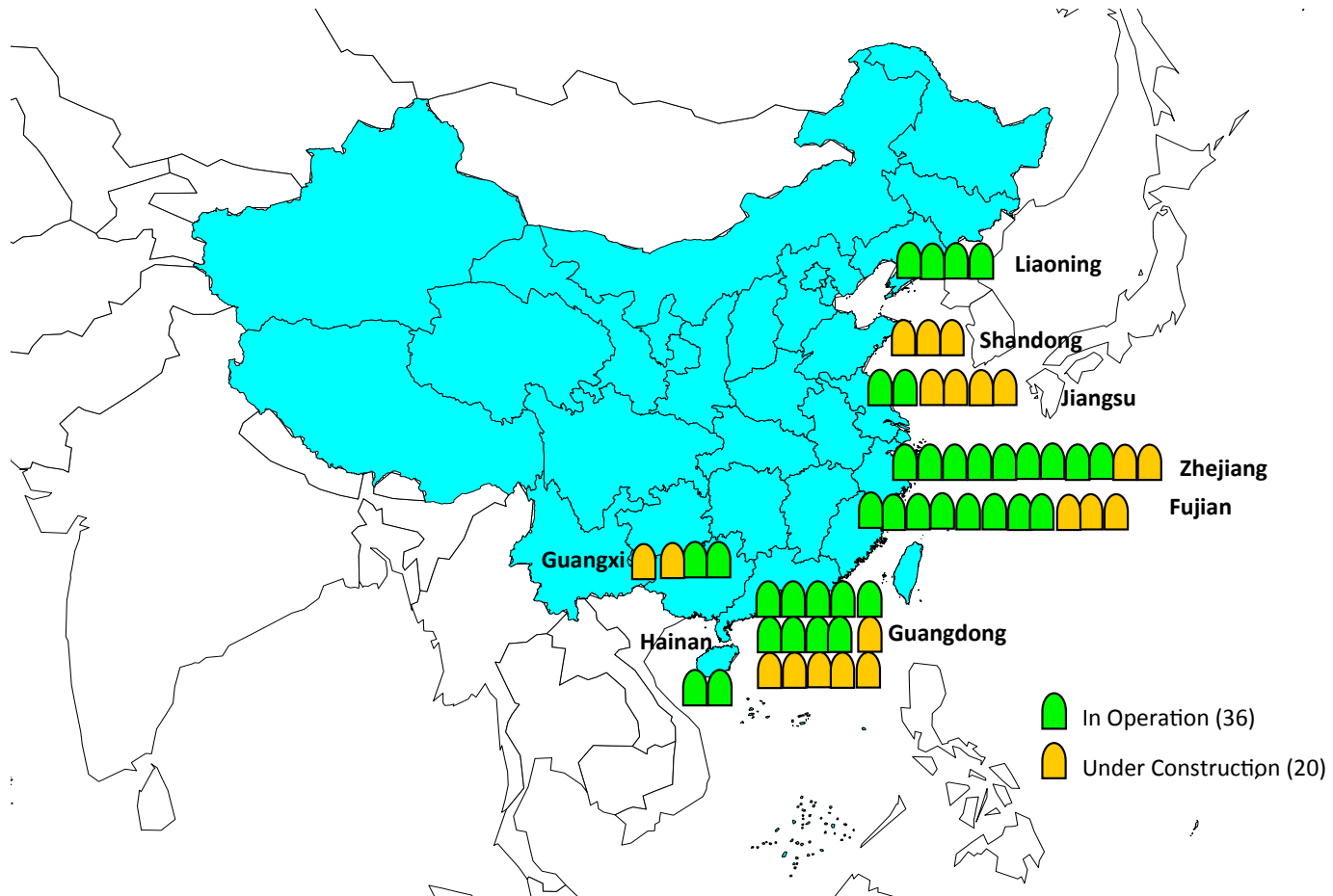
Source: 13th FYP for Power Development





4. China's Nuclear Power Plants

Location of China's nuclear reactors (as of August 2017)





4. Nuclear Energy in China: Current Status & Outlook

▶ **As of August 2017 status:**

- 36 reactors in commercial operation (32 GWe)
- 20 under construction (21 GWe)

