

## GROUPINGS OF REGIONAL CITIES IN THE ENERGY SECTOR

**Category 1** – A large market with clear aims and objectives

**Category 2** – A large market with growing aims and objectives

**Category 3** – An emerging market with growing aims and objectives

### Category 1

Baotou      Ordos  
Dongying    Shijiazhuang  
Harbin

### Category 2

Changchun   Hangzhou    Wuhan  
Changsha    Nanjing      Xi'an  
Chengdu     Ningbo       Zhengzhou  
Dalian       Tangshan  
Dongguan    Tianjin

### Category 3

Changzhou    Quanzhou    Wenzhou  
Foshan       Shaoxing    Wuxi  
Hefei         Shenyang    Xiamen  
Jinan         Suzhou       Yantai  
Nantong      Weifang      Zibo  
Qingdao      Weihai

Whilst daunting, the challenge of meeting China's energy needs presents a wealth of opportunities, particularly in meeting demand through improved energy efficiency. China is the world's fastest-growing consumer of power, and energy demand continues to rise as the economy expands. This has caused periodic power shortages, putting pressure on central and local governments to make additional supplies of energy available to consumers. China produced three billion tonnes of coal in 2009, 50 per cent of the world's total, and coal is used to generate 79 per cent of the nation's electricity.

China's staggering rate of growth has a substantial impact on the environment, as well as putting tremendous pressure on the global oil and natural gas markets, raising energy prices worldwide.

China recognises that it cannot continue to increase its energy usage at the same rate as its economic growth. Government plans are to cut energy consumption per unit of economic growth by 16 per cent and to emit 17 per cent less carbon dioxide emissions per unit of economic growth. China also aims to increase the use of non-fossil fuels from 8.3 per cent in 2010 to 11.4 per cent by 2015 and to raise the overall use of clean energy. This is part of the country's wider plan to reduce carbon intensity by 40 to 45 per cent by 2020 from 2005 levels. This government policy provides a rare opportunity to provide powerful environmental improvements while developing a solution to an economic problem.

## OIL & GAS

Oil makes up 17 per cent of China's energy mix. However, at present production levels, currently exploited national oil reserves will only last until about 2025. Ninety eight per cent of total crude distillation capacity is controlled by China's two oil giants, Sinopec and PetroChina. State Owned Enterprises (SOEs) account for 66 per cent of the well-drilling equipment market. Other Chinese private SMEs make up another 19 per cent of the market, producing mainly individual stand-alone equipment. Foreign companies account for 15 per cent of the market and supply advanced complete-set equipment. Key international players have established their presence in China mostly through partnering with Chinese companies.

Most of China's technology is focused on the exploitation and processing of its domestic light crude oil. However, limited domestic reserves have forced China to exploit more of its heavy crude reserves and to import increasing quantities of heavy crude oil. This type of oil is more difficult to recover from the ground, more difficult to

refine, and more polluting than light crude, thus requiring advanced technology from abroad. China currently imports half the crude oil it uses and this is expected to rise to 65 per cent by 2020.

Current government policies cover several areas: the emphasis on the use of high-efficiency technologies to develop low-grade oil & gas resources and improve oil recovery ratios; the replacement of fuel oil (light oil) with clean coal, petroleum coke and natural gas; the more rapid development of coal-to-liquids projects; the development of oil bases and expansion of oil pipelines and networks; and the adoption of petroleum-saving and consolidation policies in the electric power, petrochemical, metallurgical, building material, chemical, and transport industries.

The biggest growth area in petrochemical refining is ethylene production. All major Chinese producers already use ethylene steam-cracking technology constructed by or licensed from foreign companies. The large SOEs are mostly interested in acquiring patented technological processes and

technical expertise. Tianjin has announced plans for a new ethylene project for completion by 2015.

Lanzhou, Chengdu, Daqing, Urumqi and Hohhot are all existing centres of onshore oil drilling, with plans for increased output and technological development. Typical energy-saving technologies in demand are likely to include: optimised operation technologies to water filling systems; comprehensive energy-saving technologies for oil and gas-enclosed collection and transmission; and recovery and reutilisation technologies for discharged natural gas.

Natural gas makes up almost 4 per cent of China's total energy consumption. This is growing rapidly due to increases in demand from the chemicals industry and household use. The 12th Five-Year Plan implies that natural gas consumption will rise to 8.3 per cent or 260bcm by 2015.

The cities of Changsha, Changchun, Chengdu, Dongying, Zhuhai, Daqing, Weifang, Urumqi and Hohhot all have plans for further gas exploration and technological upgrades within the next five years. The cities of Dongguan, Hangzhou, Harbin, Jinan, Suzhou, Tianjin, Wenzhou and Xi'an each have plans for improved local storage and distribution.

