
A COMPARISON OF U.S. & CHINA ELECTRICITY COSTS



INTRODUCTION

Manufacturing companies continually evaluate production costs in order to remain competitive. A search for lower costs led many companies to set up operations in China starting in the early 1990s. However, costs are constantly evolving and generally have been rising at a faster rate in emerging versus developing economies. Much has been studied and written on China's rising labor rates, driven historically by a combination of economic growth and demographic shifts resulting from China's One Child Policy and now by government policy to push up real wages in an effort to restructure the economy from one driven by investment and export toward one powered by consumption. Supply chain costs, which are impacted by shipping times and now falling fuel and transportation costs, have increasingly been analyzed as well. However, limited research has been conducted to date comparing electric costs in China and the United States. To fill this void, Biggins Lacy Shapiro & Co. (BLS & Co.), in cooperation with its Asia-based partner firm, Tractus Asia (Tractus), prepared the following comparison of electricity prices for industrial users in the United States and China.



ASSUMPTIONS & METHODOLOGY

In order to perform the analysis, assumptions have been made regarding usage and electric load characteristics. Readers should make note of these assumptions, as well as the fact that electric price structures can vary tremendously between locations and power providers. The following analysis has been undertaken to illustrate the relative differences between the costs of electricity in the U.S. and China. It should not be used for any specific location analysis.

Based on client experience, BLS & Co. and Tractus developed three test scenarios for use in the comparison. The following table represents a summary of the driving assumptions:

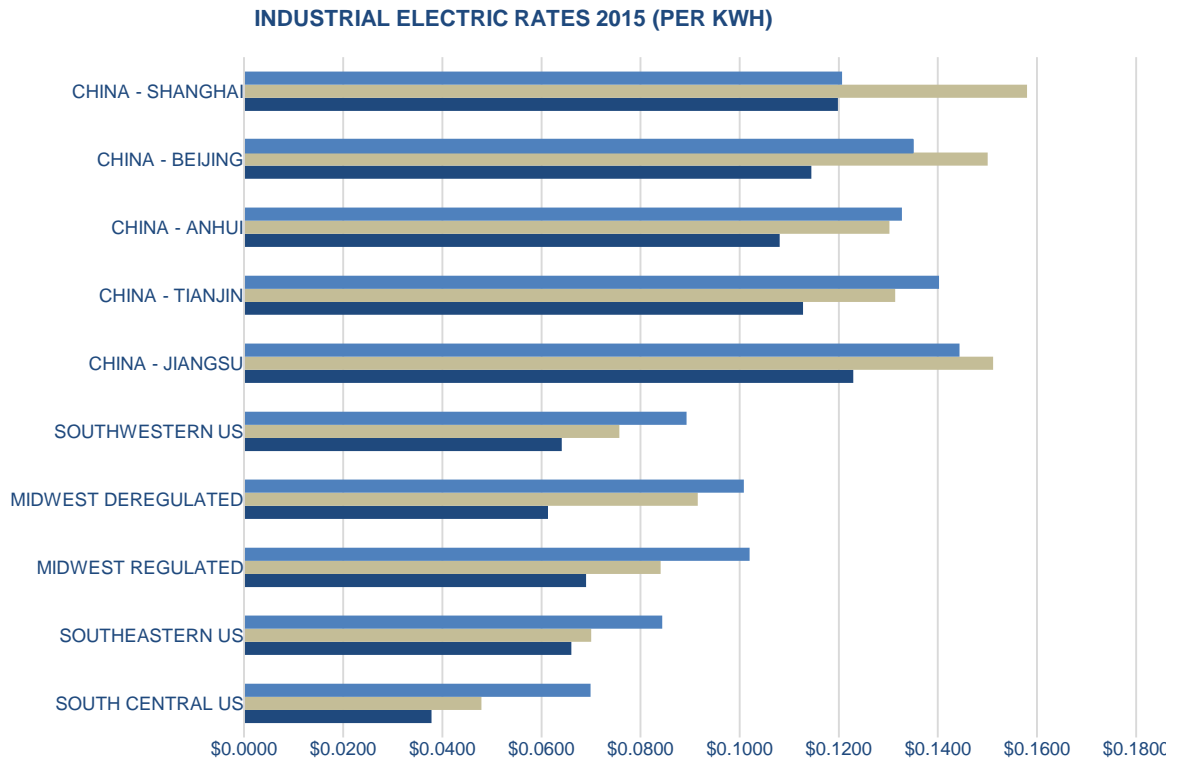
	Small Industrial Client	Medium Industrial Client	Large Industrial Client
Kw Demand	250	2,500	20,000
Full Load Hours (FLH; monthly)	350	400	600
Monthly kWh	87,500	1,000,000	12,000,000
Power Factor	85%	85%	90%
kVA	294.12	2,941.18	22,222.22
Annual kWh	1,050,000	12,000,000	144,000,000
Typical Service	Secondary 120/240 v 3P	Secondary 277/480 v 3P	Primary or Transmission >34,000 v
Duplicate Service	No	No	No

In both countries, electric costs vary according to a facility’s load characteristics.¹ For U.S. locations, BLS & Co. was able to work with utilities from across the country to develop the estimated U.S. costs. Tractus consulted with authorities from China’s State Grid Corporation in various provinces and municipalities. BLS & Co. energy specialists and Tractus engineers reviewed and refined the estimates to ensure consistency in relation not only to the assumptions used in making the estimates, but also the inclusion/exclusion of various cost categories. Estimates are fully burdened, including commodity charges, transmission and distribution/delivery charges, taxes and societal benefit fees (such as programs for conservation, renewal energy, etc.).

