ACMR

IBISWorld Industry Report
Nuclear Power in China

August 2017

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About This Industry

Industry Definition

The Nuclear Power industry in China is composed of state-controlled nuclear power plants that employ nuclear fission to generate heat, which is then converted to electricity. Nuclear power plants then provide this electricity to transmission systems or to electric power distribution systems.

Main Activities

The primary activities of this industry are:
- Generating electricity by fast reactors
- Generating electricity by pressurized heavy water reactors
- Generating electricity by pressurized water reactors

The major products and services in this industry are:
- Nuclear power generated by pressurized water reactors
- Nuclear power generated by heavy water reactors
- Nuclear power generated by fast water reactors

Similar Industries

4411 - Thermal Power Generation in China
Establishments in this industry are mainly engaged in operating thermal power generation facilities.

4412 - Hydroelectric Power in China
Establishments in this industry are engaged in operating hydroelectric power generation facilities.

4419a - Wind Power in China
Establishments in this industry are engaged in operating wind power generation facilities.

4419b - Solar Power Generation in China
This industry in China generates power via photovoltaic (PV) power generation and solar thermal power generation.

Additional Resources

For additional information on this industry:

np.chinapower.com.cn
Nuclear Power Information in China

www.china-nea.cn
China Nuclear Power Industry Association

www.sp.com.cn
State Power Information Net

www.serc.gov.cn/english
State electricity regulatory Commission

www.cec.org.cn
China Electricity Council

www.eri.org.cn
Energy Research Institute of National Development and Reform Commission

Industry Performance

Executive Summary

The emerging Nuclear Power industry in China has been developing quickly and steadily. Over the past five years, industry revenue has been growing at an annualized rate of 14.7% to an estimated $11.43 billion in 2017. The two major companies, China National Nuclear Corporation and China Guangdong Nuclear Power Group, are state-owned and contribute over 80.0% of total industry revenue. The total installed nuclear power capacity in China increased to 33,632 megawatts (MW) by the end of 2016.

China's economy has been slowing down over the past few years, which has led to a fall in power demand from the manufacturing sector. As such, electricity consumption growth fell. Nevertheless, the Chinese government will continue restructuring the energy sector, with the Nuclear Power industry as a key focus. Over the five years to 2022, ACMR-IBISWorld forecasts that industry revenue will grow 7.1% annually to about $16.1 billion. As nuclear power technology matures, the energy efficiency of the power plants will improve by 60.0% to 70.0%, ensuring that the industry's profitability remains high.

Key External Drivers

The key sensitivities affecting the performance of the Nuclear Power industry include:

Competition from Substitutes - Thermal, Solar, Wind & Nuclear Power Generation - Hydroelectric Power Generation

The Nuclear Power industry faces competition from the Thermal, Hydroelectric and Wind Power Generation industries (IBISWorld industry reports 4411, 4412 and 4419a). Such competition stimulates nuclear power enterprises to improve their techniques and increase efficiency.

Gross Government Fixed Investment - State and Local

State and local government investment promotes the development of the Nuclear Power industry in China. The current government policy encourages the development of alternative energy, which has a positive impact on the industry.

Infrastructure - Electricity Distribution Network

The establishment of a complete nationwide electricity distribution network is essential for the development of the industry.

Key Attitudinal Changes - Health and Safety Awareness

After the Fukushima Daiichi nuclear disaster in Japan in 2011, the Chinese public has become very concerned about the safety of nuclear power station projects. This had a negative impact on the development of nuclear power in China.

Natural - Ecological & Disasters

Nuclear power stations are very vulnerable to earthquakes, and many industry establishments are located in earthquake-prone areas.

Real GDP

Real GDP is a measure of general economic activity. Growth in demand for electricity is very closely linked to overall economic growth. A growing Chinese economy is an important factor in the development of nuclear power in China.

Systems and Technology - by Industry

The Chinese government has invested a large amount of money into the research and development of nuclear power. Advanced reactor techniques may be applied in the near future, which will decrease the cost of the construction of nuclear power plants, and enhance the safety level and the efficiency of the

production process.

World price of uranium

China does not have abundant uranium reserves, so most of the nuclear fuels used by nuclear power stations are imported. Changes in the global uranium price directly affect production costs, and a rising price has a negative impact on the industry.

Current Performance

Revenue for the Nuclear Power industry in China has been increasing at an annualized rate of 14.7% over the past five years. Industry revenue is estimated at $11.4 billion in 2017, up 7.5% from 2016. The total installed nuclear power capacity in China increased to 33,632 megawatts (MW) by the end of 2016.

On March 11, 2011, a massive 8.9-magnitude quake hit northeast Japan. The disaster resulted in an increased emphasis on the safety of the nuclear power plants, and the State Council suspended the approval of construction proposals for new nuclear power plants. However, the operations of existing plants were not influenced.

On June 21, 2011, the China Experimental Fast Reactor was successfully combined to the grid, raising the fuel utilization ratio from 1.0% to 60.0%. Industry revenue growth was 15.9% over the year. As fast reactor (i.e. fourth-generation) technology matures, it will be applied to more nuclear power plants, pushing the development of the Nuclear Power industry in China.

In May 2012, the 12th Five-Year Security Plan of Nuclear Energy was approved by China's State Council (2011 to 2015). The approval of the five-year plan indicates the government's support of further development of the industry.

In 2013, the Chinese government continued to support the development of nuclear power. Nuclear power output increased to 110.7 trillion watt hours, up 13.7% from 2012, and industry revenue reached $6.8 billion, up 10.7%.

In 2014, five nuclear power units were put into operation: unit one of the Yangjiang Nuclear Power Plant, unit two of the Ningde Nuclear Power Plant, unit two of the Hongheyan Nuclear Power Plant, unit one of the Fuqing Nuclear Power Plant and unit one of the Fangjiashan Nuclear Power Plant. Industry revenue increased to $7.9 billion, up 15.8% from 2013.

In 2015, there were six nuclear power units put into commercial operation, including unit two of the Fangjiashan Nuclear Power Plant, unit two of the Yangjiang Nuclear Power Plant, unit three of the Ningde Nuclear Power Plant, unit three of the Hongheyan Nuclear Power Plant, unit two of the Fuqing Nuclear Power Plant and unit one of the Changjiang Nuclear Power Plant. By the end of 2015, there had been 28 nuclear power units running in commercial operation, with total installed capacity of 26,427.4 MW. Total nuclear power output increased to 169.0 billion KWh in 2015, up 28.4% from 2014. Industry revenue increased to $9.8 billion, up 24.5% from 2013.

By the end of 2016, there were 35 nuclear power units in commercial operation, with total installed capacity of 33,632 MW. In 2017, industry revenue is expected to increase to $11.4 billion, up 7.5% from 2016.

