

Investment Opportunities in China's Industrial Gas Market

Due to their wide-ranging downstream applications and impact on the overall market, industrial gases have been dubbed the “blood of the industrials market” and hence play an important role in China's national economy. Industrial gases are widely used in metallurgy, petroleum, petrochemicals, chemicals, mechanical, electronics and aerospace and are of great importance to a country's national defense, construction and healthcare sectors. However, given the current economic downturn, slowdown in growth and excess capacity reduction, investors may be hard-pressed to determine where new investment opportunities and growth prospects lie. In this *Executive Insights*, L.E.K. Consulting assesses investment opportunities in this market.

Industrial gas value chain

The industrial gas value chain encompasses four major stages: raw material and equipment, gas production, gas supply, and downstream applications. The first three stages have been largely integrated already. Examples of each stage are outlined below:

- **Raw material and equipment:** air, industrial waste gas, basic chemicals, air separation units, gas tanks, etc.

- **Gas production:** air separation gas, synthetic air and specialty gas, etc.
- **Gas supply:** on-site pipeline, bulk transport of liquefied gas, gas cylinders, etc.
- **Downstream applications:** mainly metallurgy, chemicals, electronics, etc.

Over half of the global value share of the industrial gas market is made up of air separation gases (e.g., nitrogen, oxygen and argon). The remaining market share is split between industrial synthetic gas (e.g., hydrogen, carbon dioxide and acetylene) and specialty gases (e.g., ultra-high-purity gases and electronics gases), with 35% and 8–10% of the market share, respectively. Each of the three main downstream applications focuses on different raw materials: metallurgy favors the use of air separation gases, chemical processes primarily consume synthetic gases and electronics makes use of specialty gases.

Three main supply models exist to provide different levels of flexibility to customers. On-site gas pipelines are suitable for the supply of large quantities of gases and typically come with a lock-in contract period of up to 15 years with the same supplier. Alternatively, customers with medium-scale sourcing needs tend to use a bulk model with a shorter contract period, while small-scale customers use a cylinder model in order to maximize flexibility for the purchase of small quantities of gas.

The market: maintaining rapid growth

The global industrial gas industry has been growing steadily at 7.6% per annum in the past two years, and was valued at 98 billion USD in 2015. As the industrial gas market typically grows at two times

Investment Opportunities in China's Industrial Gas Market was written by **Yong Teng**, Principal; **Yiru Lou**, Consultant; **Webster Guo**, Senior Associate Consultant; and **Helen Chen**, Managing Director, in L.E.K. Consulting's Shanghai office.

For more information, please contact lekchina@lek.com.

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the rate of a country's GDP growth, L.E.K. forecasts the market to continue to grow at 7.3% from 2015 to 2018 — to be worth 122 billion USD in 2018. Global growth can be primarily attributed to the rapid industrialization of developing countries; increasing adoption of alternative energy also maintains growth in this market.

China's industrial gas industry is developing even faster, with the market growing from 82 billion RMB in 2013 to 100 billion RMB in 2015 at a rate of over 10% each year. Despite growth over the past 10 years, there is still considerable potential for development, since China's per capita consumption of industrial gases is still low compared with that of developed countries. L.E.K. expects that the industrial gas industry in China will maintain double-digit growth over the next two to three years to reach 135 billion RMB in 2018. Key drivers include 1) steady GDP growth (6–7%) and 2) the Chinese government's 13th Five-Year Plan's prioritization of eight industries, which is expected to boost key industrial gas end markets such as metallurgy, semiconductors and healthcare.

Additionally, Chinese industrial gas customers are increasingly abandoning the building of large factories that manufacture end-to-end, but are increasingly outsourcing their gas supply (currently 55% of gas is outsourced, significantly lower than 80% in developed countries). Outsourcing gas supply saves consumers from spending vast amounts on equipment and drives greater efficiency of capital allocation. Moreover, such outsourcing of ancillary services allows companies to focus on their core business, diversifying their risk. At the same time, this allows gas suppliers to build their operational capacity and improve the quality of the gas supplied. Such trends in the market have ushered in many new opportunities for specialized industrial gas suppliers in China.

