

Sector looks set to grow to be pillar of economy

The signs are that bioenergy will become an important part of China's economy, as part of its expansion of renewable energy, says **Lou Schwartz**

China has emerged as the world's third largest producer of ethanol biofuel (after the US and Brazil), after the State Council (China's executive branch) in 2000 resolved to promote the development of large-scale production of ethanol from maize, wheat and cassava and designated Jilin, Anhui, Henan and four other provinces to be the centres of development.

That followed Beijing's realisation that, because of China's extraordinary economic growth, heavy reliance on increasingly expensive foreign oil, the vast environmental toll that has followed economic success, persistent rural poverty, periodic power shortages and a recognition of the reality of climate change, renewable energy must be a large part of the economy if China is to complete its economic transformation and achieve energy security.

China has developed renewable energy rapidly. Beijing has set an ambitious target for renewables to account for 10% of all energy consumption by 2010 and 16% by 2020. To further this goal the National People's Congress passed the Renewable Energy Law, which took effect on January 2006, and the powerful National Development and Reform Commission (NDRC) has drafted the Mid- to Long-term

Development Plan for Renewable Energy, which, among other things, sets specific targets for solar, wind, hydropower, methane and biomass capacity; 1,800MW, 30,000MW, 300,000MW, 44.3bn m³ and 30,000MW respectively.

According to the NDRC's energy bureau, by the end of the 11th Five Year Plan (in 2010) China's mix of energy sources is expected to be: coal-fired plants 70%; hydropower 23%; natural gas 4.3%; nuclear power 1.2%; wind power 0.6%; and biomass 0.6%.

At the end of the 10th Five Year Plan (in 2005) four principal companies were producing approximately 1.02m tonnes/year of ethanol biofuel, principally from grains. During the 11th Five Year Plan (2006–10) China intends to expand production capacity to 6m tonnes/year and by 2020 output is expected to grow to 15m tonnes/year.

Beijing has committed 1.1bn yuan (\$143m) to help develop, among other things, vehicles that can run on biofuels. Because the cost of producing ethanol is high, the Chinese government has given public finance subsidies; in 2006 each tonne of ethanol received a 1,373 yuan subsidy.

In addition to grains, China also generates approximately 1.5bn tonnes/year of scrap agricultural and forest materials, which is sufficient to produce 370m tonnes of ethanol.

Also, China has about 116m hectares of marginal land unsuitable for producing grains, which could be used to grow sugar cane, cassava, shrubs and other biofuel feedstocks.

For example, construction of a large biofuels project in Beihai in the Guangxi Zhuang Autonomous Region began in mid-November 2006. The 200,000t/year ethanol plant, which is an investment by Guangxi Sino Grain Bio-Fuels, will use the area's abundant cassava plants as inputs. The first stage of the project will be completed within a year.

Yearly petrol consumption in the provinces of Guangxi, Yunnan, Guangdong and Guizhou is an estimated 10m tonnes and, based on a 10% ethanol content in fuel, the demand for ethanol in those four provinces alone would be approximately 1m tonnes/year. At present Guangxi is cultivating approximately 6m hectares of cassava plants, which produce 7.8m tonnes of cassava/year. The cassava is used to produce starch and ethanol and is exported.

The China National Petroleum Corporation (CNPC), China's largest producer of oil and gas, is planning to develop 2m tonnes/year of non-grain ethanol capacity, or at least 40% of China's current ethanol output.

In November 2006 CNPC signed an agreement with the government of Sichuan province to produce 60,000t/year of ethanol and biodiesel from sweet potatoes and jatropha curcas trees. In December 2006 it signed a framework agreement with the government of Yunnan province to produce fuel ethanol from non-grain crops.

In 2003, CNPC had established a joint venture with the China Grain Group to produce ethanol in Jilin province from maize; by the end of 2006 output was 500,000t/year.

MULTIPLE REGULATIONS AND INCENTIVES

In addition to the Renewable Energy Law and the Mid- to Long-term Development Plan for Renewable Energy, China has a series of provisional measures, opinions and policies.