▶ **2020 UxC Forecast (Base case):**

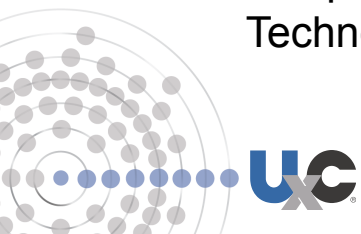
- 49 units / 46 GWe

▶ **2030 UxC Forecast (Base case):**

- 99 units / 103 GWe

▶ **3 Licensed Nuclear Power Utilities:**

- **China National Nuclear Power** – publicly traded company (subsidiary of China National Nuclear Corporation or CNNC – State-owned company)
- **China General Nuclear**– publicly traded company (subsidiary of China General Nuclear Power Group or CGN – State-owned company)
- **State Power Investment Corporation** or SPIC (State-owned company) – merged company between China Power Investment Corp. (CPIC) and State Nuclear Power Technology Corp. (SNPTC)





4. Reactor Designs: Operation & Construction*

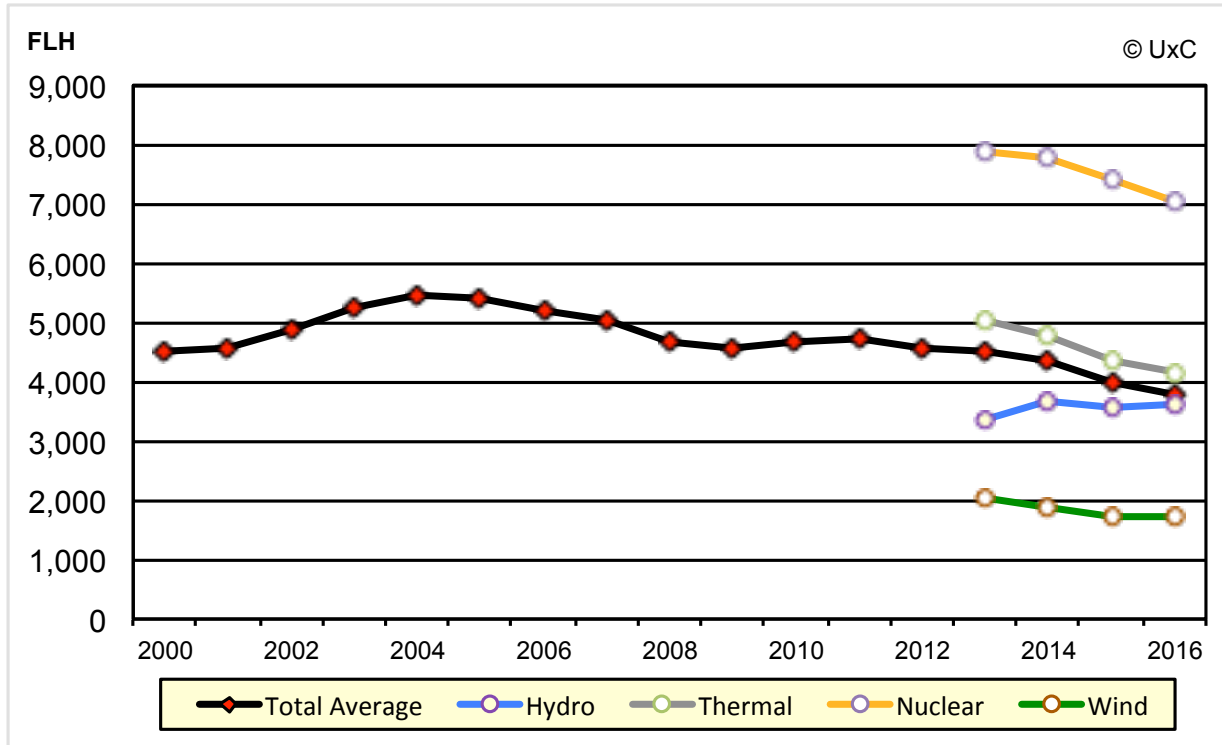
- ▶ **Canadian Design: 2 x CANDU**
- ▶ **Russian Design: 2 x VVERs and *2 VVERs**
- ▶ **French Design: 2 x M310 and *2 x EPRs**
- ▶ **U.S. Design: *4 x AP1000**
- ▶ **Chinese Design: various CNPs, CPRs, and *4xHPR-1000**

