Clean Energy – Market Profile – China

1. Sector Overview

China is rapidly strengthening its development and use of renewable energy technologies to address the challenge of its unprecedented domestic energy demand. Since 2001, China's energy demand has grown 1.4 times faster than its GDP due to increased consumption of energy intensive products and growth of energy intensive industries for exports, becoming the world's second largest consumer of primary energy after the United States.

This increased use of energy has posed a number of challenges, including increased dependence on international markets to meet energy needs, price volatility, regional energy shortages, and deteriorating environmental quality. As a result, China has substantially increased investment in renewable energy technology, both domestically developed and foreign-sourced, as one means to ensure greater security of domestic energy supply, while at the same time address sustainable and environmental concerns.

The central government has put in place a number of policies and legislations to reach its renewable energy goals. In January 2006, a China's new Renewable Energy Law came into effect. This framework law outlined a number of policy instruments, such as a feed-in tariff, priority grid access, and economic incentives, to assist in reaching renewable energy targets, later set in the State Council approved "Mid to Long Term Development Plan for Renewable Energy" (see targets in Section 2 below).

It is anticipated that the market for clean energy technology will grow to RMB 1.3 trillion in 2010 and RMB 4 trillion in 2020, presenting a wide range of opportunities. The wind, biomass/biofuel, solar photovoltaic and solar thermal energy, and hydrogen and fuel cells subsectors have the most significant near-term commercial potentials. Emerging opportunities will likely also exist in experimental-stage (tidal and ocean energy) and alternative (coal bed methane, coal-to-liquid, carbon capture and storage) energy technologies, but the markets are less developed and the commercial potential is not yet fully understood. China also has many projects and commercial opportunities in energy efficient buildings, with solar and geothermal heating gaining more importance in new building construction and with government incentives supporting new technologies. The government has likewise prioritized new energy vehicles for future development, including hybrid, renewable fuel, and fuel cell vehicles. To speed the development of its renewable energy industry, China is acquiring technologies overseas and some Chinese companies, particularly private companies, have started to look for outbound investment opportunities.

The current global financial crisis combined with low oil prices will likely have an impact on some segments of China's renewable energy sector. While forecasted impacts remain speculative, it is likely that export-oriented equipment manufacturers will suffer from a drop in international demand (e.g. in the solar PV sector). The biofuel industry, which enjoyed popularity in recent years due to skyrocketing oil prices, may also be impacted.

Canadian companies are active in China in solar photovoltaic (joint production of inverters), wind (operation of wind farms), bioenergy (joint demonstration of new technologies), hydrogen and fuel cells (technology partnerships and provision of services), and solar and geothermal heating. China and Canada have identified renewable energy as among bilateral S&T priorities, and researchers have undertaken S&T cooperation supported by bilateral federal and provincial project funding programs. Chinese firms have begun to look at Canada has a potential destination for investments in this sector and at least one partnership between a Canadian and Chinese firm is jointly investing in a renewable energy project in a third country.

2. Market and Sector Challenges

A number of government policies and incentives will encourage continued investment into and growth of the sector.

In the “Mid to Long Term Development Plan for Renewable Energy”, China enunciated its goal of increasing the share of renewables (including hydropower) in its energy mix from 8% (200 million MT coal equivalent) in 2006 to 15% in 2020. The plan establishes ambitiously installed capacity goals involving a projected investment of RMB 710 billion for non-hydropower renewable energy development – 200 billion RMB of which will be in the biomass subsector, RMB 190 billion in wind power, RMB 130 billion in solar energy and RMB 190 billion for methane for rural usage.

Renewable Energy	2005	2010 Objectives	2020 Objectives
Wind Power	1.26GW	5GW	30GW
Solar (power generation)	0.07GW	0.3GW	1.8GW
Solar heater	80 Mm2	150 Mm2	300 Mm2
Biomass (power generation)	2GW	4GW	24GW
Biomass fuel	1.07MTonne	2.2MTonne	12MTonne

Under China’s Renewable Energy Law, renewable energy prices are set by the government, and are given priority grid access. Grid companies are to accept renewable energy-generated power at the government-set price, and invest in systems and components which allow for renewable energy access to the grid.