Enterprises and employment

In December 2002, the original National Electricity Corporation was split into five state-owned electricity generation companies. From 2003 to 2008, industry enterprises experienced slow and consistent growth. Currently, there are nine enterprises operating in this industry, all of which are owned by the state. The top two major companies, China National Nuclear Corporation and China Guangdong Nuclear Power Group, contribute over 80% of total industry revenue.

Over the past five years, the number of industry employees has been increasing at an annualized rate of 8.8% to 13,623. Meanwhile, wages have been rising at the higher rate of 12.8% to an estimated $573.2 million, mainly due to inflation and nationwide increases in wage levels.

Profitability

The Nuclear Power industry is highly profitable. ACMR-IBISWorld estimated that average profitability is 35.0% of revenue in 2017, due to the industry's low and stable fuel consumption levels and high efficiency. For example, one thermal power plant (IBISWorld industry report 4411) with installed capacity of 1,000 MW consumes more than two million tons of coal per year, while one nuclear power plant of the same installed capacity consumes only 1.5 tons of uranium, a small enough amount that it can be transported by one plane.

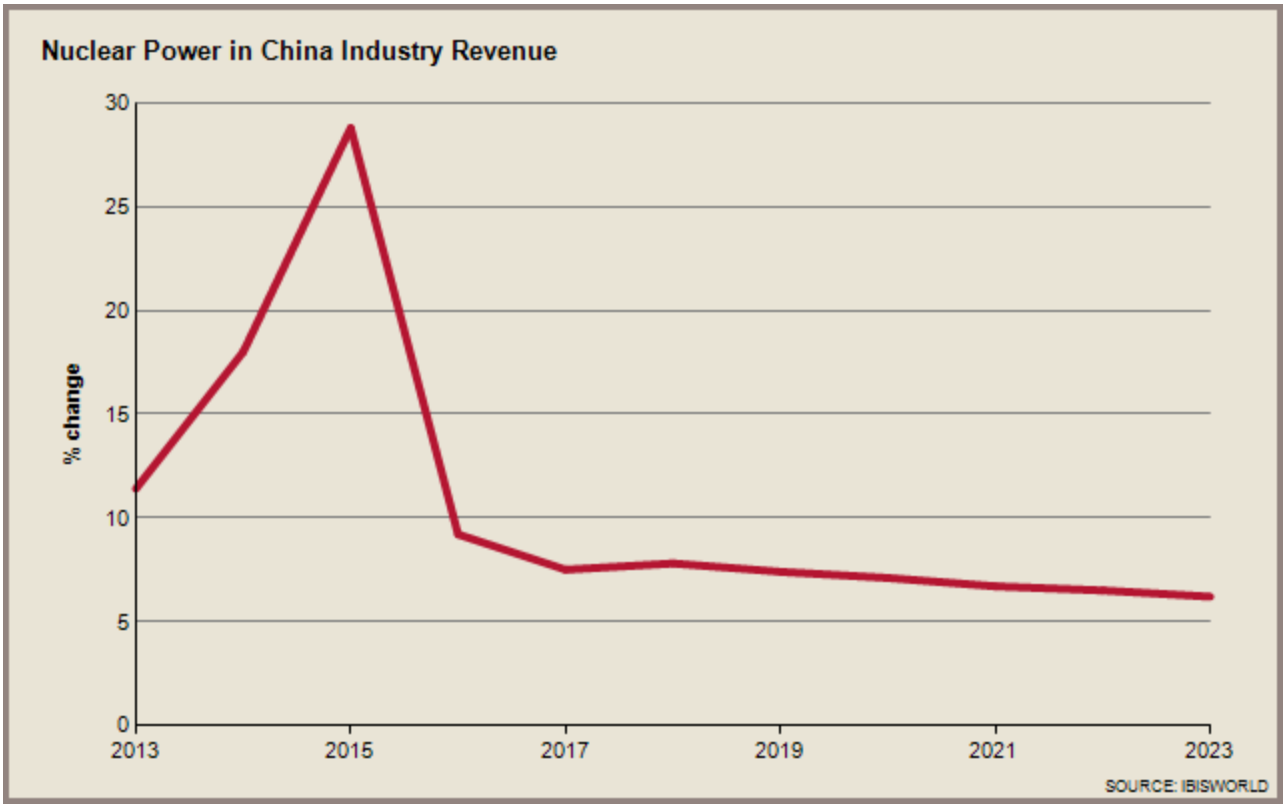
Industry Outlook

Over the next five years, revenue for the Nuclear Power industry in China is forecast to grow at an annualized rate of 7.1% to reach about $16.1 billion in 2022, largely due to the establishment of new nuclear power plants. Other key drivers of industry growth include China's substantial domestic power demand and the government's restructuring of the energy sector.

As all the nuclear power enterprises in China are state-owned and the construction of nuclear power plants require high, long-term investments, the development of the industry depends on favorable government policies and financial support from the national government. According to the Chinese Nuclear Power industry plan (2005 to 2020), the government aims to grow installed capacity to 90,000 MW by 2020. The government supports the development of the industry as it is an alternative energy that helps to reduce the country's reliance on other, less environmentally friendly forms of energy, such as thermal power generation vial coal (IBISWorld industry report 4411). In addition, the peripheral construction around nuclear power plants, helps to stimulate local economies with country.

There are about 24 industry enterprises in the industry at present. ACMR-IBISWorld anticipates that the rapid growth and high profitability of the industry will see the entry of several new players over the next five years. As nuclear power technology matures, the energy efficiency of power plants will improve by 60.0% to 70.0%, ensuring that the industry's profitability remains high. However, due to the high capital intensity of the industry, only large state-owned power generation companies will be capable of investing in the construction of nuclear power plants.

The number of the employees is projected to grow along with the establishment of new power plants in the next five years. Total employment is forecast to grow 6.4% annually to reach 18,573 by 2022. Wages are set to grow 6.8% annually to $795.6 million, mainly due to the high skill requirements of employees and rising labor costs across China.



Industry Life Cycle

This industry is in the growth stage of its life cycle.

Life Cycle Stage

- Industry value-added is growing much faster than China's GDP
- Reactors based on new technology are being regularly introduced to this industry
- Enterprises are establishing new power plants in inland areas

The emerging Nuclear Power industry in China has been developing quickly and steadily. Over the 10 years to 2022, industry value-added is estimated at 11.4% per year, much higher than China's GDP growth of about 6.5% per year over the same period. In the next five years, growth in the industry is forecast to surge, due to a doubling in the number of nuclear power plants.

On June 21, 2011, the China Experimental Fast Reactor was successfully combined to the grid. As fast reactor technology matures, it will be applied to more nuclear power plants, raising the fuel utilization ratio from 1.0% to 60.0%. This is expected to push the development of the Nuclear Power industry in China.

As the industry develops and safety levels increase, more enterprises will enter this industry.