- ▶ **In the future, HPR-1000 and CAP designs (based on the AP1000 design) are expected to be the basis for the nuclear fleet. Focus will be on domestic designs and not on additional imports.**



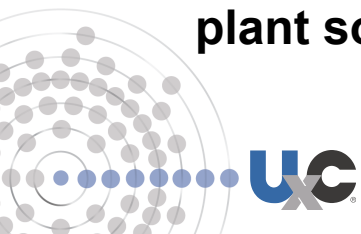


5. Overcapacity?: Average Full Load Hours (FLH) of Power Plants



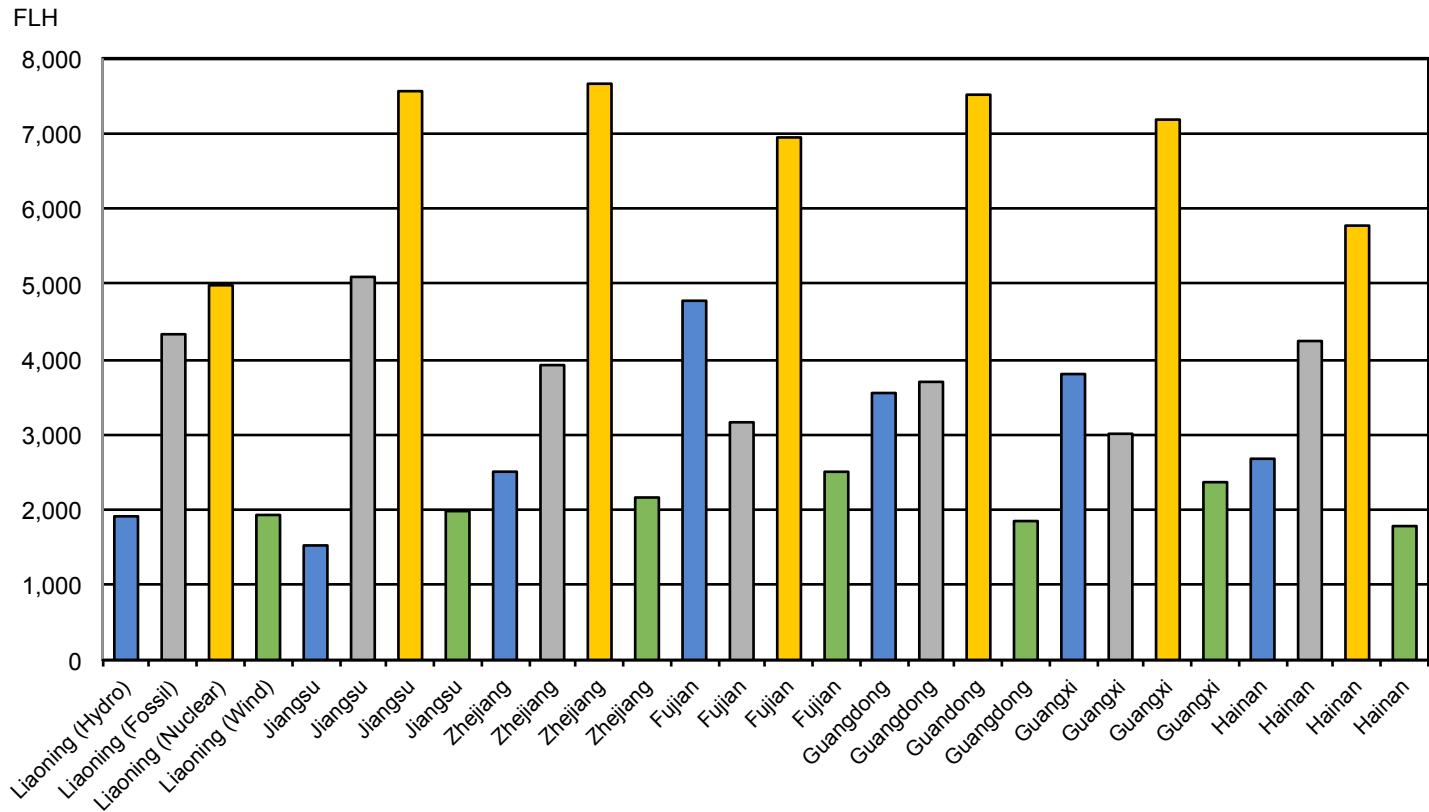
Source: China Electricity Council

Indicator 1: Demand has been met by operating thermal and hydro plant sources at low FLH for a long time.