Those include the Implementing Opinions On Financial and Tax Policies Supporting the Development of Bioenergy and Biochemicals, which was issued jointly by the Ministry of Finance, the National Development and Reform Commission (NDRC), the Ministry of Agriculture, the Bureau of Taxation and the State Forestry Bureau. They also include Provisional Measures for the Administration of Specialised Funds for Renewable Energy Development, which, among other things, provides a framework for grants and low-interest loans to support renewable energy projects, such as biofuel plants.

The various measures will culminate in the promulgation of stand-alone regulations governing the bioenergy industry, which the NDRC is now researching and drafting.

China's provinces and the four cities administered directly by Beijing have also adopted their own renewable energy strategic plans. One example is the coastal Shandong province, which has set a goal of increasing the percentage of total installed renewable energy capacity from 0.2% in 2005 to 5.3% by 2015.

Sichuan province has objectives for further renewable energy development through the recent Sichuan province 11th Five Year and 2020 Energy Development Plan. According to the plan, by 2010 installed biomass energy capacity (primarily based on crop stalks) should reach 50MW, biofuel production capacity should be 100,000t/year and 5m farm households should be using methane gas. In Sichuan crop waste (stalks, etc.) totals 49.7m tonnes/year, which is equivalent to 24.6m tonnes/year of coal.

Sichuan already has two crop-to-energy facilities, in Mianyang and Neijiang. Based on a November 2006 framework agreement, Sichuan and China Oil and Gas Joint Stock Company will develop a 100,000t/year biofuels capability based on the manioc tree, which is abundant in Sichuan.

In mid-January 2007 CNPC and the State Forestry Bureau signed an agreement to develop at least 600,000 hectares of forests in Yunnan and Sichuan with the capacity to produce more than 60,000t of biomass for fuel production. According to Liu Baohe, a deputy chairman of the biofuels committee of CNPC, the aim is to have 200m hectares of forest producing more than 6m tonnes/year of biomass by 2020.

At current levels of ethanol production, the Chinese contend that there is no threat to food security, although they acknowledge that an increasing number of farmers will be 'farming oil' if the price of crude oil continues to increase. However, in some provinces not enough maize will be produced to supply all the maize-based ethanol plants planned in those areas.

In a recent *World Economic Outlook*, the International Monetary Fund expressed concern that there would be increasing competition worldwide between biofuels and food consumption for agricultural products, probably resulting in increases in crop prices. It is likely that China will contribute to this as the widespread phenomenon in China of "blind" investment in industry after industry has led to widespread raw material shortages.

Beijing will need to be vigilant to restrict ethanol investments based on maize inputs, especially considering the financial incentives which it is providing to boost ethanol production. In late 2006 the NDRC issued an "emergency notice" requiring all proposed grain ethanol projects, both new and expansions, to be vetted at the national level. More comprehensive oversight of projects is planned as the NDRC is drafting the Biofuel Ethanol and Vehicle-Use Ethanol Fuels 11th Five Year Development Programme, which, among other things, will provide a framework for the development of non-grain ethanol demonstration projects.

BIODIESEL BOOM

China has dozens of biodiesel companies, which cumulatively produce in excess of 100,000t/year of fuel. The principal producers include Hainan Zhenghe Bio Energy, Sichuan Guchen Youzhi Chemical and Fujian Zhuoyue New Energy.

Since 2006 biodiesel plants have cropped up in Shanghai, Fujian, Jiangsu, Anhui, Chongqing, Xinjiang and Guizhou, among other places, in the form of private, state-owned and even foreign-owned enterprises.

New plants are much larger than the small, 10,000t/year or less developments of previous years. For example, Anhui Guofeng Bio-Energy is investing 500m yuan in a 600,000t/year biodiesel plant (the first 50,000t/year line went into operation in November 2006). Another example is the 750,000t/year project being developed by Nanjing Qingjiang Bio-Energy Science and Technology.

