Overseas Market Information

Market Survey Report on the China Motor Systems

Economy

By October 1, 1999, the PRC had undergone a glorious yet tortuous course of 50 years, amid great changes in Chinese society.

Before the founding of New China in 1949, China's highest yearly outputs of major industrial and agricultural products were 445,000 tons of yarn, 22.79 billion meters of cloth, 61,880,000 tons of coal, 320,000 tons of crude oil, 6 billion kwh of electric energy production, 150 million tons of grain, and 849,000 tons of cotton.

Since the founding of New China, especially in the 20 years after the start of reform and opening to the outside world in 1978 China has made great achievements in economic construction and social development.

In 1998, the GDP was 7,955.3 billion yuan, an increase of 6.4 times over 1978, at constant prices; the outputs of some major industrial and agricultural products, such as grain, cotton, meat, edible oil, coal, steel, cement, cloth and TV sets, leapt from a backward position to first place in the world.

In accordance with Den Xiaopeng's theory of building socialism with Chinese characteristics, the 13th National Congress of the CPC, held in 1987, adopted the strategy of three stages for China's economic construction; First, doubling the GNP of 1980 to end shortages of food and clothing, which was basically completed at the end of the 1980s; Second, quadrupling the GNP of 1980 by the end of the century, which was achieved in 1995, ahead of schedule.

Thus the Chinese government worked out the Ninth Five-Year Plan for National Economic and Social Development and Long-Term Objectives for the Year 2010, which put forward new objectives; Those for the Ninth Five-year Plan (1996-2000) were as follows - Complete the second phase of the strategic plan for the modernization drive in an all-round way and quadruple the per capita GNP of 1980 in 2000, when the population will have increased by about 300 million over that of 1980; raise the people's living standard to that of a fairly comfortable life, with poverty practically eradicated; and expedite the formulation of a modern enterprise system and initially establish the basis of a socialist market economy.

The objectives for the year 2010 are to double the GNP of 2000 so that the people will enjoy even more comfortable lives, and bring a more or less complete socialist market economy into being.

With the fulfillment of these goals China's productive forces, overall national strength and the people's living standards will have gone a big step further, and the country's social and economic aspects will have undergone historic changes, laying a solid foundation for the realization of modernization.

It has been only in recent years that the economy of China has improved. Early in history, it was an agricultural controlled culture, manned by the peasants. Essentially, it was an economy owned by a unitary public. It was a weak economy in which there was an unbalance between industries.

At first, China had a potentially progressive economy, however it seemed to diminish during the 13th and 14th centuries. One due to the massive amount of manpower available, which in turn discouraged the development of time saving methods.

The other was the strict rule of the government, one that didn't encourage personal initiatives and creativity. It lacked vitality and life. Because of its weak economy, it fell easily to political powers stronger that itself. By 1949, China was ready to reconstruct the country.

Unfortunately, most of the industries were around the coastal regions, where most of the foreign companies had set up business. It was during this time that economic policies were set into play. First, it was important to strengthen the role agriculture played.

Second, the imbalance with industry between the coastal regions and the inner regions needed to be corrected. In order to do so, a plant was built in towns without industry, closer to where the raw materials could be obtained. To open up desert areas for further expansion, they improved land drainage, river control and dam construction. Also, they laid out improved roads and further expanded the railway system.

By 1976, another five-year plan was set into motion. Reforms were introduced in agriculture and industry. Mainly to encourage private, profiteers to the economy.

It was during the 7th five-year plan that the economy began to improve. Prices, taxation, credit and wages were regulated. Also, coastal regions and towns were given economic privileges, including better working conditions. These led to a larger increase in the gross national product. It also led to higher levels of inflation and helped to decrease the budget deficit.

The 8th five-year plan was a continuation of improving raw material production.

By 1992, state controlled industry declined, given precedence to the private industries. Since reformation, many outside foreign companies have been interested in China. However, most of the interest has been relegated to the coastal areas. Those on the interior of China have had the least growth.

This is one of the problems faced with economic growth. Another is the loss incurred by the state run industries. In turn, many workers are leaving the inland industries and head to the coastal provinces for better work.

The ninth five-year plan put together new objectives. One of which was to continue with the plan for modernization in an all-round way. Also, to raise people's standard of living and have poverty almost erased. Basically, establish the basis of a socialist market economy. By 2010, China hopes to double the gross national product of the year 2000, to bring people to an even more comfortable standard of living.

China has maintained favourable trade relations with other countries since the 1990's. Unfortunately imports from South Korea, Japan, Taiwan and Hong Kong are higher than exported goods. These countries generally are importing machinery, transport equipment, and chemical products into China. The three top trade partners are Hong Kong, Japan and the USA.

Manufacturing Industry

China's manufacturing industry, after the reform and opening up twenty years ago, has been developing rapidly with increased product catalogues and improved producing technology. "Made in China" has grabbed a rather advantageous position in international division of labour and the nation is transforming from a processing and assembling base of transnational corporations to a center of production.

Besides, China's manufacturing industry has become quite competitive in many trades, currently with the added value of equipment manufacturing taking the world fourth place, next only to the US, Japan and Germany.

Manufacturing industry refers to the 29 trades except for excavation and public (electricity, gas and water) which process and reprocess raw materials (excavation and agricultural products) and assemble parts.