¹ Load characteristics refer to whether the facility requires a steady flow of power, or whether there are drop-offs and/or spikes in the usage. Variations in the amount of power needed will generally result in a higher cost per kWh.

COMPARATIVE RESULTS

Analysis results are shown in the following chart, which clearly indicates the U.S. has a cost advantage in the area of electric pricing.



As illustrated, median electricity prices for industrial loads in the U.S. tend to be 34-49% lower than Chinese prices, with point-to-point comparisons varying between a 15% and 70% savings in the U.S. In other words, Chinese industrial electric prices tend to be materially higher than those in the U.S., although the margin varies widely based on which locations are being compared. Additional variables exist, as well. For example, the Chinese government is actively discouraging investment in some heavy power usage sectors (such as cement producers) and imposing punitive surcharges of from US\$0.0076 - 0.0615/kWh for those companies.

CHINA ELECTRIC UTILITY AND PRICING STRUCTURE

Electricity rates in China are highly regulated and controlled centrally by the National Development and Reform Commission (NDRC), China's central economic planning ministry reporting to the State Council, which establishes rates by consumer sector as well as benchmark network charges. However, the actual tariff structure in each province is determined by the distribution network operator. In China the transmission of all electricity is controlled by two state-owned organizations, the State Grid Corporation in the north of China and the Southern Power Company in the south.

In China companies have limited flexibility to manage their electricity costs. Companies that can operate at lower supply voltages may be able to manage their rates somewhat. Small industrial users who require a low voltage supply, can sometimes qualify for commercial rates, which, although higher than the average medium industrial rate, are fixed throughout the day. In our example the costs for the small industrial user in Jiangsu province are lower than a medium user because the peak rates for the medium user are higher than the flat rate for a small user. In our example, the test case company was not operating at night during the low demand off-peak period, hence could not benefit from the much lower marginal rate during off-peak hours. While in principle consumers in China can purchase power in the wholesale market as a way to manage costs, in practice this has been limited to some very specific industry sectors, such as aluminum, and only on a trial basis.

Electricity consumed in office areas of a manufacturing facility is charged at a higher commercial rates. Companies must either use a separate meter to measure the office's consumption or allocate a certain percentage of their total consumption for the office area, as agreed by the Grid.

While China's electricity grid is reliable and doesn't require the ubiquitous back-up generation needed in other Asian locations like India, Myanmar and Cambodia, there are regional mismatches of generating capacity and supply that lead to forced shutdowns of operations during peak demand periods, usually in the summer. Some types of manufacturing are highly sensitive to power fluctuations and outages. These firms typically install back-up on-site generation and/or require dual feed (and sometimes dual source) electricity supply. Installing back-up emergency generation systems require special permission from State Grid or Southern Power and it is difficult to obtain. Companies must justify why they require it and how and when they will generate their own power. The power authorities do not permit individual firms to generate their own electricity either for their own use or for sale back to the grid. While the grid may be theoretically reliable, companies located in economic development zones (industrial parks) close to large metropolitan areas like Shanghai and Guangzhou are sometimes required to shut down during peak demand days during the summer when electricity demand for air conditioning use spikes or when air pollution conditions in some areas reach critical levels affecting public health.

Similarly, requesting dual feed (and dual source) power in China to enhance reliability requires special permission and a cumbersome application process, which is particularly difficult for companies located on the border of two grid areas where connecting to the adjacent grid may offer cost advantages.

LOOKING AHEAD

Electric prices in the U.S. have been stable or have seen downward pressure over the past two years. According to the U.S. Energy Information Agency (EIA), U.S. industrial electric rates increased 11.9% over the 10-year period from 2006 thru 2015 (1.2% annually). This is a result of a significant increase in the supply of natural gas, and the near record low natural gas prices. Many U.S. utilities are converting or shutting down coal generating facilities in favor of combined cycle natural gas plants. The price of natural gas and the environmental pressure to convert to cleaner fuels is driving this trend. The EIA has forecast virtually no price increase for 2016 and a 1.9% increase in 2017.

