

ENERGY EFFICIENCY BUSINESS IN CHINA: A ROADMAP FOR AMERICAN COMPANIES

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ABSTRACT

China represents an emerging market for American energy efficiency technologies. Rapid growth and market reforms are driving increased demand for foreign investment and advanced technologies that will help China meet its energy needs while protecting its environment. The industrial sector is a particularly promising area for energy efficiency investments because many enterprises use equipment and processes that are decades old. Energy efficiency technologies for new buildings and appliances are also in demand. Barriers to doing business in China are significant, but can be overcome by companies that commit themselves to a long-term business development strategy. Companies interested in investigating these opportunities can take advantage of a variety of organizations, services, and events created to help them do business in China.

MARKET CONDITIONS

The pressures of market forces, power shortages, capital shortages, and environmental degradation have created tremendous opportunities for foreign companies to participate in Chinese markets for energy-efficient technologies.

The market reforms initiated in 1978 have dramatically reduced the state's role in the Chinese economy. The state sector's share of industrial output value dropped from 76 percent of the national total in 1980 to 34 percent in 1994. State allocation of goods shrank from 65 types of products in 1979 to 14 in 1995. Price controls in heavy industry and the communications and transportation sectors have been reduced. Most commodity prices are set by the market, although prices for a few key items, such as grain, cotton and petroleum products, remain under state control. China is working to meet World Trade Organization guidelines by reducing import tariffs and quotas and moving toward a fully convertible currency (16).

As part of the economic reform program, the Chinese government stopped paying the coal industry its annual subsidy of \$230 million. Coal prices began rising sharply in many areas in 1993 and continued to increase after being deregulated in 1994 (3). The

government reported that many major coal mines began to make profits in 1995 (14). Oil price reform, on the other hand, has taken two steps forward and one step back. After announcing several measures to open the market beginning in 1992, the government changed course in the summer of 1994 and re-centralized the pricing and distribution system (6). The government also stepped in to prevent social unrest by issuing price controls for the sale of coal and gas to residential customers in the spring of 1994 (2). Electricity prices, while still heavily regulated, are now rising faster than fuel prices in most areas.

As a result of the reforms, China's economy has grown dramatically and GDP is projected to continue to grow at an average rate of 8-9 percent per year. Although energy use grew only half as fast as the economy in the 1980s, production of China's primary fuel—coal—still doubled between 1978 and 1995 (12). With 1.28 billion tons of raw coal production in 1995 (11), China is the world's largest producer and consumer of the world's most carbon-intensive fossil fuel. Little wonder that China now has severe air pollution and acid rain problems, and has become the world's second largest contributor of greenhouse gas emissions, after the United States. These environmental problems are magnified by low efficiency throughout the energy system, from production and transmission to end use.

Also, partly because of inefficiency, electric power production has failed to keep pace with the demands of the booming economy. Frequent power outages lower productivity on the job and cause inconvenience in the home. The problem is so common that many local newspapers carry notices, rather like weather reports, of planned outages. The Ministry of Electric Power plans to raise installed capacity from less than 200 gigawatts (GW) to 300 GW between 1995 and the end of the century, an average of 24 GW per year. However, neither China's capacity to manufacture large power generators nor its capital resources are sufficient to achieve such a tremendous expansion (13). This explains why the Chinese government is so eager to attract foreign capital for power sector investments.

The government is also well aware, however, of the potential for energy efficiency to ameliorate energy-related economic and environmental problems. In the 1980s, the state invested significant resources in improving efficiency in key energy-intensive industries, as well as in improving the efficiency of motors, fans, and pumps in all industries. The government's goal for the 1990s has been to shift responsibility for efficiency investment from the public to the private sector. The State Planning Commission's China's Energy Conservation Investment Company (CECIC) was converted from a grant-making to a lending institution. CECIC's loans, which totaled \$300 million in 1993, are supplemented by funds from local governments, and each loan requires the enterprise to contribute a share of the investment (4).