From 1980 to 1998, China saw a yearly average of GDP growth at 9.94 per cent, while that for the manufacturing industry registered at 12.65 per cent for the same period. The total output of the industry had reached 3500 billion yuan by 2000 with its added value in GDP's proportion remained around 40 per cent for many years. Half of China's national revenue came from the industry as it brought jobs to half of employed population in cities and half extra rural labours. Since the 1990s, industry products have taken over 80 per cent in exportation and earned about 75 per cent foreign exchange income for the nation.

Rising of the manufacturing industry was marked by "world first" output of over hundred types of important products such as iron and steel, cement and digital programme control exchanges. In 1990, China's steel output only stood at 66 million tons, but which surpassed 150 million by 2001. Traditional products as colour TV, washing machine, textile and containers all have become competitive and number of light industry products had developed from several thousand kinds to over 300,000 during the 9th Five-year Plan period (1996-2000).

Expanded quantity brings changes in quality. "Made in China" has developed from simple to hi-tech and sophisticated products. Twenty years ago almost all digital machine tools were imported from abroad but now China boasts 1300 types of its own make. The 30 MW generator and 60 MW sub-critical pressure generator, all designed and produced on our own, have been at world advanced level. "Made in China" is now enriching itself in the country's opening up. Nearly 400 of world top 500 strong have invested over 2000 projects in China and world chief producers of telecommunication equipment, chemistry, automobile and machinery have all extended their production network to China. "Made in China" will enjoy a more and more important position in the world.

Electric motor systems are widely used in China to power fans, pumps, blowers, air compressors, refrigeration compressors, conveyers, machinery, and many other types of equipment. Overall, electric motor systems consume more than 600 billion kWh annually, accounting for more than 50% of China's electricity use. There are large opportunities to improve the efficiency of motor systems. Electric motors in China are approximately 2-4% less efficient on average than motors in the US and Canada. Fans and pumps in China are approximately 3-5% less efficient than in developed countries. Even more importantly, motors, fans, pumps, air compressors and other motor-driven equipment are frequently applied with little attention to system efficiency. More optimized design, including appropriate sizing and use of speed control strategies, can reduce energy use by 20% or more in many applications. Unfortunately, few Chinese enterprises use or even know about these energy-saving practices. Opportunities for motor system improvements are probably greater in China than in the US.

In order to begin capturing these savings, China is establishing a *China Motor Systems Energy Conservation Programme.* Elements of this programme include work to develop minimum efficiency standards for motors, a voluntary "green motor" labeling programme for high-efficiency motors, efforts to develop and promote motor system management guidelines, and a training, technical assistance and financing programme to promote optimization of key motor systems.

The Current Situation in China

In 1998, China consumed 1159 billion kWh of electricity (SSB 2000), which is about 36% of U.S. consumption (EIA 2000a), and ahead of all other countries (EIA 2000b). Of this figure, about 60% was consumed by motors, split roughly evenly between fans/pumps and other equipment. The installed capacity of electric motors in China exceeds 450,000 MW (CECIDC 2000).

In the following sections, we briefly describe the Chinese market for motors, including the market for motors, motor-driven equipment (e.g., fans, pumps and compressors), speed control equipment, and motor system design services. Following this, we briefly summarize the many opportunities to improve motor system efficiency in China, the barriers that hinder capture of these opportunities, and discuss current programmes and policies that are designed to overcome these barriers. This information is intended to provide context for a discussion later in this paper on a planned national programme to improve motor system efficiency in China.

China's Motor Market

Motors. In China, most factories operate on 380 volt, 50hz electricity, and most motors follow the IEC design parameters, the same parameters that are widely used in Europe. In China today, there are presently three series of motors in widespread use – the JO series (originally developed in the 1950s in Russia and redesigned in China in the 1970s), the Y series (designed in China in the 1980s), and the Y2 series (developed in China in the early 1990s). In general, the newer series of motors have better optimized designs and use less materials. However, while the newer series are better optimized, much of this optimization has been used to reduce materials – as shown in ***Table 1*** below, efficiency improvements from series to series are generally either small or non-existent. Under government regulations, the production of JO series motors has been banned since 1984, but these motors are still in place in many factories and now account for about one-third of the installed motor stock. Approximately 95% of motor sales in China are now of the Y series, with the Y2 series accounting for about 5%. In addition, a higher efficiency Y2e series has recently been introduced but currently is a special order item produced by just a few manufacturers.

Table 1. Comparative Efficiency of Chinese Motor Series

Motor Size		*Efficiency*			
KW	***Horsepower***	***JO***	***Y***	***Y2***	***Y2e***
.75	1	76.5	74.5	73.0	75.5
3.75	5	85.0	84.5	84.0	86.0
15	20	88.0	88.5	89.0	91.0
45	60	91.0	92.3	93.0	94.2
90	125	92.0	93.5	94.2	95.0

Values are for 4-pole motors. For JO, Y2 and Y2e, motors were tested according to the IEC test procedure. For Y motors, tests are according to a Chinese standard that is claimed to be similar in results to IEEE 112-B.

Presently, China has hundreds of motor manufacturers, ranging from small backyard manufacturers to large industrial enterprises. The top 15 manufacturers account for about half of the market. In recent years, economic growth has slowed in China (although growth is still rapid by international standards). With the slowdown, and due to economic troubles at many old state-owned Chinese factories, the size of the Chinese domestic motor market has shrunk significantly. As a result, competition in the domestic market is fierce, and customers are expecting steadily lower prices for motors. In this market, the majority of Chinese motor manufacturers are now losing money. On the other hand, the export market has been growing rapidly. The top-five Chinese manufacturers serve approximately half the export market.