Preferential tax policies and incentives have been put in place to support the development of the renewable energy sector. For example, China offers a preferential renewable energy on-grid subsidy price for the first 15 years of renewable energy power operation. Under this program, China has granted electricity price subsidies and quota trading to 148 projects between October 2007 and June 2008, amounting close to RMB two billion. Renewable energy companies may also be eligible for: i) an exemption from or reduction of the value added tax (VAT) on certain types of renewable energy projects, ii) a preferential import tax which could exempt certain renewable energy equipment from import duties and import-linked VAT (though regulations are vague and imports may be considered on a case by case basis), iii) a preferential corporate income tax (CIT), which could grant enterprises that use renewable energy a reduced tax rate, and iv) access to preferential loans with a financial interest subsidy for renewable energy development and utilization projects.

A renewable energy development fund supports research, pilot projects, construction of renewable energy projects for domestic use in rural areas and use in remote areas and islands, surveys and assessments of renewable energy resources, and localized production of equipment for the development and utilization of renewable energy.

While China’s renewable energy market is large and expanding, many barriers and challenges remain. The market is highly competitive and new companies will in many cases need to fill a niche or offer specific expertise. The best opportunities for Canadian companies are likely where domestic capacity is not adequate, and where foreign technologies and services are of better quality and efficiency. Canadian companies will also face strong competition from other foreign firms, many of whom already have an established presence in the market.

Chinese laws and regulations for this sector are often vague or poorly defined. It may be difficult for foreign firms to determine whether their activities are in accordance with regulations. The renewable energy pricing system also poses a challenge. For example, wind energy prices are set locally according to a combination of factors, leading to a wide range of prices across the

country. Companies who have installed wind power projects often see their expected profits evaporate when local pricing has been less than anticipated. While the government will likely need to reform the pricing system to ensure continued industry growth, it is unlikely that changes will be made quickly.

China's renewable energy industry also lacks coordinated planning to ensure sufficient feedstock supplies, power grid accessibility, and efficient distribution of projects. Biomass projects are often built too close together resulting in a lack of sufficient inputs, and lack of coordination between wind power producers has resulted in inefficient use of high-value land.

The intellectual property (IP) protection environment in China is improving but remains a concern, particularly at the enforcement level. Companies interested in pursuing the China market need to take the necessary measures to register and protect their intellectual property and to consider market entry plans that minimize their exposure to potential IP violations.

Doing business in China takes time, financial and human resources, a long-term vision and patience. It also requires time and commitment to build relationships and develop business opportunities. Companies can overcome some of the challenges to entering the Chinese market by forming alliances with larger multinationals or Chinese companies to use their existing market access and networks, as well as to gain referrals and credentials by working with and/or for them.

3. Sub-Sector Identification

WIND POWER GENERATION

China is rapidly becoming a world leader in wind power generation, and is one of the fastest installers of new capacity with 4000MW of new capacity added in 2008 for a total installed capacity of approximately 10,000 MW. China's wind turbine manufacture capacity has also undergone extraordinary growth, and China may become the world's leading exporter of wind turbines by 2009. The rapid development of China's domestic capacity has been facilitated by a number of favourable government policies – such as central government support for large scale projects, long-term power purchase agreements, and domestic sourcing requirements– along with technology transfers from foreign companies. A Renewable Energy Law requirement that 70 percent of wind turbines must be sourced from domestic manufacturers has led to localization of wind turbine manufacturing, and the development of technologies adapted to China's weather environment.

China has plentiful wind resources, with an estimated 700 to 1200GW of potentially utilizable onshore resources and over 1,000GW of offshore resources. The richest resources are distributed in north-eastern China, including HeBei, Inner Mongolia, GanSu, Qinghai and Xinjiang provinces, and in the south-eastern coastal provinces like Guangdong. Domestic companies, such as Longyuan, Ningxia Power, Shenhua, Datang, and Guangzhou Engga Generator Company dominate wind power development. However, a number of challenges remain for wind farm operators. While the cost of producing wind power is approaching that of coal-fired power, China's coal resources are still relatively cheap and abundant, and it is thought that many developers may be operating with no profit margins.

Both domestic and international players are actively involved in wind turbine generator (WTG) manufacturing. Major manufacturers include: Goldwind, Dongfang Electric Machinery, Sinovel, Vestas, GE Wind, Gamesa and Nordex. Leading technologies remain largely foreign owned (e.g. Gamesa, GE, Nordex, Suzlon, Vestas). China's wind turbine manufacturers may be limited by quality problems, and often have limited experience or capacity to produce technologically advanced wind turbines that can endure long-term wear or environmental conditions.