Competition: multinational corporations still have the advantages, but locals are catching up

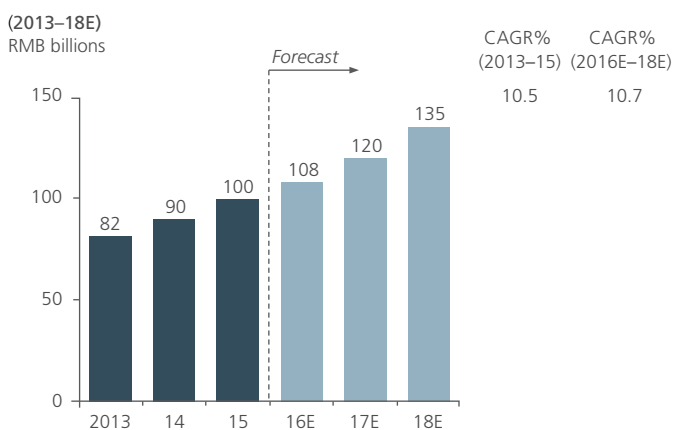
Four types of players exist within the industrial gas market.

- The “big four” multinational companies (Linde, Air Liquide, Air Products and Praxair) make up nearly half of the market for gas outsourcing; each has a revenue of over 6 billion RMB in China and operates more than 50 factories.
- There are five to seven large domestic (Yingde and Hangyang) and MNC (Taiyo Nippon Sanso and Messer) industrial gas players in the market. These companies make up around 30% of the market share, with revenues of 2–6 billion RMB and 30–50 factories each.
- The third-tier medium industrial gas companies consist of 20–30 domestic gas producers, including Jinhong Gas, Shanghai Pujiang, Nantong Tianyuan and Kaifeng Air Separation. These companies make up 10–15% of the market share with around 10 factories each in China.
- Lastly, there are more than 1,000 smaller manufacturers that make up 5–10% of the overall market share.

Presently, domestic players are still unable to compete with foreign players in terms of scale and technology. For example, Hangyang is the first domestic company able to offer medium-to-large-scale air separation units (>60k m³/h) and is a formidable player in the Chinese market, whose revenue reached three billion RMB in 2015 with 27 subsidiary gas companies across 14 provinces in China. However, Hangyang is still behind with regard to automation and technical capabilities. For instance, the American company Air Products allocates only 16 operators for each 80k m³/h unit, while Hangyang requires approximately 50 operators for its Guangxi Shenglong plant on the same scale.

Hence, Chinese companies must continually invest in R&D in order to compete with MNCs, while simultaneously positioning price and service as their key selling points. The private domestic company Jinhong Gas successfully researched and developed the capability of mass production of 99.9999% high-purity ammonia in 2012. Wide adoption in the domestic electronics industry allowed Jinhong Gas to rapidly capture over 50% of the market share, and reduced the domestic industry's reliance on imports. Merger and acquisition is also a key driver of growth: Jinhong Gas recently spent 163 million RMB acquiring seven industrial gas-related companies.

Figure 1
China's industrial gas market



Source: Chyxx.com, L.E.K. analysis

Downstream applications: the electronics industry offers attractive opportunities

Among the three major downstream applications industries, metallurgy and chemicals are traditional industries with great overcapacities, while we believe the electronics industry is more attractive for future investment opportunities due to 1) rapid growth in demand; 2) high reliance on specialty gas and advanced technologies; and 3) relatively low competition compared with other industries.

Industrial gases are indispensable raw materials used in manufacturing electronics such as semiconductors, flat-panel displays, solar cells and LED lighting. The electronics end market relies heavily on the use of specialty gases in various processes, including etching, film forming, doping and ion injection, and crystalline production.