China exports NEMA-design motors for the North American market (these meet the US. EPAct efficiency standards), Y2 motors for the European market, and Y motors for markets in the Middle East and Southeast Asia.

The majority of motors are sold to OEM manufacturers for installation in fans, pumps and other OEM equipment. However, about 40% of production is sold directly to users, either by manufacturers or through retailers.

Fans. Overall, China has an installed base of approximately 7 million fans, with a combined capacity of about 30,000 MW of power. Fans consume approximately 10% of the total electricity in China. In some sectors such as mining and the metallurgical industries, electricity consumption by fan systems can be much higher, reaching 20-30% (Wang 2000).

Currently, there are more than 4,500 different fan products produced in China by a wide range of manufacturers. By the end of 1997, there were 87 members in the Fan Manufacturing Association, most of which are small manufacturers. In 1997, Fan Manufacturing Association member plants produced more than 240,000 fans with a combined motor capacity of 2,690 MW. In 1997, the value of shipments by the Fan Manufacturer Association reached RMB 2.89 billion (approximately $ 350 million), a 10% increase over the previous year. Centrifugal fans, axial-flow fans and other types of special purpose fans account for more than 95% of product sales. For example, in 1997, axial-flow fans and centrifugal fans accounted for 23% and 31% respectively of product sales on a volume basis and other types of special purpose fans accounted for an additional 42% of sales (Xu 1999).

Fans manufactured in China prior to the 1980s primarily used Russian technology and the overall efficiency of these fans were 10-15% lower than advanced international standards of the time. In the 1980s, China began a sustained effort to develop new efficient fan products and to introduce advanced international fan manufacturing technologies (mainly from Japan and Germany). Even so, there still exists a gap in the overall standard of Chinese-made fans relative to international fans in terms of design, efficiency, overall performance, and manufacturing quality.

Currently, overall fan system efficiency is only 30-40%. The low overall efficiency of fan systems in China can be attributed to insufficient appropriate products in the marketplace, poor system design, motor over-sizing and poor operational practices. In order to increase the overall system efficiency, since 1982 the Chinese government has issued regulations to phase out (ban production of) outdated fan products and promote new efficient products. So far, more than 110 products have been listed for elimination and more than 80 new products for promotion.

Today, there is strong competition in the domestic market for fan products. On the one hand, strong competition exists among the domestic manufacturers for commodity small land medium-sized fan products. On the other hand, international manufacturers have come into the Chinese market in large numbers. Currently, approximately half of the domestic market for high quality and large capacity fans is occupied by imported products. Approximately 3% of Chinese-made fan products are exported and most of the exported products are small-to-medium sized fans.

Pumps. There are currently approximately 30 million pumps in use in China with a combined motor capacity of approximately 80,000 MW, accounting for approximately 20% of total national electricity use. In particular, pumps consume a very high proportion of electricity in facilities such as oil fields, mines and thermal power plants (reaching 30-35% of plant electricity use) (Wang 2000).

China now produces more than 1,200 different types of pumps. Pumps in China are manufactured by a wide range of enterprises and the vast majority of these are small. In 1997, over 2.2 million pumps were sold in the Chinese market. Of these, approximately 400,000 were industrial pumps and about 1.8 million were agricultural pumps. Based on a survey in 1998, 163 member companies in the Pump Manufacturing Association produced just over 1.25 million pumps, accounting for less than 60% of total Chinese pump production (many small producers are not in this association). In 1997, total sales volume of the Pump Manufacturer Association reached approximately RMB 5.15 billion (approximately $ 625 million), a 7% increase over the previous year. Single-stage single-suction water pumps and submersible pumps are two of the major products accounting for approximately 35% and 20% of total annual production respectively. Other major products include multi-stage centrifugal pumps and pipeline pumps.

Over the past 20 years, numerous advanced pump technologies and products have been introduced into China, mainly from Europe and North America. These introductions have significantly increased the technology level of Chinese pumps. In order to increase pump system efficiency, since 1982 the Chinese government has issued regulations to phase out old products and encourage use of new more efficient pump products. So far, 192 old products and 291 new efficient pumps have been included in the list of banned and encouraged products respectively. Overall, the new products are 3-6% more efficient than the old ones.

Still, overall technical standards and quality of pumps manufactured in China lag behind international standards. For example, many less efficient pumps are still on the market, which are 2-5% less efficient on average than typical international products. Furthermore, large gaps in pump reliability and lifetime also exist between Chinese and international products.

In recent years, supply has exceeded demand in the domestic pump market and competition among the various manufacturers is strong. In addition, Chinese pumps are also sold in other countries, particularly the US, Japan, Germany, and Canada. Total export value was RMB 421 million (approximately $ 50 million) in 1997. Most pump exports are from the leading domestic manufacturers (CBMI 1998).

Compressors. Compressors are widely used to increase gas pressure in industrial facilities. There are currently about 5 million units of various compressors in operation in China with a combined motor capacity of approximately 20,000 MW. In 1997, the amount of electricity consumed by compressors amounted to 8 billion kWh, which is 7% of total Chinese electricity consumption.