Products & Markets

Supply Chain

Key Buying Industries

C - Manufacturing in China
Manufacturing industries are the major consumers of electricity.

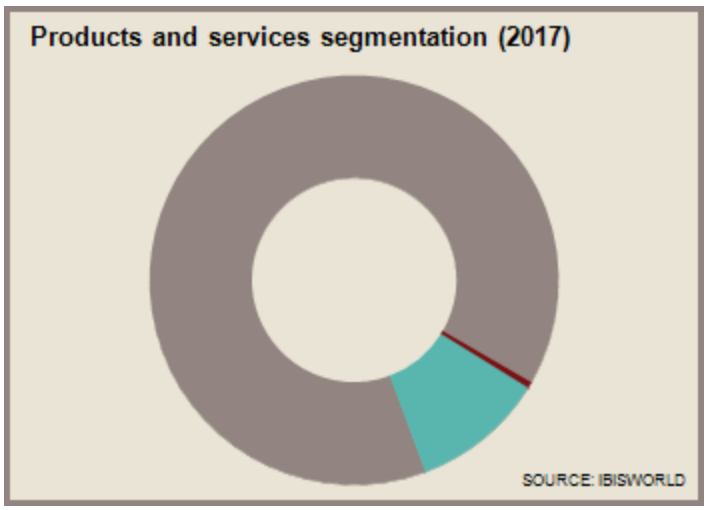
4420 - Electricity Transmission and Distribution in China
This industry purchases electricity and distributes electricity to end users.

Z9901 - Households in China
Individuals and households are one of the final end-users of electricity.

Key Selling Industries

2530 - Nuclear Fuel Processing in China
This industry extracts nuclear fuel, which is the main input for nuclear power generation, from uranium mines.

Products & Services



Nuclear power generated by pressurized water reactors

Pressurized water reactors are widely used in the Nuclear Power industry, and account for 89.0% of the total industry installed capacity. Most pressurized water reactors use second-generation technology, which has been regarded as mature since the late 1980s. With the emergence of third-generation technology, the cost of pressurized water reactors has been further reduced and plant safety improved. Most of the nuclear power plants under construction will use third-generation pressurized water reactor technology.

The downside of pressurized water reactors is that they must be located in coastal or riverside areas, as the operation of reactors requires large amounts of water to keep temperatures down. This limitation will affect the further development of this technology.

Nuclear power generated by heavy water reactors

Pressurized heavy water reactors were used in Qinshan Phase three. It is the only nuclear power plant that uses pressurized heavy water reactor technology. Although pressurized heavy water reactors have advantages, they are not widely applied in China.

Nuclear power generated by fast water reactors

On June 21, 2011, the China Experimental Fast Reactor was successfully combined to the grid, raising the fuel utilization ratio from 1.0% to 60.0%. However, in 2012, the installed capacity of fast reactors is expected to account for only 0.5% of total installed capacity. In the next five years, ACMR-IBISWorld does not expect fast reactor (i.e. fourth-generation) technology to be mature enough to be widely applied in China.

Demand Determinants

Government policy

The development of the Nuclear Power industry in China is heavily regulated by governmental policy. The current government policy of encouraging low-carbon power generation has been driving the development of the industry.

GDP growth

Economic growth in China directly influences the power demand from manufacturing enterprises, which are the primary consumers of electricity in China.

Income levels

Growth in per capita household incomes in China in recent years has greatly benefited the domestic electricity market. Most nuclear power plants provide electricity to eastern coastal area residents, whose personal income growth rates have been higher than the average in China.

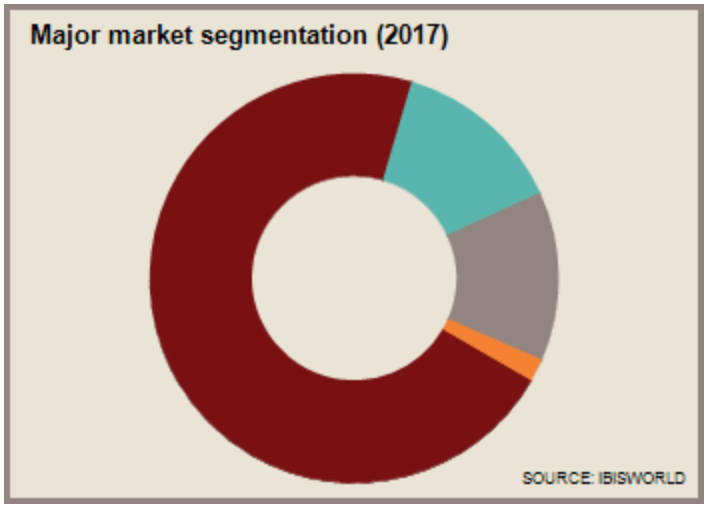
Nuclear technology

Nuclear power generation is a typical technology-driven industry. Advanced technologies can enhance the efficiency and reduce the production costs of the industry, driving down the price and stimulating market demand.

Electricity consumption per capita

China's per capita electricity consumption level was quite low at only 4,037.4 kilowatt hours per resident in 2015. In comparison, the consumption level in Organization for Economic Co-operation and Development (OECD) North America was already 11,113 kilowatt hours per resident in 2008. In OECD Pacific and Europe, the levels were 8,618 kilowatt hours and 6,287 kilowatt hours, respectively, in 2008. The relatively low level in China indicates that there is substantial potential for growth in the Nuclear Power industry.

Major Markets



Secondary industries	71.2%
Households	13.6%
Tertiary industries	13.4%
Primary industries	1.8%

Secondary industries

Secondary industries, particularly the manufacturing sector, are expected to consume 71.2% of nuclear power electricity in 2017. Over 90.0% of nuclear power electricity is transmitted to the East China Grid and South China Grid, which cover the coastal areas of Southeast China where secondary industries are well

developed. ACMR-IBISWorld anticipates that secondary industries will remain the major market for nuclear power electricity over the next five years.

Households

Households living around nuclear power plants are the second-largest market, accounting for 13.6% of total nuclear power electricity generation consumption in 2017. Most of these households are in the southeast of China, where incomes tend to be higher than the average in China, and power demand is high. As incomes increase, the amount of nuclear power electricity demanded by this market will grow.

Tertiary industries

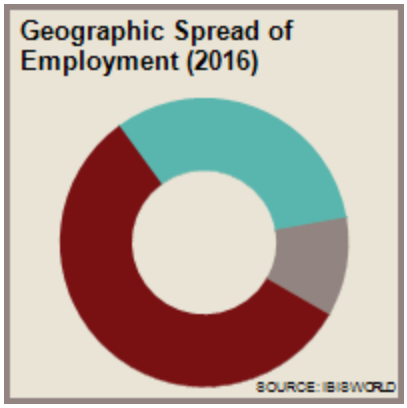
Tertiary industries, (i.e. the service sector) are estimated to account for about 13.4% of total electricity consumption in 2017. Service industries have been experiencing high growth in recent years, especially in coastal areas. ACMR-IBISWorld anticipates that the share of this market will grow in the future. Nuclear power generation is a typical technology-driven industry. Advanced technologies can enhance the efficiency and reduce the production costs of service industries, driving down the price and stimulating market demand.