The government has issued energy standards and a range of additional energy efficiency regulations which are now embodied in China's draft Energy Conservation Law. If the law is passed later this year, hundreds of local energy conservation technologies service and monitoring centers will be authorized to conduct audits and report their findings to the government. Stronger legislation will enhance the demand for efficiency that is already growing as a result of existing energy regulations and of market and environmental pressures.

Foreign technologies and investment can play a key role in fulfilling China's need for efficiency improvements. Since China opened its doors in 1978, 240,000 foreign-funded enterprises have been established (15). Direct foreign investment in fixed assets now accounts for over 10 percent of the national total, and foreign-funded enterprises are now responsible for over one third of China's total foreign trade (10). American investments in energy and power in China totaled \$774 million in 1992 (5).

OPPORTUNITY AREAS

Economic and political forces are creating demand for energy efficiency in many areas. As poorly performing firms are allowed to go bankrupt, the survivors are more likely to invest in advanced technologies, such as industrial process controls, steam traps, and efficient motors, boilers and furnaces, that will give them a competitive edge. Rising electricity prices make end-use efficiency and cogeneration ever more attractive options, although low, controlled prices for delivered heat in most areas are still a serious barrier. City governments are under pressure to reduce pollution and costs by improving district heating systems. Foreign developers of hotel and office buildings are buying efficient lighting, thermostatic

control systems and appliances. Savvy Chinese consumers with growing levels of disposable income—not to mention limited wiring capacity—are also demanding high quality, efficient appliances that will save money in the long run through reductions in repairs and utility bills.

Improving Industrial Equipment and Processes

China's industrial sector offers great opportunities for foreign investment in energy efficiency. Industry currently consumes just over two thirds of China's total commercial energy (12). The types of equipment that consume most of China's energy are shown in Figure 1. The non-state share of industrial output has expanded considerably, but since the state dominates many heavy industrial sectors of the economy, it still accounts for a large share of energy use.

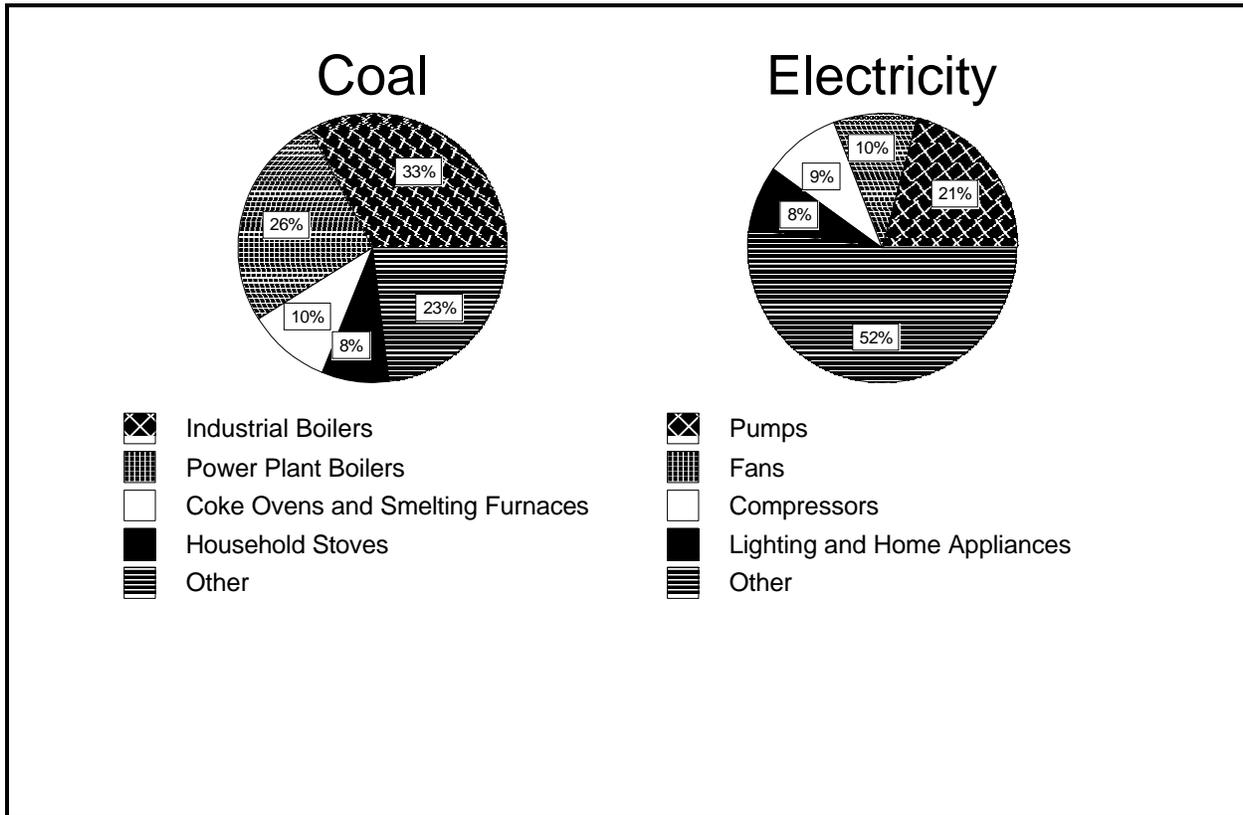
Studies of energy use in state-owned enterprises conclude that China has the technical potential to save 40-50 percent of the total volume of current energy consumption by raising its energy efficiency to advanced levels (1). This potential is defined as the savings that could be achieved if China's existing obsolete equipment and processes were immediately replaced with the world's most advanced technologies. While this type of wholesale replacement of equipment is not practical, the figure serves as a useful technical reference point.