There are more than 1,300 types of compressors produced in China, most of which are small compressors (defined as 3-70 kW). Although small compressors dominate in terms of numbers, 90% of the electric power consumption is by larger compressors. In 1996, compressor sales totaled approximately 60,000 units with a combined motor capacity of more than 1,700 MW. In 1997, compressor sales were similar to 1996 on a capacity basis, although the number of compressors sold dropped by more than 20% (i.e. the average compressor size increased). In 1997 there were 78 compressor manufacturing enterprises in China. Of these, only 12 had sales revenue over 100 million RMB ($ 12 million) and the combined production value of these 12 firms accounted for over 65% of the total Chinese production value.

Current domestically-made new compressors are comparable in terms of energy efficiency with international products. However, Chinese products lag behind their international counterparts in terms of reliability and control.

In order to improve compressed air system energy efficiency, the Chinese government has issued regulations to phase out 26 types of outdated compressors and encourage 34 new air compressor products. In general, new compressor products have much higher efficiency than the old ones. However, due to end-user habits as well as inefficient enforcement of these regulations, some old products on the banned list can still be found in the market (Wang 2000).

Speed Control. As in most countries of the world, many motors used in China operate under varying load conditions and can potentially benefit from speed control technologies. Speed control technologies available in China range from eddy-current drives to two-and multi-speed motors to electronic variable speed drives (VSDs). In general, use of these technologies is limited, with less than 10% of motor systems in China using any of these measures (studies in China estimate that up to 70% of motor applications can potentially benefit from speed control technologies). Moreover, flow control measures in use are mainly of low efficiency such as baffle plates or valves and the use of VSDs is low.

Domestic VSD production totals approximately 15-20 MW annually, whereas, imported products total approximately 400 MW. Thus, imported VSDs have more than a 90% share of the Chinese market, even though imported products are subject to an import duty. Chinese made VSDs are not of sufficient quality to meet market demands and also lack some features desired by purchasers.

The high price of imported VSDs restricts their use. The current market price for small-medium sized VSDs (for motors of 200 kW or less) is approximately RMB 800-1200/kW ($ 95-145/kW) while the price for larger capacity VSDs is RMB 1800-2500/kW ($ 215-305/kW).

Based on surveys in the metallurgical, chemical and building material sectors, energy saving potential through motor speed control can be as high as 40 billion kWh/year in China. Energy savings in good VSD applications typically ranges from 20 to 40% and the investment in these good applications can be recovered in 1-3 years (CECIDC 2000).

System design. Motor systems in China are traditionally designed by Design Institutes which function somewhat like architectural and engineering firms in Western countries. In China, each industrial sector (e.g. steel and petroleum) has its own design institute or institutes. These design institutes are in many cases very conservative and often overly emphasize system safety in motor system design. They often rely on past experiences and even copy existing designs in some cases. These practices often lead to motor oversizing resulting in low system efficiency. In addition, the design engineers are often specialized on certain specific subjects and are often not familiar with energy conservation issues. They tend to use existing or old products and equipment and are not aware of the latest energy efficient products.

b Chinese electric rates vary from region to region but are roughly comparable to US electric rates. Motor system improve-ments can be particularly attractive in southern China where electric rates can exceed the equivalent of $ 0.10/kWh.

Opportunities for Reducing Motor System Energy use in China

There are large opportunities to improve the efficiency of motor systems. Electric motors in China are approximately 2-4% less efficient on average than motors in the US and Canada. Fans and pumps in China are also commonly 3-5% less efficient than in developed countries. Even more importantly, motors, fans, pumps, air compressors and other motor-driven equipment are frequently applied with little attention to system efficiency. More optimized design, including appropriate sizing and use of speed control strategies, can reduce energy use by 20% or more in many applications. Thus, motor system optimization is probably the single biggest source of motor system energy savings. Unfortunately, few Chinese enterprises use or even know about these energy-saving practices. Studies in the US indicate that by using all of these techniques in cost-effective applications, motor energy use can be reduced by about 28-42% (Nadel et al. 2001). Opportunities in China are probably even greater due to the lower average current efficiency of Chinese motor systems.

Barriers to Motor System Efficiency Improvements in China

Primary among the barriers are the following :

1. **End-users lack information :** Few Chinese enterprises are aware of the opportunities for reducing energy use and improving operating practices through high efficiency equipment and system optimization, and those that are aware of the opportunities generally lack the expertise to properly optimize their systems.
2. **Energy-efficiency low on list of end-user priorities :** Most end-users are pre-occupied with other concerns and pay little, if any, attention to energy efficiency.
3. **Limited infrastructure to provide optimization services :** Experts on optimizing motor systems are few and far between in China, making it difficult, if not impossible, for a Chinese enterprise to obtain expertise on system optimization.
4. **Efficient/energy-saving equipment often not readily available :** One aspect of system optimization is often use of high-efficiency equipment including speed controls and high efficiency motors, fans, pumps, and compressors. Most Chinese manufacturers do not produce this equipment, making it difficult for Chinese enterprises to purchase this equipment unless they resort to very expensive imported equipment.
5. **Shortage of financing :** Enterprises frequently lack the capital to pay for optimization projects or to pay extra to upgrade the efficiency of products they purchase. Motor and other equipment manufacturers sometimes lack capital for equipment or the purchase of higher quality raw materials that will help improve product efficiency.