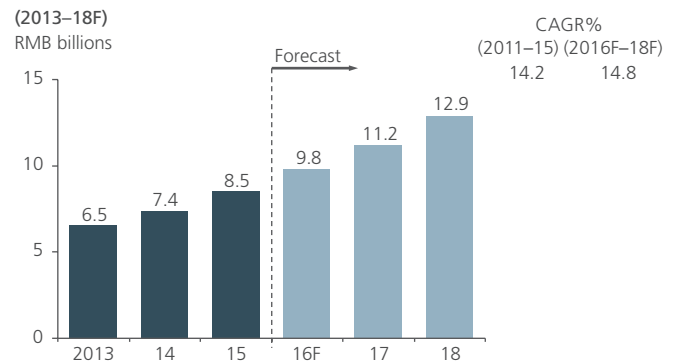
Rapid growth in demand

Using the semiconductor market as an example, the global market has grown at 4.3% per annum from 2011 to 2015 to reach the present value of 396 billion USD. With increasing demand for data processing, automotive electronics and internet-related services, the semiconductor industry is expected to grow at 5.1% per annum in the future to reach a value of 508 billion USD in 2020.

Asia Pacific represents the main driver of growth for the global semiconductor market, making up 69% of the global market in 2015. Within this, China makes up 41% of the region's market share and is the largest driver of growth within Asia Pacific.

The electronics industrial gas market in China benefits not only from the domestic electronics end market, but also from large foreign manufacturers setting up factories in China. While foreign direct investment accelerates growth in the Chinese electronics industrial gas demand, the Chinese government is simultaneously promoting the increasing application of industrial gases in the electronics market. R&D and the industrialization of high-purity specialty gases for the electronics market have been listed as major technical priorities for China in conjunction with manned spaceflights and lunar exploration projects within *China's national medium- and long-term plan for science and technology development (2006–2020)*. Although the electronics industrial gas market is a small subset of the overall industrial gas market, its rapid growth is very promising for investors. L.E.K. expects the specialty gas industry for the electronics end markets to grow up to 15% per annum in the next five years to a value of 13 billion RMB.

Figure 2
China's industrial gas in the electronics end market



Source: Chyx.com, L.E.K. analysis

High dependence on specialty gas and technology advancement

In addition to a rapid growth in demand, the dependence of the electronics end market on specialty gases is another source of opportunity, given the wide range of applications from semiconductors and flat-panel displays to solar cells and LED lights.

Unlike metallurgy and chemical industries, the electronics industry holds industrial gas suppliers to higher standards with regard to project experience, product coverage and technical specifications. Key purchasing criteria for the electronics customers include:

- Medium-to-large-scale air separation unit expertise: Deep know-how in site and pipeline design, strict safety compliance and strong operational support.
- Adequate portfolio in specialty gases: Certain VLSI (very large-scale integration systems) require over 50 kinds of specialty gases in more than 400 manufacturing processes.
- High purity: Key processes require levels of 6N (99.9999%) or higher.

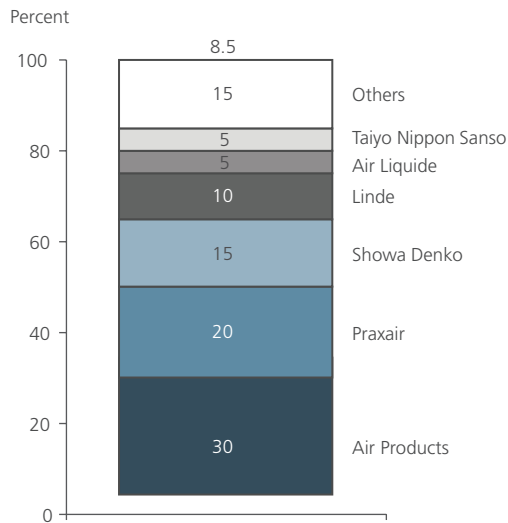
Relatively low competition

Because electronics specialty gas has such high technical requirements, the market is mostly dominated by foreign lead suppliers. Air Products, Praxair, Showa Denko, Linde and six other foreign manufacturers account for 85% of the market share in China.

Local players are able to produce and supply high-purity silane, ammonia, nitrous oxide and neon gas, and are expected to be able to provide CL2 and arsenic in the near future. Local specialty gas has a 30% share in the 8-plus-inch semiconductor market. However, the majority of local gas suppliers typically have small-scale operations and can't provide customers that mainly rely on price competition with a full range of services.