An analysis of China's industrial boilers and furnaces provides striking evidence of the potential for conservation through industrial equipment upgrades (1). China's industrial boilers consume 8.6 quadrillion Btu (9.1 exajoules) of coal annually, about one third of end-use energy. If boiler efficiency were raised from the current 65 percent average to the 80 percent average attained by developing countries, then energy waste could be reduced by 1.6 quadrillion Btu (1.7 EJ) per year.

Industrial furnaces consume about one quarter of China's end-use energy. Industrial processes such as steel and glass production and copper smelting use 25 to 110 percent more energy per unit produced primarily because of the low efficiency furnaces used in China. If China's furnaces were raised to advanced levels, then China would reduce by around 40 percent the energy used by furnaces, or avoid wasting 2.7 quadrillion Btu (2.9 EJ) every year.

A wide range of these industrial efficiency improvements are economically feasible, according to case studies sponsored by the Global Environment

FIGURE 1. Energy Use by Equipment Type in China, 1990 (1)



Facility. Table 1 indicates that financial rates of return are high enough to justify investment in many cases, as long as the projects meet other selection criteria.

The energy conservation potential described above does not even include town and village enterprises (TVEs), which use inefficient, polluting, secondhand equipment and are supplied by small, inefficient power plants. Moreover, in many areas TVEs are surpassing state-owned enterprises in terms of investment capability and technical sophistication, providing a ready market for efficiency investments with good economic returns.

Reducing the cost of high efficiency electric motors is a particularly promising area for foreign investment. Chinese manufacturers already produce a series of high efficiency asynchronous motors called the YX series. However, YX series motors cost up to 50 percent more than lower-efficiency Y series motors because they are manufactured using more expensive materials. Although the cost of replacing a Y series motor with a YX series motor can be recovered fairly

quickly,¹ many motor users are unwilling to pay the high initial cost. Chinese manufacturers of high efficiency motors would like to license foreign technology or form a joint venture in order to improve their ability to reduce material inputs and lower the price of their products.