5. Overcapacity?: Average FLH in Provinces with Nuclear Reactors (2016)



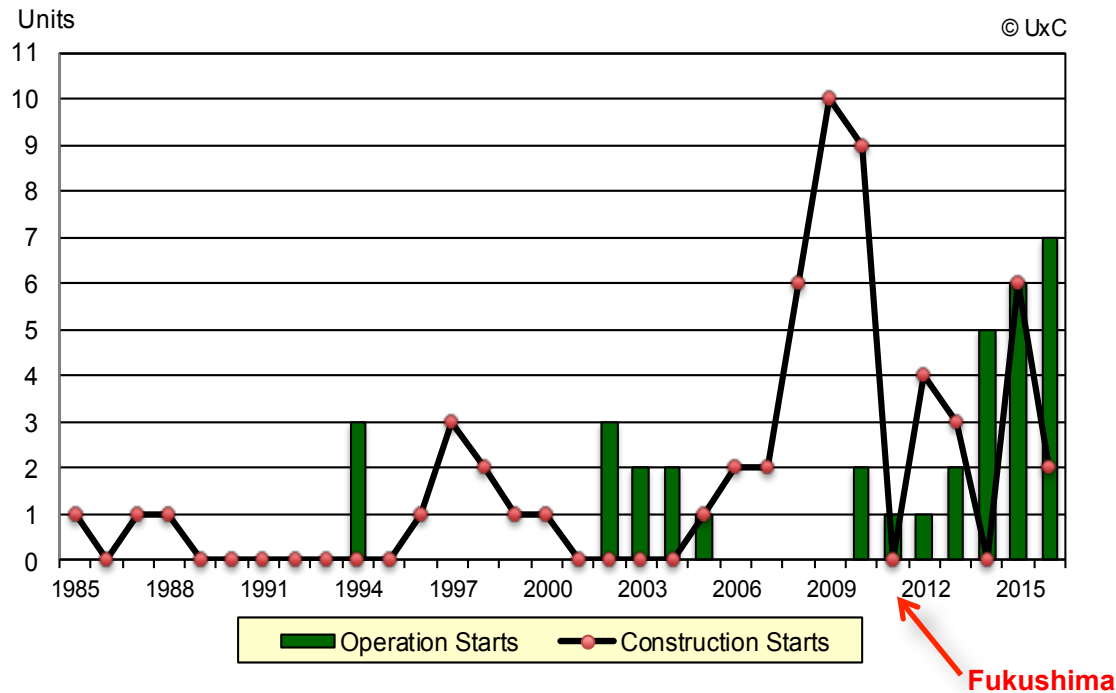
Source: China Energy Portal

Indicator 2: In provinces where nuclear reactors are located thermal and hydro power plans have low FLH. CGN Power reported in 2016 that it was operating at lower FLH when compared to 2015.