International Trade

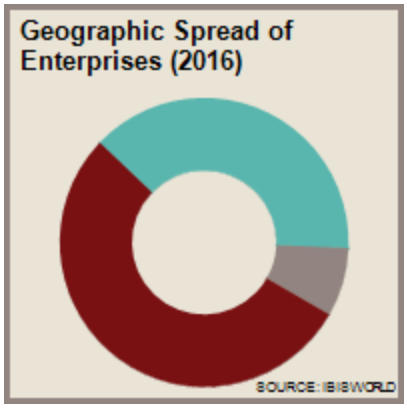
Exports in this industry are low and steady.
Imports in this industry are low and steady.

International trade is not a dominant feature of this industry. The only export trade occurs between the Dayawan nuclear power plant and Hong Kong.

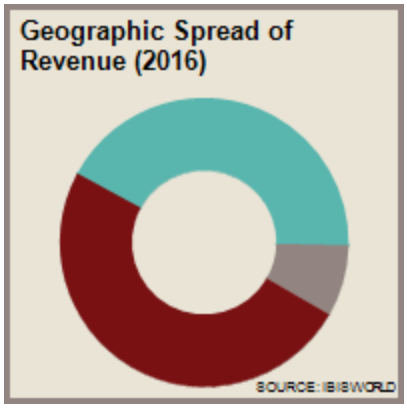
Business Locations



Region	Percentage
East China	56.6
Middle South China	32.2
North East China	11.1
North China	0.0
North West China	0.0
South West China	0.0



Region	Percentage
East China	53.8
Middle South China	38.5
North East China	7.7
North China	0.0
North West China	0.0
South West China	0.0



Region	Percentage
East China	49.6
Middle South China	42.4
North East China	8.0
North China	0.0
North West China	0.0
South West China	0.0

Currently, all nuclear power plants are located in the coastal areas, since the reactors need a large amount of water to lower their temperature during nuclear fusion. Further, the investments of nuclear power projects are significant, and wealthy coastal provinces have the means to build them.

Guangdong

Guangdong province is regarded as the vanguard in the Chinese Nuclear Power industry. Since most of the nuclear power plants need to be built in the coastal areas, Guangdong has an advantageous geographical position. Further, the construction of nuclear power plants needs financial support from the local government. As one of the wealthiest provinces in China, Guangdong's government can afford the expenditure of the construction project of nuclear power plants.

The two largest nuclear power stations, Dayawan nuclear power plant and Ling'ao nuclear power plant, are located in this province, and are expected to generate 36.5% of the total nuclear power in 2017. The revenue of Guangdong province nuclear power industry is estimated to account for 36.5% of total industry revenue.

Zhejiang

Zhejiang province operates China's oldest nuclear power plant, Qinshan nuclear power plant Phase one, which has been safely working for 21 years. Qinshan nuclear power plant Phase one was expanded, which is named Fangjiashan nuclear power station. In addition, the unit one and unit two of Fangjiashan nuclear power station were put into commercial operation in November, 2014 and February, 2015, respectively. In 2017, Zhejiang province is expected to earn 7.8% of total industry revenue and employ 12.2% of total workers.

In addition, by the end of May, 2016, the establishment of Sanmen nuclear power plant, a new nuclear power plant in Zhejiang, had been completed basically. In the next five years, Zhejiang province will expand and improve existing power plants.

Jiangsu

In 2006, Jiangsu opened its first nuclear power plant. In 2017, the output volume in Jiangsu will account for 7.8% of the total output in the industry, and its revenue will account for 7.8% of the total amount of the industry.

Fujian

Fujian put its first nuclear power station into production in 2013. By the end of June, 2016, there had been two nuclear power plants put into commercial operation, including Ningde nuclear power plant and Fuqing nuclear power plant. In 2017, the industry revenue in Fujian province is expected to account for 16.6% of industry totals.

Liaoning

Liaoning put its first nuclear power stations into production in the second half of 2012. The output volume share of Liaoning is estimated at 8.0% of the industry total in 2017.

Competitive Landscape

Market Share Concentration

The level of industry concentration is high.

The two major companies in the industry, China Guangdong Nuclear Power Group and China National Nuclear Corporation, account for an estimated 82.2% of the total in 2017.

Industry concentration has decreased over the past five years with the establishment of several new nuclear power projects by enterprises other than the top two. As the industry develops further, other enterprises are expected to enter the industry taking market share away from the top players.

Key Success Factors

The key success factors in the Nuclear Power industry are:

Must meet required safety standards

Establishments within this industry must comply with nuclear safety requirements. Projects that do not meet requirements will not be approved by the authorities.

Optimum capacity utilization

Higher capacity utilization is generally associated with lower unit costs and higher profit.

Ability to take advantage of government subsidies and other grants

Nuclear power plants require large investments for construction and the construction cycle is long. Therefore, government subsidies are critical to this industry.

Superior financial management and debt management

The level of debt of a firm has a major impact on its profitability as well as on its ability to invest in new capacity construction or expansion.

Ability to attract local support

Attracting support from local government and residents is important for enterprises as nuclear power plant construction requires large investments and construction cycles are long.

Application of advanced technology

The improvement of nuclear power technology can enhance production efficiency and thus profitability.

Cost Structure Benchmarks

Depreciation	20.8%
Tax and Interest	11.8%
Purchases	7.9%
Research and Development	6.5%
Management	5.8%
Wages	5.0%
Utilities	3.4%
Rent	2.5%
Other	1.3%
Profit	35.0%

Profit

The Nuclear Power industry in China has a very high profitability level. In 2017, profitability is estimated at 35.0% of revenue. The cost for the uranium needed to generated 1.0 kilowatt hour (KWh) of electricity by nuclear power is $0.001, much lower than per-unit fuel costs for traditional power plants. As nuclear power technology matures, the energy efficiency of the power plants will improve by 60.0% to 70.0%, ensuring that the industry's profitability remains high.

Depreciation

The share of depreciation in industry revenue has increased steadily during the past five years, reaching 20.8% in 2017. This reflects the increasing investment in capital equipment in the industry. ACMR-IBISWorld anticipates that the share of revenue absorbed by depreciation will continue to increase over the next five years.

Purchases

Purchases account for only 7.9% of the industry revenue due to the low consumption of fuel material. A nuclear power plant with installed capacity of 1,000 megawatts (MW) consumes only 1.5 tons of uranium, a small enough amount that it can be transported by one plane. Since China's nuclear power plants depend on imported uranium, the share of purchases fluctuates with global price changes.