Foreign investment is also needed to promote the use of waste gas for power production in the iron and steel industry. Carbon-monoxide-rich waste gas produced by blast furnaces can be used to generate electricity at low cost while reducing pollutant emissions from the factory. For example, a 6 MW generator with capital cost in the range of 15-25

¹ A draft study the motor market in China by the Beijing Energy Efficiency Center (BECon) reports that an 11 kW YX series motor operating 4000 hours per year with a load factor of 0.75 will save 826 yuan (\$100) per year, assuming an electricity price of 0.6 yuan (7 cents) per kWh. The incremental cost of the efficient motor, 1900 yuan (\$229), can be repaid in 2.3 years.

TABLE 1: Financial Internal Rates of Return for Selected Energy Efficiency Investments in China (9)

<u>Investment</u>	<u>Percent</u>
Steel	
Conversion of open hearth furnace to basic oxygen furnace	16
Adoption of continuous casting	19
Reheating furnace renovation	36
Blast furnace gas recovery	41
Aluminum	
Kiln renovation	84
Ammonia	
Medium-sized plant restructuring	20
Small plant waste heat recovery	71
Caustic Soda	
Adopting membrane electrolyzer	29
Cement	
Medium-sized kiln renovation	15
Conversion from wet to dry process	19
Small-scale kiln renovation	35
Pulp and Paper	
Adoption of cogeneration	25
Black liquor recovery	25
Textiles	
Cogeneration in printing and dyeing	38
Caustic soda recovery	58
Computerized energy management	>100

million yuan, and no fuel cost because it runs on waste gas, can produce 36 GWh annually. Assuming an electricity price of 0.6 yuan per kWh, the value of energy produced would total more than 20 million yuan, enabling the plant to recoup its investment in less than two years.² The Beijing Energy Efficiency Center (BECon) has identified eight steel plants in China that are interested in using this technology.

² Figures are taken from BECon's draft survey of high priority energy efficiency technologies for China's industrial sector.

Recognizing the potential to profit from industrial energy conservation opportunities in China, some American companies have already begun working in this area. For example, a leading American controls company has formed a joint venture with a Chinese petrochemicals company to retrofit its oil refineries with process controls. An American steam trap company has formed a joint venture with a leading Chinese machinery company and a ministry. This venture is aimed at improving steam system efficiency in a variety of industrial applications. In a third case, a consortium of steel-industry-related companies has set up an office in China to pursue steel plant retrofits and related business opportunities.

Cogeneration³

Combined production of heat and power, known as cogeneration, accounted for almost 12 percent of China's installed thermal power generation capacity in 1993. The central government supported the development of cogeneration in the 1980s because it solved several problems at once: power supply expansion, energy conservation, and environmental protection. Responsibility for small-scale cogeneration is now shifting to provincial and local governments and the private sector, creating demand for foreign investment in this area.

The technical potential for cogeneration development is greatest in China's northern and eastern provinces because of the combination of low winter temperatures and high levels of industrialization. However, the booming coastal provinces to the south may also have great market potential because their demand for electric power and space cooling is greater. In areas of energy shortage, new plants can charge higher prices than the grid for sales to local customers. The actual price is usually negotiated between the electric power producer and the local government on a case-by-case basis. (Heat sales usually are not a promising source of income because the government heavily regulates heat prices.)

The textiles, food, medicine, paper, oil refining and chemical fertilizer industries are particularly strong candidates for cogeneration development. In-plant cogeneration units serving a single enterprise are likely to be the most profitable types of projects. Small district cogeneration facilities would be the next most

³ Information on the market for cogeneration in China is taken from a trip report by Fuqiang Yang of Lawrence Berkeley National Laboratory, cited with the author's permission.

profitable, followed by large central cogeneration plants. A larger system tends to be more expensive than a small one because the heat distribution system accounts for a higher percentage of the total cost and the construction period is longer. Also, government control of electricity and heat prices constrains the profitability of large projects.