5. Overcapacity?: Reactor Construction and Operation Starts



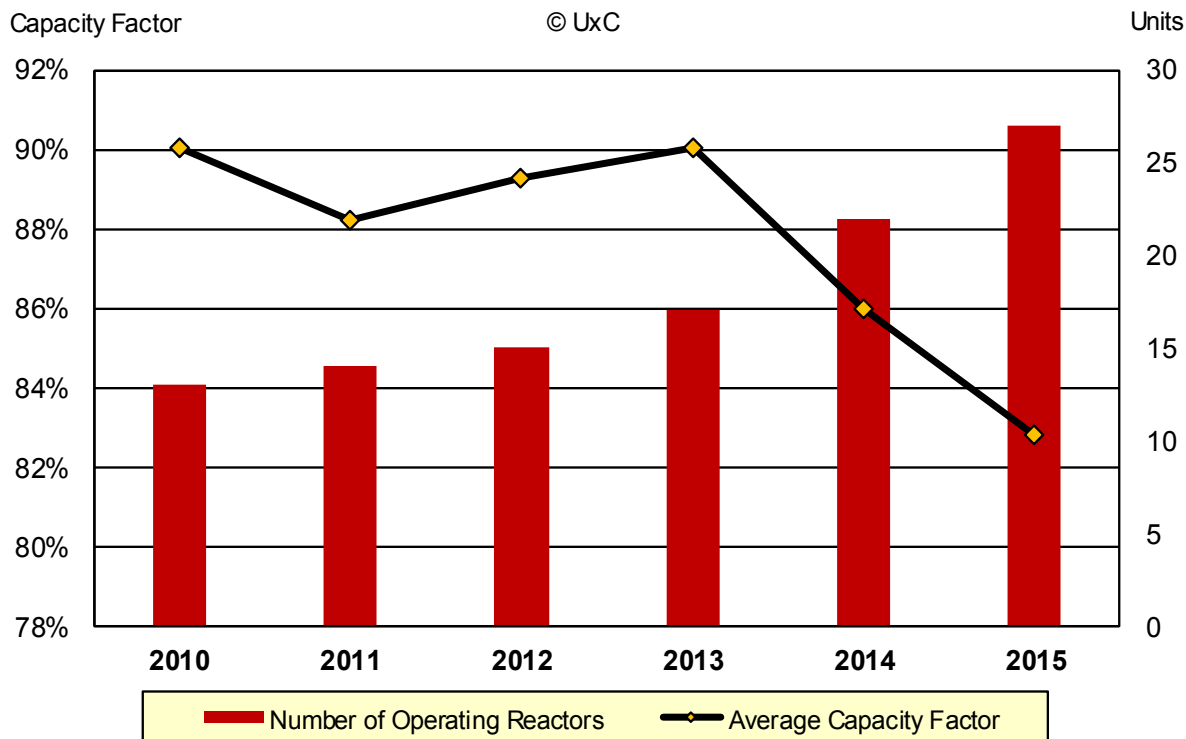
Indicator 3: CGN Power reported in 2016, it had to delay the start of operation of one reactor due to market conditions.

As of August 2017: Only 1 reactor has started operation this year. No reactors have started construction.