Current Programmes and Policies

Given the fact that motor systems are the preeminent electrical end-use in China and given the potential for substantially reducing this electricity-use cost-effectively, a number of efforts have begun, or are scheduled to begin soon, that provide a useful foundation for efforts to improve motor system efficiency in China. Among the current programmes are the following :

- *International Institute for Energy Conservation (IIEC)/ International Copper Association (ICA) China Energy Efficiency Programme :* A project to promote high-efficiency motors in China by encouraging and providing technical assistance to the Chinese government to develop motor minimum efficiency standards, a premium-quality motor brand and a motor efficiency certification programme. The programme also provides information and training to manufacturers and end-users, identifies and explores financing mechanisms for energy efficiency investments, and facilitates demonstration projects.
- *Sino-US Motor Systems Team :* Developing and implementing pilot training programmes and informational materials and tools on motor, pump, fan and compressed air systems in order to lay the groundwork for a nationwide China motor systems programme Principal participants include the Chinese State Development Planning Commission (SDPC), US DOE, and the China Energy Conservation Investment Corporation (CECIC).
- *Technology Cooperation Agreement Pilot Project :* A US EPA-funded effort to demonstrate technology cooperation as called for in the Framework Convention on Climate Change. One of the initial target areas is motor systems, with a particular focus on the introduction and increased awareness of new technologies.
- *China State Economic and Trade Commission/China Energy Conservation :* Association/*Energy Foundation* : A multi-year effort focused on policies for improving industrial-sector efficiency; the effort will address establishing national energy use guidelines in selected industrial sectors. One of the areas under consideration for meeting these new guidelines is increased efficiency in industrial motor systems.

- *GTZ/China Electric Power Research Institute motor test laboratory and test procedure project :* Funded by the German government, this project is working on establishing revised motor efficiency standards in China and establishing a new motor efficiency test laboratory; this effort is coordinated with the IIEC effort discussed above.
- *World Bank/Global Environment Facility (GEF) Energy Management Company Project :* A multiyear project to help establish multiple energy management companies (EMC's) in China; so far three EMC's have been formed and more are planned. Motor systems are a significant area of focus for these EMC's.
- *China Energy Conservation Information Dissemination Center :* Prepares case studies and good practice manuals on energy-saving measures; some of the case studies are on motor systems. The first manual published is on VSDs.
- *United Nations Industrial Development Organization/SDPC/UN Foundation motor systems project in Shanghai and Jiangsu :* A project scheduled to begin in spring 2001 to offer a pilot motor systems programme in two Chinese provinces.

The first and last of these projects are major foundations for the China Motor Systems Energy Conservation Programme and merit further description.

IIEC/ICA China Energy Efficiency Programme

Sponsored by ICA (International Copper Association) and CFC (Common Fund for Commodities), IIEC started the CEEP (Copper Energy Efficiency Programme) in 1998. CEEP is a 3-year programme to promote high efficiency motors in China and improved efficiency transformers in India. In China, work began with a one-year market assessment which led to development of four strategies designed to transform the Chinese market towards higher efficiency motors. The strategies are :

1. Encourage the Chinese government to develop motor minimum efficiency standards;
2. Facilitate the development and promotion of a voluntary programme to certify high efficiency motors;
3. Develop pilot projects to demonstrate the economic benefits of high efficiency motors;
4. Identify financing mechanisms for high efficiency motors.

Many activities have been undertaken to implement these strategies. Activities in support of the first two strategies are discussed later in this paper.

UNITO/SDPC Motor System Energy Conservation Project in Shanghai and Jiangsu

This project is an educational effort to promote motor system optimization in China and to put a local infrastructure in place in two provinces (Shanghai and Jiangsu) to promote greater efficiency in industrial motor driven systems. This project is a direct outgrowth of activities undertaken by SDPC and the US DOE since 1997 as the result of a China-US bilateral cooperation agreement.

Primary funding for the project is being provided by the United National Foundation (UNF) with substantial in-kind contributions from US DOE and SDPC. Additional funding is being made available from the Energy Foundation. UNIDO is administering the project on behalf of UNF. The intent is to use lessons learned in the pilot phase of this project to develop an integrated programme model that can serve as the foundation for a national programme.

The project will concentrate on two provinces, Shanghai and Jiangsu, which have expressed strong interest, include a significant industrial base, have organizational support, and have a small cadre of energy professionals who can be trained on the technical specifics of motor system optimization. This will greatly assist the project in meeting programme objectives within a relatively short period of time (3 years). The programme will encompass the following activities :

(i) Develop a series of educational materials and application tools (e.g., software) to assist motor system experts and factory engineers to assess and better optimize motor systems;

(ii) Revise existing Chinese national standards on the economic operation of motors, fans and pumps;

(iii) Train a group of at least 10 motor system optimization experts who will work in Shanghai and Jiangsu;

(iv) Implement and evaluate a series of eight motor system improvement demonstration projects in different industrial sectors in Shanghai and Jiangsu and prepare case studies of these projects;

(v) Provide training to at least 200 additional Shanghai and Jiangsu factory managers and engineers and provide technical assessments to at least 30 additional Shanghai and Jiangsu factories to assist them to identify and undertake their own motor system optimization projects;

(vi) Evaluate the different project components and assess how the project can be improved; and

(vii) Assist the Chinese government to plan for and lay the groundwork for a major national motor system improvement programme.