While several foreign companies have expressed interest in investing in cogeneration in China, a single joint venture is yet to be formed. Lawrence Berkeley National Laboratory and Energy Resources International are working with the China Cogeneration Society to bring potential Chinese and American partners together at a cogeneration workshop in Washington, DC in June 1996.

Making New Buildings Efficient: Lighting, Controls, and Insulation

China's construction boom has created tremendous market potential for building components, such as lighting, controls, and insulation. However, the market is currently divided into cheap residential buildings, usually designed and funded in China, and state-of-the-art commercial buildings, often designed and funded by foreign developers. While the former represents a much larger number of buildings and tremendous technical potential, it currently represents a much smaller market for high-efficiency products.

The construction of inefficient residential buildings represents a tremendous waste of energy over the life of the buildings, but, as in the United States, there is little incentive for efficient construction for several reasons. The first is that municipalities are facing a housing crisis and are under pressure to provide housing as quickly and cheaply as possible. Second, the person who pays for the building is not always the same as the person who pays the utility bills, a situation that eliminates the incentive to consider lifetime cost. Finally, efficient construction represents a high initial cost while the cost of energy waste can be spread out over a long time. Demand for efficient residential buildings will remain stunted until new policies or changes in the market foster its growth. Some cities, however, foster introduction of efficient building technologies by sponsoring "building efficiency zones," a nationwide effort supported by the Ministry of Construction.

Despite the barriers, several American companies have begun marketing efficient building products in China, primarily targeting the commercial sector. Two American companies have successfully penetrated the market for thermostatic controls in China's commercial

buildings. One of these companies intends to continue to market exclusively to China's commercial building market, while the other has a long-term goal of providing integrated control systems for water and air heating and cooling in all types of Chinese buildings.

A leading producer of fiberglass insulation has set its sights on China's huge residential building sector. Because of the high risk involved, this American company's plants in China are initially producing fiberglass pipes for municipal sewage systems. Meanwhile, the company is seeking policy changes at the municipal level to spur investment in residential building efficiency. The firm is also encouraging design institutes to specify the use of insulation in residential building construction.

Several American companies have also done business in China's efficient lighting market. For example, two American companies contributed to the formation of joint ventures that produce compact fluorescent lamps in China. One company supplied the capital for the venture, while the other sold the jointly owned enterprise a turn-key production facility, a technology license, and technical training.

Consumer Goods: Appliances

China's growing economy is producing more consumer goods, such as appliances, and putting more money in the pockets of a growing middle class. Household electrical appliances have become extremely popular, particularly among urban Chinese. Urban residents' ownership of refrigerators increased from less than one percent in 1981 to 62 percent in 1994. The rate of air conditioner ownership increased from zero to 5 percent during the same period. Meanwhile, clothes washer ownership grew from 6 percent to 86 percent between 1981 and 1993 (7). Demand for appliances is expected to continue to grow as more big-city dwellers buy air conditioners and residents of smaller cities and well-off rural areas purchase their first washing machines and refrigerators.

Chinese appliance production has surged as a result of this tremendous demand. Refrigerator production may reach 8 million units per year, and production of room air conditioner units may reach 6 million units per year in 2000 (7).

American appliance manufacturers have not exported their products to China because the combination of transportation costs and import duties would price them out of the market. Until recently, these companies have attempted to penetrate the appliance market only through technology licensing

and technical assistance contracts. Now they are trying to break into the market through joint ventures.

The Chinese government has allowed the formation of several air conditioner joint ventures (8), but barred joint ventures in the refrigerator industry until 1994 because it judged Chinese refrigerator manufacturers to be successful without foreign investment. The government is most interested in approving joint ventures in those sectors that are judged to be in dire need of investment and with those state-owned enterprises that are on the verge of bankruptcy.

On average, Chinese appliances are less efficient than those produced in developed countries, in part because national efficiency standards are lower. However, energy efficiency varies widely among different brands of appliances produced in China. Manufacturers of highly efficient appliances will find a small but growing market for their products, particularly if they incorporate the characteristics most important to Chinese consumers: quality, repair service, competitive price, and name recognition. At least one American company has formed a refrigerator joint venture, and several others have invested in air conditioner joint ventures.