5. Nuclear Plant Capacity Factors

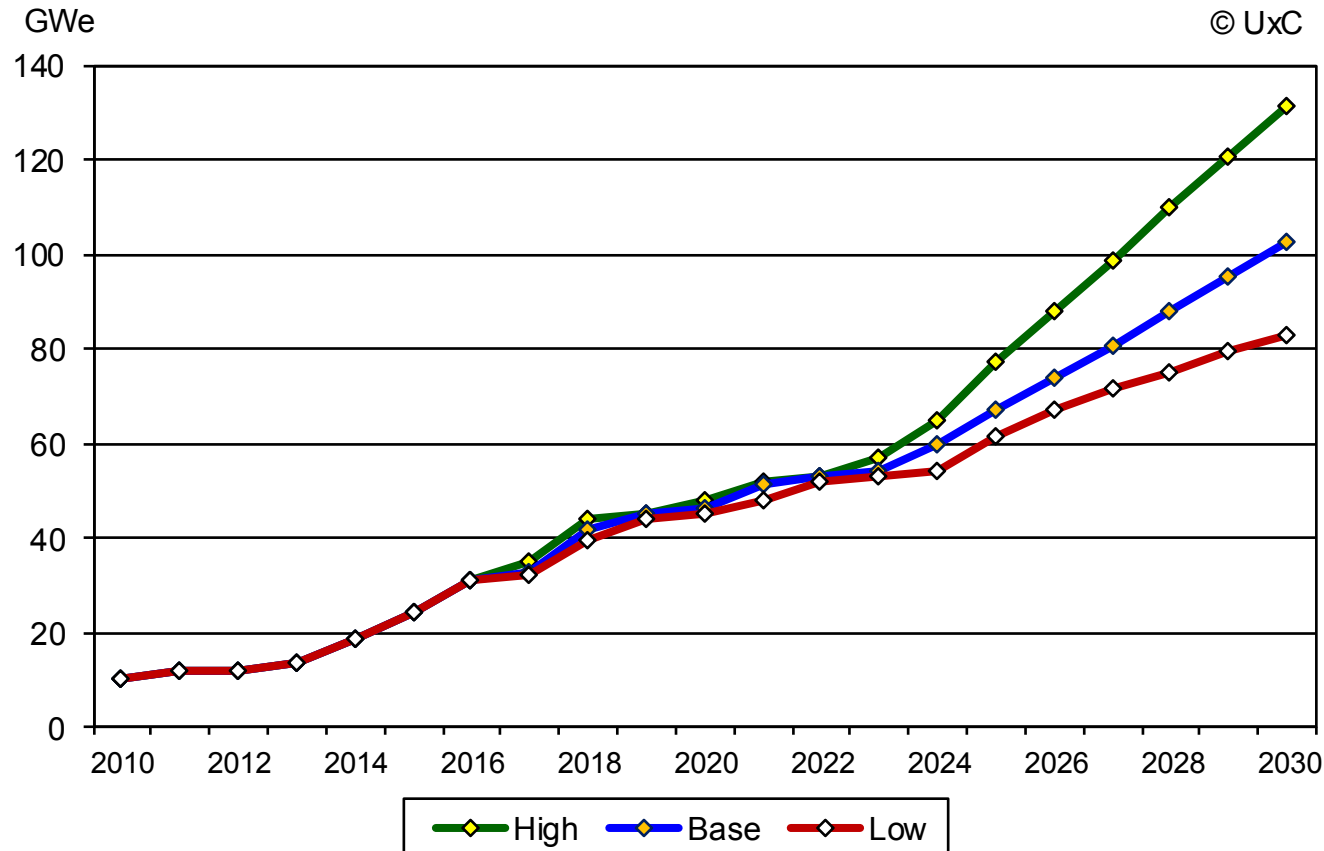


Indicator 4: Capacity factors have gone down in the 2013-2015 period. In 2016, CGN reported that due to low demand, some units operated that year temporarily at reduced load or were offline.





6. Analysis: Nuclear Energy Forecasts for China



Base Case:
2020: 46 GWe
2030: 103 GWe

Source: UxC Nuclear Power Outlook, Q3 2017





6. Factors Influencing China Forecasts

- ▶ **Changes in energy supply in view of lower economic development**
- ▶ **Some nuclear operators are publicly traded companies: Are additional nuclear reactors a good investment in an over-supplied market?**
- ▶ **China is reforming its electricity market to address several related issues:**
 - Electricity overcapacity
 - Grid connections
 - Bringing the electricity system closer to market forces (e.g. electricity prices and power market trading)
 - Changes in FiT (FiT are also available for other sources)
- ▶ **Wait for 14th FYP: Which sites? Which reactor designs? When?**





6. China 13th Five Year Plan (2016-2020) for Nuclear Energy

- ▶ **By 2020, there should be 58 GWe in operation and 30 GWe under construction.**
- ▶ **Completion of AP1000 projects (Sanmen and Haiyang)**
- ▶ **Construction of HPR-1000 demonstration projects**
- ▶ **Start construction of CAP1400 demonstration project**
- ▶ **Start construction of a number of new reactors in coastal areas. No plans for inland reactors.**





7. Conclusions

- ▶ **China will not meet its 2020 nuclear power targets**
 - The Fukushima accident clearly slowed the development of nuclear energy in China (e.g. new safety reviews)
 - There is electricity overcapacity and this will also slow down the construction of nuclear reactors
 - Lower economic development: less energy demand
- ▶ **Based on the 13th FYP, China is planning to add more electricity capacity in the next years:**
 - Does more capacity in an already oversupplied market make sense (in the short term)? In the long term: Phasing out coal.
- ▶ **One way to use China's large nuclear supply chain: Build reactors abroad (e.g. HPR-1000 design)**
 - One Belt One Road push for reactor exports