Opportunities for Canadian company participation exist in a number of areas. Currently, Chinese wind industry can not produce megawatt class offshore wind turbines (2.5 MW or greater), and still rely on imports for certain parts (e.g. bearings). Canadian companies will also find opportunities in design and testing, grid integration, and providing services in the area of quality control and engineering. As competition for ideal wind farm locations increases, and farms are developed in ever-more remote areas, demand will increase for wind power prediction equipment and remote monitoring systems.

BIOFUELS/BIOMASS

China's biofuels and biomass capabilities are currently in early stages of development, and while challenges remain, it offers significant potential. An estimated 1.5 billion tons per year of waste agriculture and forest materials are generated each year.

The availability of sugarcane, cassava, corn and broomcorn cultures in particular provides great potential for the production of bioethanol and biodiesel fuels at competitive prices, offering a potentially viable and large scale alternative to petro-chemical based fuels. The central government is encouraging rapid growth of the production of bio-ethanol to five million tons in 2010. A number of large conglomerates are developing sizeable bio-ethanol demonstrations. For example, China National Petroleum Corporation is developing two million tons per year of non-grain ethanol capacity in Sichuan, while Yunnan and Jilin provinces are using such inputs as sweet potatoes, jatropha curcas trees and maize. Biodiesel production has also been encouraged, with growth expected to reach two million tons in 2010. However, sector outlook is uncertain due to an unclear regulatory framework and high feedstock prices. Capacity of new plants is now upwards of 750,000 tons of biodiesel per year, with chief inputs comprising rapeseed oil, imported palm oil, vegetable oils and used cooking oil. Private, state owned enterprises and foreign owned plants have been installed in Shanghai, Fujian, Jiangsu, Anhui, Chongqing, Xinjiang and Guizhou. Domestic producers include such companies as Hainan Zhenghe Bio Energy, Sichuan Guchen Youzhi Chemical, Dragon Power and Fujian Zhuoyue New Energy, as well as China's leading state-run oil companies, PetroChina, Sinopec and CNOOC.

Biomass power generation also promises rapid growth, and is expected to more than double to 5GW by 2010 (from 2.2 GW in 2006), and increase more than 10-fold to 30GW by 2020. China has an abundance of potential feedstock including: wood (300million tce/y), straw and stalk (150 tce/y), waste water (57 million tce/y) and urban garbage (13 million tce/y). China Energy Conservation Investment Company, State Power Longyuan Group, Dragon Power and Kaiyou Green Energy biomass power plant have each undertaken biomass electricity generation pilot projects. Currently, the biggest barrier to large-scale use of biomass is the scattered distribution of inputs and seasonal variations in production.

Biogas is commonly used in north-western and north-eastern China, where the government provides subsidies to households who purchase a system. Largely thanks to these incentives, upwards of 17 million Chinese households have biogas digesters, as do 140000 municipal waste treatment facilities and 4000 industry sewage biogas facilities.

Canadian firms with technologies not yet available in China may wish to seek partners to jointly develop pilot projects or demonstration plants. Opportunities also exist in training on technologies and equipment, introduction of higher efficiency and more reliable technologies, and joint development of new technologies.

SOLAR PHOTOVOLTAIC POWER GENERATION

China's solar photovoltaic (PV) manufacturing industry is developing rapidly. Solar PV panel production capacity reached 1.18 GW in 2007, a 315% increase over the previous year, making it the world's third largest producer of solar panels after Germany and Japan. Ninety percent of production is exported to foreign markets such as Europe, United States and Japan, and the

remaining production is largely used in China's rural areas and off-grid systems. The market for solar cells has been dominated by such companies as Suntech, Ningo Solar, Nanjing PV and Jiangsu Linyang SolarFun.

Production capacity has been constrained by the lack of silicon resources (the material used in PV semi-conductors). In 2007, China's domestic supply of polycrystalline silicon was 1000 tons, compared with an estimated consumption of 14000 tons, most of which had to be imported, resulting in high production costs. China is developing its own polycrystalline silicon production capabilities, but has faced challenges with production techniques, costs, and capacity.

China's solar resource is estimated at 1.7 trillion tons of coal equivalent, with high quality resources distributed in Tibet, south Xinjiang, Qinghai, Gansu, Inner Mongolia, Huabei, North Jiangsu, Huangtu Plateau, Sichuan, Fujian, Guangdong and Hainan. In spite of rich resources, China's domestic installation of solar PV is relatively underdeveloped, and use remains largely limited to rural electrification, communications and industry. The cost of installation remains high, as much as five times that of coal-fired power, and will require technological advances and government support before it becomes a sufficiently attractive investment and a mainstream energy source.