BARRIERS

While energy efficiency investment opportunities abound, so do obstacles. The main barriers to doing business in China relate to cultural differences, legacies of central planning, and infrastructure limitations.

China's weak infrastructure will pose familiar challenges to companies that have worked extensively in developing countries. The scarcity of phone lines and computers, particularly outside major cities, slows down transactions and basic business communication. The lack of standard computerized records makes market research difficult. Bottlenecked rail lines and poor roads cause major delays in the distribution of goods. The shortage of skilled labor will also come as no surprise.

China's economy, like other formerly planned economies, still suffers from inefficient and incomplete organizational structures needed for a smoothly functioning market. Bank reform in China is slowly but surely transforming government investment arms into commercial banks, while several new policy banks have been created to direct state investment in key sectors. However, many foreign firms find it nearly impossible to get loans from Chinese banks and almost

as hard to obtain sovereign guarantees from the Chinese government for foreign loans.

A shrinking but not insignificant share of goods is still produced by state-owned companies. Ministries and local governments continue to interfere in operations of firms whether they are state-owned or not. Chinese currency is not yet convertible, although the government predicts that it will be by 2000. Meanwhile, companies wishing to take their profits out of the country must convert their yuan at swap markets or earn foreign currency by exporting their products.

China has made progress toward meeting international business and trade norms, but still routinely faces a range of complaints from foreign investors and trading partners. Foreign companies working in China have difficulty protecting their intellectual property and ensuring that contracts are binding. Foreign exporters sometimes find their sales limited by China's import quotas and other protectionist policies. Laws, regulations, and approval procedures are opaque and vary from province to province.

Perhaps most jarring to foreigners are the cultural barriers. Chinese business people often have attitudes toward law, government and the business relationship that differ from those of their foreign partners. The Chinese partner usually views a joint venture contract as a flexible guideline and expects to negotiate changes throughout the period of the contract, whereas the foreign partner sees the contract as a final agreement. Chinese companies usually acquiesce to the expediency of cultivating good relationships with ministries and local governments through expensive gifts and favors, which their foreign partners consider to be bribes and kickbacks. These are just two examples of the general emphasis on trust, flexibility, and long-term relationships in Chinese business culture, in contrast to the emphasis on enforceability, consistency, and immediate service on the part of foreign business people.

It is difficult to generalize much further about infrastructure, market conditions, and culture in China because they vary so widely from city to city, between the coast and the interior, and between the state and non-state sector. Beijing's business climate is dominated by the government, while Guangzhou is more free-wheeling and Shanghai falls somewhere in between. Foreign investment is concentrated in China's large coastal cities, but is slowly moving inland, despite infrastructure limitations, in search of cheaper labor and land. Businesses in the non-state sector are less regulated, but they have greater difficulty

than their state sector counterparts in obtaining bank loans. Even dialects are so different that people from Guangzhou cannot understand the speech of people from Shanghai. Everyone learns Mandarin in school, but that does not prevent potential business partners from conferring among themselves during negotiations in a dialect that the translator cannot understand.

HOW TO DO BUSINESS IN CHINA

The combination of opportunities and barriers may leave American firms with mixed feelings about investing in a joint venture or even marketing their technology in China. Some tips on conducting market research, finding a partner, and negotiating a deal from American companies that have already taken the plunge may help them decide whether and how to proceed.

Many American companies find that the cultural chasm between them and their Chinese counterparts prevents them from obtaining even the most basic market information. Companies employ a variety of strategies to overcome cultural barriers to doing market research. One way is to hire a Chinese or Chinese-American employee or consultant to conduct market research and make connections in China. Another route is to make frequent trips to China, visiting factories and officials in large and small cities on the coast and in inland areas.