In contrast, electric rates in China have risen 17.5% over the past ten years, which equates to about 1.6% compound annual growth rate. But rates have already begun to fall in US dollar terms for several reasons. First, the U.S. dollar Chinese renminbi foreign exchange rate has softened by about 8.3% over the last six months, causing U.S. dollar denominated rates to fall a corresponding amount. Second, as coal prices and the Chinese economy have weakened over the last year, the State Council has reduced electric tariffs somewhat. In Jiangsu province, for example, electric rates for all classes of industrial users were reduced by US\$0.001/kWh as of April 2015 and further reduced by US\$0.005/kWh as of January 2016 for all but the largest industrial users.

The higher Chinese rates reflect the costs of paying for an entire national generation, transmission and distribution grid built in a little over 20 years during a period of rising capital and raw material costs. Thus, the gap between U.S. and Chinese electric prices is expected to remain more or less consistent over the next few years.

The longer-term is harder to project. We expect to see the central government under President Xi Jinping continue pushing forward reforms to China's electricity market to include more market-based pricing and demand signaling. As China does this, generation costs will become more closely linked to the global price of coal, its primary fuel source, which appears to be on a long cyclical downward trend, as cleaner, renewable sources gain favor. At the same time, however, China has also been tightening controls on emissions, which could have an upward impact on the price of coal-generated electricity.

In China, electric prices have also been used as leverage by the central government to make macroeconomic adjustments and use price signaling to incentivize efficient industry. Since June 2004, six energy-intensive industrial sectors (electrolytic aluminum, ferroalloy, calcium carbide, caustic soda, cement and iron and steel) were classified into four categories: Eliminated, Restricted, Permitted and Encouraged. Punitive Surcharges are applied to standard tariffs for users categorized as Eliminated and Restricted. The categorization is applied to individual companies in each of these sectors based on a combination of factors including the products produced, manufacturing process used and the energy efficiency of the process. For example in the iron & steel sector, hot-rolled strip (<1,450 mm wide) or hot dip galvanized sheet (with capacity <300,000 tons per year) is categorized as Restricted. In contrast, hot-rolled band is categorized as Eliminated. The State Council through the National Development and

Reform Commission (NDRC) maintain a guidance list of sectors and products by which the State Grid and Southern Power choose what Punitive Surcharge to apply.

The Punitive Surcharge was US\$0.0031/kWh for the Restrictive category and US\$0.0077/kWh for Eliminated category. Since June 2006, the Punitive Surcharge increased to US\$0.0077 for Restricted and US\$0.0308 for the Eliminated category and the policy applied to two more industries, phosphorus production and zinc smelting. In 2010, the State Council authorized provincial governments to further increase the electric price difference. As the result, Jiangsu province increased the Punitive Surcharge rate to US\$0.0462/kWh for the Eliminated category. In 2014, State Council required that provincial governments impose a minimum Punitive Surcharge of US\$0.0615/kWh for cement manufacturers classified as Eliminated and gave provincial governments the discretion to increase it further. This is the highest Punitive Surcharge in China to-date.

Recently, some provincial governments have started to use the differential electric price to penalize companies that can't or refuse to meet environmental protection requirements. In Jiangsu province, since Jan 2016, companies whose environmental standards compliance was classified as Red, the second worst compliance or Black, the worst compliance, will need to pay an additional US\$0.0077 or US\$0.0154 more than the standard tariff.

IMPLICATIONS FOR CORPORATE LOCATION SELECTION

Does this mean manufacturing operations in China will be moving to the United States? Corporate moves are never driven by one number alone. It is, however, safe to say that for most industrial operations, the electric spend is material. In our experience, electric costs frequently represent one of the top operating costs for energy intensive industries, such as plastics, metals, chemicals and pharmaceuticals. Electricity costs as a percentage of total production costs or value added in heavy industrial processes vary by sector, from a low of 12-16% for blast/basic oxygen furnace steel production and textiles, to 20-25% for electric arc furnace steel and copper, to 30-50% for aluminum and chemicals.

A comparison of this nature for all regions in China and the United States would have presented an insurmountable task. We chose to focus on those geographies most active in attracting new manufacturing investment, including reshoring. A review of aggregated published data in the U.S., as well as our client experience, shows the areas highlighted in this report tend to be among the lowest, although there are many exceptions. However, it should also be noted that manufacturing and reshoring activity does occur in other regions of the U.S. In some cases, cost savings in other categories may overshadow electric costs. Further, even in regions such as the Northeast, which is known for high utility prices in general, one finds some of the least expensive hydro power in the country. In other words, there is no single location that works best for all investments.

Companies that consume large amounts of electricity are advised to invest in a thorough analysis of power costs before making location decisions. Power rates and rate structures vary widely by location and over time. Data available from secondary sources and on-line is often overly aggregated and outdated. It is critical to undertake a thorough comparative analysis in each market of interest based on the latest information obtained through direct interaction with utility providers. The results of that analysis will need to be considered in the context of other location drivers, such as overall operational cost structures, quality of labor, speed to customer, and many other factors.

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