Materials development and training of the Chinese motor optimization experts will be a primary responsibility of an international team of experts, who will use information from existing motor system programmes, most notably in the US and the UK. Topic areas will include : motors and drives, pumping systems, compressed air systems, and fan systems. Post training technical support will also be provided for plant assessments, project development, and case study preparation.

A Chinese organization will be selected by UNIDO through a competitive bidding process to become the primary subcontractor. The primary subcontractor will be responsible for overall

management of programme implementation activities, including contracting with local agencies in Jiangsu and Shanghai. A substantial evaluation component is also included in the project to determine the effectiveness of the pilot programmes. Evaluation will be the responsibility of a Project Management Office (PMO) established by the SDPC. Preliminary evaluation results are anticipated in 2002. The pilots will be completed by mid-2004.

The China Motor Systems Energy Conservation Programme

While the programmes and policies listed above are making some progress towards improving motor system efficiency in China, relative to the size of the Chinese motor market, these efforts are small and much more work is needed for even one-quarter of the potential motor system energy savings in China are to be captured. In order to make progress towards this larger potential, the Chinese government is now developing a major national programme tentatively called the China Motor Systems Energy Conservation Programme. In the following sections, the history, current status, and tentative plans for this new programme are discussed.

Brief History

Work to develop the China Motor Systems Energy Conservation Programme grew out of discussions between SDPC and US DOE that began in 1997. These discussions recognized that most of the available motor savings in China are from system design and optimization, but that to capture these savings, a large-scale multifaceted effort is needed. Partial models for the China Motor Systems Energy Conservation Programme are the China Green Lights Programme, a major Chinese programme to improve the efficiency of lighting systems (Nadel et al. 1999), and the US Motor Challenge Programme, a programme which provides training and tools to industry and trade allies on techniques to better optimize motor systems (Nadel et al. 2001). A key step in the development of the China Motor Systems Energy Conservation Programme is the UNIDO/SDPC project discussed above which in many ways is a pilot for the national programme.

Current Status and Schedule

In the tenth-five year plan for energy efficiency prepared by the Chinese Government, electricity savings from motor driven systems has been classified as one of the key areas.

Currently, a range of activities are being carried out to prepare for the initiation of the China Motor System Energy Conservation Programme. The preliminary objective of this programme is to reduce motor system energy use in China by at least 10% by 2010. Realization of this target will reduce annual Chinese electricity use by more than 60 billion kWh.

As a first step towards a national programme, the UNIDO/SDPC China Motor System Energy Conservation Project is in the final stages of preparation. It is hoped that this programme will provide a test ground for the concept of the full national programme. Parallel to the UNIDO project, the Energy Foundation is supporting the Chinese effort by providing assistance for the development of the national programme.

To date, an expert team has been organized to carry out a motor market survey and to analyze the motor market energy efficiency improvement potential. A number of seminars have been held to review the status of motor system energy efficiency, the application of motor systems in the various sectors, and the potential for motor system energy efficiency improvements. Efforts are also being made to investigate the motor manufacturing industry and market through further seminars and field investigation. A report on the "China Motor System Market and the Potential for Energy Efficiency Improvement" will be prepared. On the basis of this, the main contents and framework of the national programme will be put forward.

Likely Programme Components

While plans for the China Motor Systems Energy Conservation Programme are still being formulated, based on discussions to date, several programme components are likely to be included. These are discussed in the following sections. In general, the plan of approach is to pursue the Jiangsu/Shanghai pilot project over the next few years while also developing appropriate policies such as standards, efficiency labeling, and encouraging the consolidation of motor, fan, pump and compressor manufacturers. Beginning in approximately 2003, the hope is to begin implementation of the overall national programme.

Minimum efficiency standards for motors. Although motor efficiency is a part of product specifications for Y and Y2 series motors, there is not a requirement that each manufacturer has to test and report the efficiency of their products. Due to price pressure in the market, experts estimate that to reduce material costs, manufacturers representing more than 20% of motors in the market do not reach the published efficiencies in the Y and Y2 specifications. To address this situation, the China State Bureau of Technical Quality Supervision (with assistance from IIEC/ICA) is currently developing a minimum efficiency standard for motors. The standard is currently in draft form and calls for motors to meet the "Efficiency 2" level developed CEMEP (a European association of individual-country motor manufacturer associations) (Exico 2001). This efficiency level is illustrated in Figure 1 which also includes information on Chinese Y and Y2 motors as well as the US Energy Policy Act (EPAct) minimum efficiency standard.

In addition to developing new motor standards, the programme will also investigate appropriate mechanisms for implementing these standards. Past Chinese government efforts to ban particularly inefficient products have met with mixed success and thus there is a need to develop improved legal, regulatory and voluntary implementation frameworks.

Voluntary "Green Motor" labeling programme for high-efficiency motors. Under China's new Energy Conservation Law, a China Energy Conservation Product (CECP) certification committee was formed with a mandate to certify, label and promote energy-saving products in China. The Committee has already implemented certification and labeling procedures for refrigerators. Under the motor systems project, as motor and related standards are revised, a certification, labeling and promotion programme will be inaugurated for high-quality, high efficiency motors. Equipment certification and labeling will allow purchasers to readily identify quality, efficient products in the market, something that is presently difficult to do as efficiency information is currently not readily available to purchasers and there are often inaccuracies in the efficiency information that is reported.