Interest and tax

Interest and tax will account for a relatively large percentage at about 11.8% of total industry revenue in 2017. Loan is a significant feature of this industry due to the high level of investment required for the construction of nuclear power plants.

Wages and R&D

In 2017, wages are expected to absorb 5.0% of revenue. Nuclear power electricity generation is a high-tech industry, thus employees are highly skilled and highly paid. The average annual wage per industry employee person is estimated at $42,075 in 2017, significantly higher than the wage level of most of other industries. An additional 5.8% of revenue is allocated for management expenses in this industry.

Research and development is high in this industry, accounting for 6.5% of industry revenue. Advanced technologies can enhance the efficiency and reduce the production costs of the industry, driving down the price and stimulating market demand.

Basis of Competition

Competition is low and increasing

Since the Nuclear Power industry in China is dominated by two giant state-owned enterprises, and the barriers for enter into this market are very high, the competition level in this industry is low. Along with the rapid growth of this industry, more enterprises are expected to access to this market, which will increase competition over the next few years.

Approvals

Competition within the Nuclear Power industry starts during the project application phase. The approval of nuclear power plant projects is affected by many factors, including geography, transportation and water resources. Very limited locations meet the requirements in China, so competition for the approval of projects is high.

Availability of financing

The ability to raise funds is essential given the industry's high capital intensity and the particularly long construction cycle of nuclear power plants. The cost to construct a nuclear power plant is over $5.0 billion and a considerable portion is required as a precondition for project financing.

Human resources

The shortage of professional nuclear engineers in China is a big problem for enterprises in this industry. The training fee for a nuclear engineer is over $15,000. Along with the rapid development of the industry, talent competition is expected to intensify.

Nuclear fuel resources

China is not abundant in uranium, the main fuel of nuclear power plants. By 2020, China's uranium mines reserves will be able to satisfy only about a third of demand. As such, enterprises that can establish stable purchase channels for uranium will have a competitive edge.

External competition

The Nuclear Power industry in China faces competition from the Thermal Power Generation (IBISWorld industry report 4411) and Hydroelectric Power (4412) industries. These industries accounted for 71.9% and 21.6%, respectively, of total power generation in 2014. The share of the Thermal Power generation industry has been decreasing, while the share of the Hydroelectric Power industry has been increasing. However, the challenge brought by these industries is limited, since nuclear power plants are cheaper, more efficient, and cleaner.

In addition to the two traditional electric industries, nuclear power industry also faces competition from other alternative energy industries (4419), such as wind power (4419a) and solar power.

Barriers to Entry

Barriers to entry are high and steady.

Barriers to Entry checklist	Level/Impact
Industry Competition	Low
Industry Concentration	High
Life Cycle Stage	Growing
Capital Intensity	High
Technology Change	Medium
Regulation and Policy	Heavy
Industry Assistance	High

SOURCE: IBISWORLD

A large amount of money and considerable expertise are essential for new players to enter the industry due to high capital and technology requirements. Furthermore, the project plans require approval by the government, and the standards are very difficult to meet. Since there are many safety concerns surrounding nuclear power generation, the approval process is not expected to be easier in the future.

Currently, the Nuclear Power industry in China is dominated by state-owned enterprises. New players will be state-owned companies as well. Sensitive as this industry is, ACMR-IBISWorld anticipates that private enterprises will not be allowed to enter this industry in the next five to ten years.

Since existing enterprises have been investing significantly into research and development, the technology gap between new players and old ones serves as another barrier to entry.

Industry Globalization

The level of globalization is low and steady.

Currently, all enterprises engaged in the Nuclear Power industry in China are state-owned. Foreign companies are not currently allowed to invest in the industry, and ACMR-IBISWorld does not expect this restriction to be removed in the near future.

In addition, imports and exports are not characteristic of this industry. The only export trade occurs between the Dayawan nuclear power plant and Hong Kong.

Major Companies

Major Player	Market Share
China National Nuclear Corporation	43.6% (2017)
China Guangdong Nuclear Power Group	38.6% (2017)
Other	17.8% (2017)

China National Nuclear Corporation

Market Share: 43.6%

China National Nuclear Corporation (CNNC) was established in Beijing, in July 1999. Its predecessor is ErJi Bu, Ministry of Nuclear Industry and China Nuclear Industry Corporation. Under the direct management of the Chinese central government, CNNC has been devoted to the development of China's nuclear power industry. In the 1950s, CNNC successfully manufactured China's first atomic bomb and hydrogen bomb. In the 1990s, CNNC turned its attention to the development of the civil nuclear power industry, designing and building the first nuclear power plant in China. CNNC has developed into an integrated nuclear power business, engaged in scientific research and development, design and construction, and production and operation.

In 2002, to ensure the supply of the uranium mine for its nuclear power plants, CNNC International Limited (CNNCIntl) was founded, and incorporated in the Cayman Islands. The primary responsibility of this company is to exploit overseas uranium resources. CNNCIntl acquired 69.5% equity of Western Prospector Group Ltd., which is principally engaged in the acquisition, exploration and development of mineral properties.

In 2008, owning total assets of nuclear power of CNNC, China National Nuclear Power Co., Ltd. was founded. In 2015, the company was listed on the Shanghai Stock Exchange. By the end of 2016, the company had 13,251 MW of nuclear power installed capacity in operation and 10,377 MW of nuclear power installed capacity in construction. Mainly due to five sets of new reactors going operation in 2016, the sales revenue increased to $4.52 billion, up 9.2% from 2015.

Qinshan nuclear power plant

CNNC's Qinshan nuclear power plant Phase one was the first civil nuclear power project in China, established in Zhejiang in 1991.

Qinshan nuclear power plant Phase two project was approved by the State Council in 1987. CNNC held 50.0% of its equity. Reactors one and two were designed with installed capacity of 650 MW each, and were completed in 1996 and 1997, respectively. Among the 55 key components of Qinshan Phase two, 47 were produced in China. Following the accumulative electricity production reached 27 TWh, the reactor three and four expansion project started. After the accomplishment of the expansion project, installed capacity reached 2,700 MW. In 2003, China's first commercial pressurized heavy water reactor, Qinshan nuclear power plant Phase three, was established with installed capacity of 1,400 MW. CNNC owns 51.0% of its

equity. In the first half of 2016, the electricity to access grid of Qinshan nuclear power plant was 22,573 GWh.

Tianwan nuclear power plant

Tianwan nuclear power plant Phase one and two were constructed by CNNC (the dominant shareholder of Tianwan nuclear power plant) and China Power Investment Corporation. Its reactors one and two were combined to the grid in 2007, and six more reactors will be built in the future, making Tianwan will become a huge nuclear power base in east China. In the first half of 2016, the electricity to access grid of Tianwan nuclear power plant was 6,915 GWh, down 2.6% from the same period of 2015.