Canadian companies may find opportunities in supplying high quality polycrystalline silicon technology, or providing services on industry development. Opportunities also exist in improved technologies for thin-film solar panels, technology transfer of higher quality, and lower cost technologies.

HYDROGEN / FUEL CELLS

China offers one of the most significant potential consumer markets for fuel cells, driven by urgent needs to address transportation-related emissions. The market remains research oriented, though China is rapidly developing capability in the development of fuel-cell vehicles, hydrogen fuel-cell buses and hydrogen refuelling stations. There are more than 60 Chinese institutions and companies doing research in this field, and China currently holds more than 400 patents related to fuel cells, ranging from catalysts to system integration technologies. Major investors into the sector include car and bicycle manufacturers, who collaborate with Chinese research institutes on developing applications.

A key component of China's fuel cell strategy is to undertake collaborative partnerships with foreign automobile, fuel cell, and oil companies. These partnerships allow China to build capacities for future research and to overcome cost and technical barriers in the early stages of development. For example, in 2006, Vancouver-based Ballard Power Systems signed a memorandum of understanding (MOU) with the Shanghai Fuel Cell Vehicle (FCV) Power-train Company to cooperate on the development of FCVs for demonstration and field trial programs. In 2008, the National Research Council of Canada's Institute for Fuel Cell Innovation (NRC IFCI) and the Ministry of Science and Technology (MOST) renewed an MOU on hydrogen and fuel cell research cooperation. The research on materials, system integration and trial application on hydrogen and fuel cell vehicles are focused in four cities in China: Shanghai (Tongji University and Jiaotong University), Beijing (Tsinghua University), Dalian (Dalian Institute of Chemical Physics), and Wuhan (Wuhan University of Technology). NRC IFCI signed an MOU with Shanghai based Jiaotong University in 2008 on a joint research program on membrane for fuel cell stacks.

Although the Chinese government has slowed in its efforts towards commercialization of fuel cell vehicles, which it had hoped to realize by 2012 - 2015, the Shanghai municipal government - inspired by China's positive experience of employing clean energy vehicles (including fuel cell vehicles, hybrid fuel and electric, and pure battery-powered) for public transportation at the Beijing Olympics - plans to deploy a fleet of 40 fuel cell cars and at least 10 fuel cell buses to serve as public transportation during the 2010 World Expo in Shanghai. Shanghai Automobile

Industry Corporation and Tongji University have been delegated to integrate fuel cell research and development into these demonstration vehicles.

While China has made progress in developing indigenous capabilities (e.g. China's fuel cells are able to power a fuel-cell car to speeds of 150 km/h, and Shanghai Pearl Hydrogen Power Resource Technology has shipped fuel-cell mopeds for international demonstrations), the technology remains expensive and fragile, and the hydrogen difficult to store and distribute.

Canadian companies and research institutes will find opportunities for collaboration on such areas as joint research and development of and supply of fuel cell stacks, refuelling infrastructure design and construction, supply of fuel cell performance test equipment, and development of codes and standards.

Canadian Government Contacts

If you would like additional market information on this sector, including up-to-date perspectives on the impact of the financial crisis, please do not hesitate to contact the following Trade Commissioners:

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Useful Internet Sites

China:

- National Energy Administration: http://nyj.ndrc.gov.cn/
- Energy Foundation: http://www.efchina.org/
- Energy Research Institute: http://www.eri.org.cn/
- China Wind Energy Association: http://www.cwea.org.cn/main.asp
- China Renewable Energy Industries Association: http://www.creia.net/

- China New Energy and Renewable Energy: http://www.crein.org.cn/
- New Energy Website: http://www.newenergycn.com/
- China Biomass: http://www.zgswzn.com/

Canada:

- NRCan – Canadian Renewable Energy Network: http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/
- Clean Energy Canada: http://www.cleanenergy.gc.ca
- Canadian Wind Energy Atlas: http://www.windatlas.ca
- Canadian Biomass Innovation Network: http://www.cbin.gc.ca
- Canadian Bioenergy Association: http://www.canbio.ca/
- Canadian Renewable Fuels Association: http://www.greenfuels.org/
- Canadian Solar Industries Association: http://www.cansia.ca/
- Canadian Wind Energy Association (CWEA): http://www.canwea.ca/
- Canadian Renewable Energy Industry: http://www.ic.gc.ca/eic/site/rei-ier.nsf/eng/Home