Concurrent with the work to develop a minimum efficiency standard (discussed above), the State Bureau of Technology Supervision and CECP is developing a voluntary specification for high efficiency motors; in the draft specification, this level is the same as the European "Efficiency 1" level now being used for voluntary motor promotions in Europe. The intent of this voluntary specification is to encourage sales of more efficient motors in China. Such a specification may also assist export sales to Europe. In addition to the European "Efficiency 1" requirement, the draft Chinese high-efficiency motor specification requires that to be certified as high-efficiency, a motor must also be tested according to the IEEE 112-B test method and measured stray load losses must be less than certain specified levels.

While the labeling programme will initially target motors, opportunities to expand the programme to fans, pumps and compressors will also be explored and implemented if feasible.

Develop and promote motor system management guidelines. In China, many manufacturers are owned by various units of government and need to follow guidelines established by the government. In addition, guidelines developed by the government are often voluntarily used by other companies. In the 1980s China developed guidelines on the economic operation of motors, fans and pumps that include guidance on such issues as motor sizing, how to evaluate motor system economics, and recommended measures for improving motor system operating efficiency. Under the UNIDO/SDPC project, these guidelines will be revised, including a significant focus on good system design and optimization techniques. Following development of these new guidelines, training programmes are planned to introduce and explain these guidelines to factory managers and engineers.

Training, technical assistance and financing programme to promote optimization of key motor systems. Training, technical assistance and financing are the heart of the Jiangsu/Shanghai pilot project and are expected to be the heart of the national programme. Among the steps being contemplated are :

1. Establish a Series of Provincial and Sector-Based Information and Training Centers

   A centerpiece of the programme will be a series of provincially-based and industrial bureau-based (e.g. Bureau of the Chemical Industry) information and training centers which will undertake a wide variety of promotion, training and information dissemi-nation activities to inform local factories about opportunities to better optimize their motor systems. These centers will be housed within existing regional and sector-based organizations and will provide the following services :

   - Short workshops for factory managers and senior staff to summarize the many benefits of optimization, based on case studies, and how to obtain optimization services.
   - Medium-length workshops to train engineering staff at factories on how they can direct some of their own optimization projects.
   - Dissemination of informational materials and tools developed at the national level.
   - Other promotional activities such as tours of nearby showcase demonstration projects, talks at industry and regional conferences, etc.

   c China recognizes that the IEEE 112-B method is more accurate (because stray load losses are actually measured) and thus China plans to move towards the IEEE 112-B method, once this method is incorporated into the IEC test procedure. IEC has been discussing ways to incorporate IEEE 112-B for several years and is expected to adopt such a change in the not too distant future.

   - Technical assistance to individual factories to help them obtain optimization services including referrals to skilled service providers.

2. Undertake a Series of Showcase Demonstration Projects and Prepare Case Studies on These Projects

   In order to demonstrate motor system optimization techniques and benefits, a series of "showcase demonstration projects" will be developed in each of the targeted provinces and industries. These projects will provide hands-on experience to local service providers and will also provide local examples of the costs and benefits of motor systems optimization.

   Case studies will be prepared on each of the demonstration projects and the case studies will be an important component in local and sector promotion efforts. Costs will be

carefully tracked, savings will be determined through metering and appropriate engineering techniques. Showcase hosts will include a variety of industrial enterprises in China including state-owned enterprises, joint ventures, and cooperative and/or town and village enterprises.

Showcases will be conducted across a range of system types including fan, pump and compressor systems. Provincial and sector centers will assist with Showcase engineering and evaluation. Financing for the Showcase projects will come from host enterprises, and local banks and energy management companies.

3. Develop Informational Materials and Tools at the National Level

   Information materials will be developed to cover a range of needs, including short pamphlets and videos for senior managers; technical case studies, manuals, videos and software for technical and financial staff; and policy pieces for government officials. Some of the information materials will be adapted from foreign sources and made appropriate for China, other materials will be prepared afresh. Development and distribution of information materials will be coordinated with (and perhaps some materials even subcontracted to) the China Energy Conservation Information Dissemination Center.

4. Expand the Availability of Financing for Motor System Optimization Projects

   One of the major barriers for the adoption of energy efficient motors is that many end-users lack access to capital. While some profitable factories have internal sources of capital, other factories lack the capital or cashflow to finance projects themselves. In recent years, the China Energy Conservation Investment Corp. (a government-capitalized investment company that focuses on energy conservation) and the World Bank/GEF supported Energy Management Companies have invested in motor system energy efficiency projects through leasing and performance contracting mechanisms, achieving some success. Still the investments being made in motor system energy efficiency are much too low in view of its vast potential in China.

   In order to expand the availability of financing, the programme will undertake efforts to encourage domestic banks and other financial institutions to expand the capital they provide for motor system optimization projects. This work will include workshops and educational material targeting financial institution staff in order to increase their understanding of the opportunities for profitable investments in motor system energy efficiency improvement projects. These activities will be undertaken in coordination with national and provincial financial agencies and organizations.

   In addition, the project will work with factories and technical assistance providers to educate them on the types of information and data they need to develop in order to have a good chance of obtaining credit. The project will work with financial experts to develop model financial templates for motor system optimization projects and will provide training in how to collect and summarize the required information in order to provide financial institutions with the information they need to make favourable loan determinations.