Sanmen nuclear power plant

In July 2004, the construction of Sanmen nuclear power plant was approved by the State Council. Located in the southern area of Zhejiang province, the electricity generation capacity of the Sanmen nuclear power plant is expected to surpass the combined capacity of Qinshan Phases one, two and three. By the end of May, 2016, the establishment of Sanmen nuclear power plant had been completed basically.

CNNC Sanmen Nuclear Power Corporation has the responsibility for the construction, adjustment, and management of the whole project. The dominant shareholder of this nuclear power plant project is CNNC; other investors include Zhejiang Energy Corporation Limited and China Power Investment Corporation.

Changjiang nuclear power plant

The construction of the Changjiang nuclear power plant was officially approved by the National Development and Reform Commission in April 2010. The total amount of investment in this project is estimated to be $3.0 billion. CNNC holds 51.0% equity in the plant, which is located in Hainan province. In total, the plant will be equipped with four reactors with total installed capacity of 1,300 MW. Reactor one was combined to the grid in November, 2015. In the first half of 2016, the electricity to access grid of Changjiang nuclear power plant was 1,707 GWh.

Fuqing nuclear power plant

CNNC is the dominant shareholder with 51.0% equity in the Fuqing nuclear power plant. Total investment was estimated at over $14.0 billion. Started in 2008, the first reactor of the project was put into commercial operation in 2014 and the second reactor went operation in October, 2015. In total, the plant will be equipped with six reactors with total installed capacity of 6,000 MW. In the first half of 2016, the electricity to access grid of Fuqing nuclear power plant was 6,529 GWh, up 58.6% from the same period of 2015.

China Guangdong Nuclear Power Group

Market Share: 38.6%

China Guangdong Nuclear Power Group (CGN), a state-owned enterprise, was founded in Shenzhen in September 1994. It is supervised by the State-Owned Assets Supervision and Administration Commission of the State Council (SASAC) of China. With registered capital of $1.6 billion, CGN has more than 30 affiliates. In 2016, total assets of CGN was $43.3 billion, and its installed electricity capacity for operating nuclear power plants was 20.38 GW. CGN also operates other new energy power plants, such as hydroelectric and wind power plants; the electricity generating capacity of nuclear power plants accounts for approximately 60.0% of CGN's total installed capacity. In 2015, the electricity to access grid of CGN was 88,346.9 GWh. In December 2011, CGN Uranium Development Corporation acquired Kalahari Corporation. After the acquisition, CGN held 89.5% of the equity of Kalahari Corporation, thus paving the

way for its takeover bid for ExtractResources. Extract's massive Husab uranium project in Namibia is the fourth largest uranium mine in the world. The acquisition guaranteed that the nuclear power plants owned by CGN will have an adequate supply of nuclear fuel in the future.

In March 2014, CGN Power Co., Ltd. was founded. In December 2014, the company was listed on the Hong Kong Stock Exchange. By the end of 2016, total installed electricity capacity for 19 nuclear power units in operation of CNG had increased to 20.38 GW, making up 60.6% of the total in China, and CNG had 9 nuclear power units under construction, with the total installed electricity capacity of 11.36 GW.

Dayawan nuclear power plant

The Dayawan nuclear power plant was the first nuclear power plant operated by CGN. It was combined to the grid in 1994. Almost all of the components of the plant were imported, since nuclear technology in China was not mature enough at the time. With installed capacity of 1,968 MW, the Dayawan power plant is the first commercial nuclear power station in China. Its electricity production is approximately 15 TWh per year. About 70.0% of the electricity it generates is transmitted to Hong Kong (accounting for 25.0% of electricity consumption in Hong Kong) and 30.0% is transmitted to Guangdong province. In 2008, CGN paid off the loans used to build the plant. In the first half of 2016, the electricity to access grid of Dayawan nuclear power plant was 7,271.2 GWh, up 14.2% from the same period of 2015.

Ling'ao nuclear power plant

Ling'ao nuclear power plant phase one is CGN's second commercial power plant. Established in 2006, the Ling'ao power plant was equipped with two pressurized water reactors with installed capacity of 990 MW. Its annual electricity production is about 15.3 TWh. In the first half of 2016, the electricity to access grid of Ling'ao nuclear power plant was 7,878.8 GWh, up 5.0% from the same period of 2015.

Ling'ao phase two was completed in September 2011, with installed capacity of 2,160 MW. All of the electricity produced by Ling'ao Phases one and two is transmitted to China Southern Power Grid.

Along with the completion of the second reactor of Ling'ao phase one, Dayawan Nuclear Power Base was finally set up. Consisting of the Dayawan nuclear power plant, and Ling'ao phases one and two, the Dayawan Nuclear Power Base became the largest nuclear power base in China in 2011.

Hongyanhe nuclear power plant

The Hongyanhe nuclear power plant is located in Liaoning province. Construction project began in 2008 and by the end of 2014, four reactors were established. In addition, the four reactors are expected to go operation by the end of 2016. The estimated investment is $8.0 billion, with 45.0% coming from CGN. After completion, annual electricity production will be over 30 TWh. In the first half of 2016, the electricity to access grid of Hongyanhe nuclear power plant was 6,799.7 GWh, up 36.4% from the same period of 2015.

Ningde nuclear power plant

Ningde nuclear power plant is the first nuclear power plant in Fujian province. The project was approved by the National Development and Reform Commission in September 2006, and construction began in 2008. The first reactor went into operation in 2012. On June 10, 2015, the third reactor went into operation. On completion of Ningde nuclear power plant phase one, the installed capacity will be at 4,000 MW. In the first half of 2016, the electricity to access grid of Ningde nuclear power plant was 8,207.6 GWh, up 13.5% from the same period of 2015.

Yangjiang nuclear power plant

Yangjiang nuclear power plant is the third nuclear power plant in Guangdong province. The entire project is being conducted by CGN Yangjiang Nuclear Power Co. Ltd. The first two reactors went into operation in 2014, and the second and third reactor went into operation in June, 2015 and January, 2016, respectively. In the first half of 2016, the electricity to access grid of Yangjiang nuclear power plant was 10,744.7 GWh, up 234.8% from the same period of 2015.CGN intends to develop Yangjiang into the second nuclear power base in Guangdong.

Other Players

State Power Investment Corporation

State Power Investment Corporation (SPIC) is established through the merger of China Power Investment Corporation and State Nuclear Power Technology Corporation in 2015.

State Power Investment Corporation is mainly engaged in hydropower, thermal power, nuclear power and new energy. At the same time, SPIC involves in industries including coal, aluminum, logistics, finance, environmental protection, high-tech industries, etc. At present, SPIC has achieved a total nuclear power installed capacity of 4,475 MW.