In all, dozens of biodiesel projects are under construction or in planning; cumulatively their output will exceed 3m tonnes/year. The principal feedstocks will be domestically-produced rapeseed oil and imported palm oil. China currently also uses other vegetable oils and used cooking oil.

Because China's biodiesel development is in its early stages it is characterised by poorly-developed industrial policy, technical standards, sales channels, production techniques, equipment, environmental evaluations, etc. China has not yet standardised its macroeconomic policies with respect to the biodiesel industry, but it will soon issue State Standards for the Use and Adjustment of Bio-Diesel Fuels.

SUPPORT FOR BIOMASS

By the end of the 11th Five Year Plan (2006–10) China is expected to have put into place a total of 5,500MW of biomass-fired power generating capacity, which would still only account for 0.6% of the nation's expected total installed

INTERNATIONAL INTEREST IN BIOENERGY IN CHINA

Investment from overseas and aid by international non-governmental organisations are an important impetus to the development of biofuels and biomass in China.

An agreement by Canada's Richway Environmental Technologies to establish a \$66m agricultural waste-to-energy plant in Pingdu, Shandong province (mid-way between Laiyang and Weifang, north of Qingdao) is one example. The facility will be able to turn 292,000t of agricultural wastes (primarily wheat and maize stalks) into 400m kWh/year of electricity. Local farmers will use the ash that is produced as fertiliser.

Combusting nearly 300,000t/year of agricultural waste is equivalent to a reduction in consumption of 150,000t of coal, which in turn will result in a reduction of more than 90t of sulphur dioxide emissions.

In November 2006 the \$8.6m Green Poverty Reduction in China project was launched jointly by China and the United Nations Development Program. It covers minority nationalities in Guizhou, Yunnan and Sichuan provinces, aims to reduce poverty and develop the ecology of the regions by training technical, commercial and management personnel for the development of a biofuels industry based on jatropha as a feedstock. Training sessions have been held in Beijing, Sichuan and Yunnan provinces.

generating capacity. The objective is 30,000MW of generating capacity fuelled by biomass by 2020.

China's agricultural sector produces more than 700m tonnes/year of crop stalks, or 350m tonnes of coal equivalent (mtce) in energy terms. Nationwide, Chinese farmers can supply approximately 200m tonnes/year of crop stalks for biomass power generation; equivalent to 100 mtce. If 40m tonnes of crop stalks were used each year for power generation, 20 mtce would be saved and China's farmers would earn an additional 12bn yuan.

To encourage the further development of biomass China has put into place a subsidy of 0.25 yuan/kWh for biomass power. Energy from agricultural waste, straw and urban waste could eventually exceed 500mtce, it says.

More than 30 biomass power projects have been approved and a handful are already operating. China's first demonstration power plant burning crop stalks began operating on 20 December 2006. The 248m yuan plant, which is an investment by the China Energy Conservation Investment Company, will burn 170,000–200,000t/year of stalks to produce 132m kWh of energy; the plant is estimated to save 98,000t of coal equivalent of conventional fuels each year.

It is expected to earn a 15m yuan/year profit and provide an income of 5,000 yuan/year for farmers in Suqian in Jiangsu province. Jiangsu is a large agricultural province with an estimated supply of more than 37m tonnes/year of crop stalks, the fourth largest amount among China's provinces.

In late December 2006 the State Power Longyuan Group began building its first biomass investment, the 24MW East China Sea Longyuan project in Jiangsu. The 240m yuan facility will be able to generate 140m kWh/year. Longyuan has existing investments in other renewables.

Work has also begun on the 250m yuan Kaiyou Green Energy biomass power plant in the economic development zone in Suqian, Jiangsu. The project will be able to generate 144m kWh/year from 200,000t of rice husks.

The State Power Grid estimates that by 2010 it will have about 2,000MW of biomass power generation, or about 36% of China's total biomass power generation capacity.

The bioenergy industry is on the cusp of explosive growth in China and the next decade is likely to establish it as yet another of China's "pillar" industries. As has been true with countless other industries in China, the growth of the bioenergy industry is likely to surpass all expectations.

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