Market Prospects

There are more and more reasons to consider China a strong market. The dynamic and growing Chinese population, combined with the market access secured by China's WTO membership, is creating many opportunities. China is not just a market for the largest multinationals.

While the global economy grew less than 2 per cent last year, the Chinese economy grew 8 per cent, according to Chinese data. Since China's opening in 1979, gross domestic product growth has averaged 9 per cent a year. Additionally, China has charted the fastest economic growth of any major economy since 1990.

While much of this growth is attributed to Chinese government spending and foreign direct investment, consumer demand in China is beginning to play a larger role in driving the economy.

China in the WTO : A First-Year Report Card

As a new WTO member, China has begun to lower tariffs, create a more transparent investment environment, overhaul and publish its laws and regulations, strengthen intellectual property laws, and restructure standards and testing procedures. But many of these reforms are being phased in over several years, and many tasks remain undone. Market barriers remain, and China still faces challenges in such areas as enforcing intellectual property rights, further improving transparency and the rule of law, and ensuring that product standards are in line with international norms and are applied equally to domestic and imported goods.

There are more and more reasons to consider China a strong market. The dynamic and growing Chinese population, combined with the market access secured by China's WTO membership, is creating many opportunities. China is not just a market for the largest multinationals.

While the global economy grew less than 2 per cent last year, the Chinese economy grew 8 per cent, according to Chinese data. Since China's opening in 1979, gross domestic product growth has averaged 9 per cent a year. Additionally, China has charted the fastest economic growth of any major economy since 1990.

While much of this growth is attributed to Chinese government spending and foreign direct investment, consumer demand in China is beginning to play a larger role in driving the economy.

Conclusion

China's new Five-Year Plan for the energy sector places equal emphasis on energy supply, energy conservation, and environmental protection. Motor systems account for approximately 60% of China's electricity use, and thus reducing motor system energy use is a primary target for China's energy conservation effort. Furthermore, improving motor system efficiency helps reduce factory operating costs and thereby can contribute to China's efforts to bring many failing state-owned enterprises into profitability. Current programmes to promote motor system efficiency provide a good foundation for a major national programme to reduce motor system energy use.

However, motor system efforts have made only limited progress in developed countries such as the US targeting motor system improvements will present great challenges in a developing country such as China. On the other hand, China is one of a handful of developing countries that has already made substantial progress on energy efficiency. Also, due to the long history of central planning in China, many Chinese companies are likely to participate in programmes run by the Chinese government and thus China is often able to achieve high programme participation levels more easily than in countries such as the US without this history.

In the next year, China will be refining its programme approach and plans to apply to the GEF (a multilateral environmental protection fund set up at the 1992 "Earth Summit" in Rio) to help fund its motor programme. Over this period, Chinese programme planners welcome input on programme elements and strategies that can make the China Motor Systems Energy Conservation Programme a success. The China Green Lights Programme has made substantial strides in building the market share of efficient lighting products in China (Nadel et al. 1999). Hopefully the China Motor Systems Energy Conservation Programme can be at least as successful.

Leading Chambers

China Chamber of International Commerce - Beijing Chamber of Commerce
Liaison Officer : Beilei Zheng
Tel. : 86-10-64250792
Fax : 86-10-64250409
E-mail : ccoicbj@public.bta.net.cn

China Chamber of International Commerce - Tianjin Chamber
Director of Overseas Liaison : Xuewu Yan
Tel. : 86-22-23301345
Fax : 86-22-23301331
E-mail : ccpit@chinainfornet.com

China Chamber of International Commerce
1, Fung Xing Men Wai Street
Beijing 100860, China
Trade Information Manager : Lin Shunjie
Tel. : 86-10-6802-1275
Fax : 86-10-6802-3554
E-mail : linsj@icc-china.com

Chinese General Chamber of Commerce
4th Floor
24-25 Connaught Road
Central, Hong Kong
Dr. Robin Chan Yau-hing
Chairman
Tel. : (852) 2525-6385
Fax : (852) 2845-2610
E-mail : cgcc@cgcc.org.hk

China Council for the Promotion of International Trade (CCPIT)
1 Fu Xing Men Wai Street
Beijing 100800, China
Tel. : (86-10) 6801-3344 (switchboard)
Fax : (86-10) 6801-1370
E-mail : ccpit@ccpit.org

China Chamber of Commerce for Import and Export of Machinery and Electronic Products
9th Floor Building
12, Panjiayuan Nanli
Chaoyang District
Beijing 100021, China
Tel. : 86-10-67735053, 67735542
Fax : 86-10-67735350, 67735419
E-mail : cccme@public.bta.net.cn
info@mail.cccme.cn.net

All-China Federation of Industry and Commerce
No.1, Floor C, Hall Lanyu Building
Beijing 100011, China
President/CEO : Jianbo Yan
Tel. : 86-10-62389641
Fax : 86-10-82073229
E-mail : acficic@datachina.com.cn

China Chamber of Commerce of Metals Minerals & Chemicals
17th Floor, Prime Tower
22 Chao Wai Street
Chao Yang District
Beijing 100020, China
Tel. : 86-10-65882823/65880325/65882501
Fax : 86-01-65882825/65880304
E-mail : webmaster@cccmc.org.cn
zhousj@mail.cccmc.org.cn

(Source : EEPC Singapore Office)