SPIC does not control the equity of any nuclear power plants in operation currently; however, it is a shareholder in the Qingshan nuclear power plant Phase three and the Tianwan nuclear power plant. Further, SPIC owns 45.0% equity of Hongyanhe nuclear power plant. SPIC is also engaged in the construction of the Haiyang nuclear power plant and Rongcheng nuclear power plant, both located in Shangdong.

CLP Group

Founded in 1901, CLP Group was one of the two electricity suppliers in Hong Kong. Its core business includes coal, natural gas, and alternative energy. The nuclear power electricity generation business of CLP Group is managed by its subcompany CLP Holdings Limited. In 1994, CLP Holdings Limited, in cooperation with CGN, established the Dayawan nuclear power plant project. CLP Holdings Limited held 25.0% equity. In 2011, CLP Holdings Limited invested $1.9 billion into the Yangjiang nuclear power plant project, accounting for 17.0% equity.

China Datang Corporation

China Datang Corporation was established in 2002; however, it did not begin to engage in the production and supply of nuclear power until 2012, when it invested in the construction of the Ningde nuclear power plant. Datang will gradually increase its focus on its nuclear power business. Considering its financial capabilities, Datang may become a competitive enterprise in this industry.

Zhejiang Provincial Energy Group Company Ltd.

Founded in 2001, Zhejiang Provincial Energy Group Company Ltd. (ZPEGC) is a State-Owned Assets Operating Organization. ZPEGC primarily engages in electricity generation, supply of coal, and exploration of natural gas. Its nuclear power business is mainly conducted by Zhejiang Electricity Development Corporation, which has invested in Qinshan nuclear power plant Phases two and three.

Shenergy Group

Shenergy Group was founded in 1996. Located in Shanghai, Shenergy invests in many industries, including electricity generation, finance, and oil. Shenergy holds equity in Qinshan nuclear power plant Phases two and three.

State Grid Corporation of China

Founded in Beijing in 2002, State Grid Corporation of China (SGCC) is a state-owned enterprise focused on electricity distribution. Although its primary business is not electricity generation, its subsidiary East China Grid Company is invested in the construction and operation of Qinshan nuclear power station Phase two.

Fujian Energy Group Co. Ltd.

Founded in 2009, Fujian Energy Group (FEG) is a new player in the Nuclear Power industry. FEG holds 10.0% equity in the Fujian Ningde nuclear power plant. It is forecast that FEG will be more competitive in this industry as the nuclear power plant in Fujian develops.

Operating Conditions

Capital Intensity

The level of capital intensity is high.

- This industry relies heavily on plant and equipment to generate revenue
- The nuclear power plant construction need more money and construction cycle is long

For every dollar spent on wages, management, and research and development in this industry, 1.2 dollar is invested in capital, indicating a high capital intensity.

Electricity generation involves the production of electricity, usually through the conversion of primary energy sources like uranium. It is a highly capital-intensive process, and the efficiency with which capital is employed has a major influence on operational costs. The Nuclear Power industry's high capital intensity is also due to the high level of technology involved in this industry.

Technology & Systems

The level of technology change is medium.

Achievements have been made in the field of nuclear power plant construction and operation in the past few decades in China. Second-generation pressurized water reactor technology (see the Products and Services section for more information) has matured enough to be employed in large nuclear power plants. Most nuclear power plants use the pressurized water reactors, and over 50.0% of power stations under construction will use the same technique.

Third-generation pressurized water reactor technology was applied in the Haiyang, Yangjiang, and Tanshan nuclear power plants, all of which are under construction.

On June 21, 2011, the China Experimental Fast Reactor was successfully combined to the grid, raising the fuel utilization ratio from 1.0% to 60.0%. This was the first application of fourth-generation nuclear technology. This technique is not yet mature enough to be used in large-scale nuclear power plants, however.

The Chinese government is very cautious in the application of new nuclear technology, especially after the accident in Fukushima, Japan. From laboratory to practical application, the development cycle of a new technique takes about 10 years.

Revenue Volatility

The level of volatility is high.

Industry revenue volatility is high level, as the Nuclear Power industry in China in the growth stage of its life cycle. In addition, it is significantly affected by government policies and regulations. For example, after the Fukushima Daiichi nuclear disaster in Japan, the State Council suspended approval of nuclear power plant projects.

Nuclear power electricity generation accounts for less than 5.0% of China's total electricity generation, so it is less sensitive to power shortages and oversupply in the overall market. However, the shortage of nuclear fuel in China makes this industry very sensitive to the global uranium price.

Regulation & Policy

The level of regulation is heavy and the trend is steady.

The Nuclear Power industry in China is heavily regulated. Safety is the most important factor that needs to be considered in the design, construction, and operation of nuclear power plants, so the quality of nuclear power plants is carefully controlled by the government.

Founded in 1984, the National Nuclear Safety Administration (NNSA) is in charge of the safe development of the Nuclear Power industry. NNSA promulgates laws and regulations regarding nuclear safety, radiation safety, radiant environment protection, and emergency rescue. In 1998, NNSA was merged into the Ministry of Environmental Protection of People's Republic of China.

As a power generation industry, the Nuclear Power industry is subject to regulation from the State Electricity Regulatory Commission (SERC). SERC was founded in March 2003, while the Office of State Power Institutional Reform was transformed from the former State Development Planning Commission to SERC. SERC is responsible for the overall regulation of the national power sector, including drafting laws, regulations, and development plans.

The State Development and Planning Commission (SDPC) is responsible for macro-planning and budget approval. The department of basic industries supervises nuclear power plant projects, and the department of product pricing and management is responsible for approving electricity prices.

The Nuclear Power industry is supervised by the Ministry of Environmental Protection of People's Republic of China (MEPC). MEPC is the primary government department in charge of environmental protection.

Since nuclear power plants consume a large amount of water during its operation, this industry is also supervised by the Ministry of Water Resources. Other governmental institutions that oversee the Nuclear Power industry include the Ministry of Finance and the State Environmental Protection Administration.

Safety regulations for nuclear power plant operation

The nuclear power plant operation safety regulations were issued by the NNSA in 1991, just before the establishment of the first nuclear power plant in China. The main purpose of the regulation is to ensure the regular operation of the nuclear power plants, and prevent accidents.

According to the regulation, the company in charge of the nuclear power plant must be responsible for the safety of the plant, as well as the safety of the surrounding environment. The operating company should also accept the oversight of the NNSA.

To ensure all the systems of the nuclear power plant run safely, the operating companies must set up operational limits and conditions, which must be audited by the relevant department of the NNSA. After the approval of the operating rules, the operating companies should ensure the implement of such rules.

The NNSA has the right to inspect nuclear power plants during their life time. If necessary, the operating companies should modify the operating rules in order to keep the power plants working in the best state. If accidents occur, the parameters of nuclear power plants should be kept in the normal range. When necessary, the nuclear reactions should be stopped.