Trade mission and study tour trips may be helpful, but they usually result in deals only when they are part of a greater commitment to understanding the market. Such a commitment may include establishing a representative office in China to get field experience while conducting investigations. Setting up a representative office in Hong Kong is another popular option, particularly for those companies with an interest in the Asian market as a whole. Most companies find that forming personal connections with the main enterprises and government agencies in their field is essential to obtaining market information.

After meeting the key players, visiting factories, analyzing market data, and learning about relevant policies, companies can begin to formulate their market strategy. They may choose a limited strategy of selling a turnkey plant for hard currency, a single project that can be concluded in two to three years. In this case a small, flexible, technology-oriented company may be more successful at adapting its plant design to Chinese conditions than will a large production-oriented company. Or they may decide to make a long-term commitment to the Chinese market by establishing a joint or wholly foreign-owned venture.

Some ventures are set up to export to earn hard currency in the short term, but have a long-term goal of selling to the Chinese market. Rather than begin by exporting, some joint ventures sell to the Chinese market initially and either exchange their currency in swap markets or reinvest the profits in China. The company's strategy will naturally be shaped by its structure and goals and by the market for its product in China.

A joint venture strategy will also be influenced by the characteristics of potential partners. American firms will have to consider who owns the Chinese company—it could be the central government, a local government, an individual, or even the People's Liberation Army. Because markets and policies vary widely from one city to another, they will also need to consider the Chinese company's location. Other key considerations are the company's connections to influential government agencies and industrial "councils" that have taken the place of some of the ministries.

Demonstration of interest is another key element. Many Chinese firms will give any visiting investor a lavish banquet and sign an agreement or a memorandum of understanding, but only those that are truly interested will invest their own funds in visiting an American plant to see the technology.

Once the American firm has identified a Chinese partner, negotiations can begin. Given the need for a strong bargaining position, foreign firms are advised against holding a minority share. Ideally, the American company will control the board and choose the manager in order to maintain leverage while working on Chinese turf. If the Chinese company breaks its contract, the American firm can take them to court, but companies do better to invest time in finding an honest partner than to count on courts to help them out.

After a company has made its first deal or established its first factory in China, it will have a much clearer idea of how to proceed. The firm may decide to build more factories in key locations where demand is higher or labor is cheaper. Or it may seek other companies to help it distribute its products in China.

The combination of business opportunities and obstacles means that foreign companies interested in forming joint ventures do best when they enter the market slowly, doing extensive research on the local business climate, regional market for their product, and reputation of potential partners. Doing business in China is not quick and easy—companies must be

prepared to make a long-term commitment to the Chinese market and their Chinese partners.

GETTING STARTED

If this introduction has piqued their interest, American companies serving the energy efficiency market may wish to learn more about existing groups, activities, and publications created to facilitate their entry in the China market. One such set of groups is the U.S.-China Energy Efficiency Teams organized by the U.S. Department of Energy (DOE) and an interagency Chinese coordinating group. DOE can direct companies to the appropriate team leader to learn more about specific activities, such as study tours, training sessions, and demonstration projects. The Information Exchange Team publishes a monthly electronic bulletin, China EE Info, summarizing the activities of the other teams and related events. Back issues of the bulletin are available on the World Wide Web at <http://w3.pnl.gov:2080/china>.

Another helpful organization, particularly for large companies, is the U.S.-China Business Council. The council represents the interests of American companies working in China to both the American and the Chinese government. The council's magazine, China Business Review, contains articles on a wide range of subjects from banking reform to product distribution in China, all specifically addressing the concerns of American firms.

Companies can learn more about the China market by participating in an energy technology conference and exposition, such as Energex '96, scheduled to take place in Beijing this summer. Or, to find out about marketing their products in energy efficiency training sessions or demonstration projects, companies can contact BECon, the Beijing Energy Efficiency Center.

Information about all these groups, activities, and publications can be obtained by calling the Committee on Energy Efficiency Commerce and Trade's Instant Response Information System (IRIS) at 1-800-779-0135.

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