Figure 3
Market dynamics of China's industrial gas market for the electronics industry

China's industrial gas consumption in the electronics end market by manufacturers (2015)



Electronics specialty gas portfolio

Manufacturers	Electronics gas			Standard gas		Ultra-high-purity gas
	Hydride gas	Fluoride gas	Fluoro-carbon gas	Single-component	Multi-component	
MNC	Linde	✓	✓	✓	✓	✓
	Air Liquide	✓	✓	✓	✓	✓
	Air Products	✓	✓	✓	✓	✓
	Praxair	✓	✓	✓	✓	✓
	Taiyo Nippon Sanso	✓	✓	✓	✓	✓
Local	Yingde					✓
	Hangyang				✓	✓
	Jinhong	✓	✓	✓		✓

Source: Company websites, Chyxx.com, L.E.K. analysis







Growth opportunities: risks and rewards

With MNCs monopolizing the Chinese electronics gas market, we suggest domestic gas companies think about the following choices:

- Accelerate R&D:** Localization of specialty gases for the electronics industry is reliant on continued R&D investment. Domestic manufacturers could enter the electronics industry through segments that require lower technical capabilities and purity requirements first (e.g., Jinhong Gas now makes up 50% of the high-purity ammonia market).
- Cooperate with industrial gas research institutions:** Business could be improved through collaboration with gas industrial research institutes that have deep experience in similar projects. Potential Chinese partners to target could include Guangming Research & Design Institute of Chemical Industry (China's only specialty gas research institute) and the Liming Research Institute of Chemical Industry (China's leading fluoride research institute).

- Mergers and acquisitions within the industry:** The top-four MNC suppliers of industrial gas have continually strengthened their business through merger and acquisition activities. In 2015, Air Liquide successfully acquired Airgas; most recently, in December 2016, Linde and Praxair agreed on a potential merger that would create the world's largest industrial gas company. Domestic Chinese companies have also been active in the merger and acquisition space. For example, Baosteel Gases, with the help of Warburg Pincus, acquired Jinkai Gas, and Baosteel Gases acquired Anhui Hongsifang, etc.. Other domestic enterprises could also increase their competitiveness to enter the electronics industry market by using similar tactics to forge powerful collaborations.
- Pursue joint ventures with foreign manufacturers and facilitate technology exchange:** In the absence of suitable domestic targets, local companies can look to overseas targets by combining the strengths of local client relationships with foreign companies' leading technology capabilities (see Figure 4).

Figure 4
Examples of foreign industrial gas companies

Company	Headquarters	Comments
	Australia	Largest Australian-owned gas company that supplies specialty gases in addition to industrial process and medical gas
	U.S.	Supplies gases (specialty gases for the electronics industry, rare gases, hydrocarbons, halocarbons, pure gases, etc.) and cylinders to North American gas distributors
	Germany	Supplies specialty blended gas mixtures for a variety of applications including electronics manufacturing, power-generation utilities, etc.
	Japan	Supplies industrial gases (electronics material gases, air separation gases and basic chemicals), as well as energy, materials, agri-bio and foods
	U.S.	Supplies rare gases and specialty gas mixtures, gas handling equipment, and calibration gas standards
	Australia	Supplies specialty and high-purity gases in addition to equipment (cylinders, regulators and control systems), gas detection systems and other accessories

Source: Company websites, L.E.K. analysis

Investment considerations

L.E.K. believes there are still attractive industrial gas opportunities for private equity investment, especially with regard to specialty gases. The following points are worth deeper consideration when evaluating investment opportunities in this sector:

- What are the underlying drivers of these markets in China?
- What is the trend for the future?
- Who are the leading gas suppliers?
- Will there be new entrants?

- What requirements and specifications do customers have with regard to purchasing gas?
- How competitive is the target's offering compared with those of market competitors?
- What investments are required to fill capability and resource gaps?

Investors should simultaneously scrutinize the potential headwinds and risks in order to develop mitigation plans accordingly, such as the impact of macroeconomic fluctuations on the growth of target, end-market consolidation, the development of disruptive technologies by competitors, and the retention of senior management and key technical staff.

For further information, contact:

L.E.K. Shanghai

Floor 34, CITIC Square
1168 Nanjing Road West
Shanghai 200041
China
Telephone: 86.21.6122.3900
Facsimile: 86.21.6122.3988

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