Safety regulations for nuclear power plant design

The nuclear power plant design safety regulations were also issued by the NNSA in 1991. The purpose the regulation is to ensure basic safety requirement in the nuclear power plant designing process.

According to the regulation, the nuclear power plant construction company should be responsible for the radiation safety of the surrounding environment. When designing nuclear power plants, the designer

should consider the consequences of nuclear leaks, and develop measures to ensure the safety of residents. Radiation protection levels and the quality of the power plants should meet the national standard. When selecting the site of the nuclear power plants, designers should consider population, weather, hydrology, geology, and other relevant factors.

Industry Assistance

The level of industry assistance is high and the trend of industry assistance is steady

There are no specific tariffs for this industry.

Nuclear power electricity generation is a key industry to be developed by Chinese government, thus it enjoys a high level of assistance from the government. The substantial economic benefit created by nuclear power plants makes encourages local government to offer support to the nuclear power projects as well. The government offers favorable taxation policies, and banks offers low-interest loans.

According to the Chinese government's 12th Five-Year Plan, the total installed capacity of nuclear power plants will reach 90,000 MW by 2020. As such, the level of government assistance is expected to remain high over the next few years.

Key Statistics

Industry Data

	Revenue ($m)	IVA ($m)	Establish-ments (Units)	Enterprises (Units)	Employ-ment (Units)	Exports ($m)	Imports ($m)	Wages ($m)	Assets ($m)	Nuclear Power Output (Trillion Watt Hour)
2008	4,461.7	3,123.1	7	6	5,463	-	-	237.6	20,620.2	68
2009	4,601.7	3,037.1	8	7	5,568	-	-	281.2	21,455.5	69
2010	4,493.7	3,055.7	8	7	6,871	-	-	273.5	25,804.3	74
2011	5,189.6	3,373.2	8	7	8,221	-	-	284.1	25,418.0	86
2012	5,747.4	3,781.8	9	7	8,932	-	-	313.2	27,058.1	97
2013	6,402.7	4,257.8	12	9	9,758	-	-	350.8	42,454.9	111
2014	7,558.2	5,043.6	14	11	10,656	-	-	406.4	62,356.6	132
2015	9,734.8	6,503.8	16	12	11,615	-	-	482.9	68,182.8	169
2016	10,630.4	7,173.7	18	14	12,614	-	-	527.8	74,319.3	213
2017	11,427.7	7,826.5	20	17	13,623	-	-	573.2	81,230.9	250
2018	12,319.0	8,499.6	22	19	14,658	-	-	617.9	88,460.5	-
2019	13,230.6	9,171.0	25	21	15,699	-	-	661.8	95,979.6	-
2020	14,170.0	9,822.2	27	23	16,719	-	-	706.1	103,754.0	-
2021	15,119.4	10,460.6	28	24	17,689	-	-	750.6	112,365.6	-
2022	16,102.2	11,119.6	29	24	18,573	-	-	795.6	120,905.4	-

Annual Change

	Revenue (%)	IVA (%)	Establish-ments (%)	Enterprises (%)	Employ-ment (%)	Exports (%)	Imports (%)	Wages (%)	Assets (%)	Nuclear Power Output (%)
2009	3.1	-2.8	14.3	16.7	1.9	N/C	N/C	18.4	4.1	1.3
2010	-2.3	0.6	0.0	0.0	23.4	N/C	N/C	-2.7	20.3	6.6
2011	15.5	10.4	0.0	0.0	19.6	N/C	N/C	3.9	-1.5	16.9
2012	10.7	12.1	12.5	0.0	8.6	N/C	N/C	10.2	6.5	12.7
2013	11.4	12.6	33.3	28.6	9.2	N/C	N/C	12.0	56.9	13.7
2014	18.0	18.5	16.7	22.2	9.2	N/C	N/C	15.8	46.9	18.9
2015	28.8	29.0	14.3	9.1	9.0	N/C	N/C	18.8	9.3	28.4
2016	9.2	10.3	12.5	16.7	8.6	N/C	N/C	9.3	9.0	26.2
2017	7.5	9.1	11.1	21.4	8.0	N/C	N/C	8.6	9.3	17.4
2018	7.8	8.6	10.0	11.8	7.6	N/C	N/C	7.8	8.9	N/C
2019	7.4	7.9	13.6	10.5	7.1	N/C	N/C	7.1	8.5	N/C
2020	7.1	7.1	8.0	9.5	6.5	N/C	N/C	6.7	8.1	N/C
2021	6.7	6.5	3.7	4.3	5.8	N/C	N/C	6.3	8.3	N/C
2022	6.5	6.3	3.6	0.0	5.0	N/C	N/C	6.0	7.6	N/C

Key Ratios

	IVA/revenue (%)	Imports/ demand (%)	Exports/ revenue (%)	Revenue per employee ($'000)	Wages/ revenue (%)	Employees per est.	Average wage ($)
2008	70.0	0.0	N/C	816.7	5.3	780	43,492.6
2009	66.0	0.0	N/C	826.5	6.1	696	50,502.9
2010	68.0	0.0	N/C	654.0	6.1	859	39,805.0
2011	65.0	0.0	N/C	631.3	5.5	1,028	34,557.8
2012	65.8	0.0	N/C	643.5	5.4	992	35,064.9
2013	66.5	0.0	N/C	656.2	5.5	813	35,950.0
2014	66.7	0.0	N/C	709.3	5.4	761	38,138.1
2015	66.8	0.0	N/C	838.1	5.0	726	41,575.5
2016	67.5	0.0	N/C	842.8	5.0	701	41,842.4
2017	68.5	0.0	N/C	838.9	5.0	681	42,075.9
2018	69.0	0.0	N/C	840.4	5.0	666	42,154.5
2019	69.3	0.0	N/C	842.8	5.0	628	42,155.6
2020	69.3	0.0	N/C	847.5	5.0	619	42,233.4
2021	69.2	0.0	N/C	854.7	5.0	632	42,433.2
2022	69.1	0.0	N/C	867.0	4.9	640	42,836.4

Figures are inflation-adjusted 2017 dollars

NOTE: UNLESS SPECIFIED, AN ASTERISK (*) ASSOCIATED WITH A NUMBER IN A TABLE INDICATES AN IBISWORLD ESTIMATE AND REFERENCES TO DOLLARS ARE TO US DOLLARS.

Jargon

NUCLEAR REACTOR The core of nuclear power plants, where uranium or plutonium is converted to heat energy.

PRESSURIZED HEAVY WATER REACTOR Water reactors in which heavy water is used as a cooling liquid.

PRESSURIZED WATER REACTOR A second-generation nuclear power technology widely used in China.

URANIUM ORE A widely used nuclear fuel.

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