As China imports approximately 20 per cent of its gas supplies as Liquefied Natural Gas (LNG), major port facilities are required for handling, storage and processing. The Dagushan LNG project in Dalian and the Jiufeng LNG project in Dongguan will begin production in the third quarter of 2011. Dongying and Ningbo have stated that they will develop new port facilities by 2015.

China has over 20 trillion m<sup>3</sup> of shale gas reserves. Development of the country's inland shale gas is a promising market. The regions identified for exploitation are Sichuan (Chengdu), Inner Mongolia (Ordos), Heilongjiang, Jilin, Liaoning, Hubei, Xinjiang, Guizhou and Shandong (Dongying), although many are hampered by poor logistics or scarce water resources.

PetroChina aims to produce 500 million m<sup>3</sup> of shale gas by 2015, while Sinopec intends to have combined production capacity of 2.5 billion m<sup>3</sup> of shale gas and coalbed methane gas by the end of that year.



# CLEAN & RENEWABLE ENERGY

Within just a few years, China has emerged as a global leader standing at the centre of almost every clean and renewable energy market. It is an area which relevant UK investors or companies cannot ignore.

Propelled by China's economic expansion and ambitious policies, these markets have grown swiftly. For example, by the end of 2010, China had become the world's largest investor in clean energy, at RMB354 billion (£35 billion), and had installed 44.7 GW of wind power. The 12th Five-Year Plan and other policies will propel further expansion in coming years.

## Solar

China plans to boost solar capacity 20-fold by 2020, from 800 MW in 2010 to more than 20 GW. Capacity will increase to 10 GW within the next Five-Year Plan, including more development in western China, with technologies beyond the crystalline silicon (c-Si PV) solutions the country has favoured so far. China is home to four of the world's 10 largest manufacturers of solar panels by volume (Trina Solar (Changzhou), Yingli, Suntech (Wuxi) and JA Solar) and is the global leader in this area. Within its city Five-Year Plan, Changsha emphasises its intention to develop solar panel manufacturing.

The first provinces to develop large-scale grid-connected projects, using primarily domestically produced crystalline silicon PV panels, will be Xinjiang, Gansu, Inner Mongolia, Qinghai, Ningxia and Shaanxi. As technology and power-generation costs decline, it is likely that China will install a mix of solar technologies to achieve its 2015 and 2020 solar- power generation targets.

Fourteen of the cities in this report have specific solar-power initiatives, including the installation of solar panels on the roofs of business park buildings. They are: Changchun, Changsha, Chengdu, Hefei, Jinan, Nanjing, Ningbo, Shenyang, Suzhou, Tangshan, Weifang, Wuhan, Wuxi and Changzhou.

## Offshore Wind

China's offshore wind market only began in 2009 with the construction of the Donghai Bridge Wind Farm near Ningbo, but government targets call for swift growth to

30 GW by 2020. Offshore wind capital costs in China are projected to be at least double onshore costs, resulting in the bids for four new developments not being high enough to continue. These projects may be subsequently awarded higher tariffs by the government to ensure profitable operation, just as with early onshore wind farms. For foreign equipment and service providers, the market may be favourable, but due to pricing constraints there may be limited opportunities for overseas turbine manufacturers.

## Onshore Wind

Although China is both one of the world's leading wind-power generators and one of the fastest installers of new wind-generating capacity, the amount of energy it generates from this method is tiny compared with that from coal or hydro. Even by 2020, wind power generation will not be a major energy source. China has recently announced the scrapping of subsidies to power generators who use domestic parts at the expense of imports.

Beijing-based Longyuan Power Group is the country's largest wind-power equipment manufacturer and wind-farm developer, with existing farms in Xinjiang (Urumqi), Gansu, Inner Mongolia (Baotou), Hebei, Liaoning (Shenyang), Jilin, Heilongjiang and Fujian. Other companies have developed wind farms in Yantai, Nantong and Daqing, and there are plans for development in Quanzhou, Wuxi, Weifang, Tangshan, Nanjing and Jinan. Changzhou, Wuhan, Suzhou and Ningbo all have plans to develop and manufacture wind-power equipment.

LM Wind Power, a world leader in rotors, has its China headquarters in Beijing and operations in Tianjin, Urumqi and Qinhuangdao. Vestas, which also has its Chinese headquarters in Beijing, has six factories in Tianjin and another three plants in Jiangsu and Inner Mongolia.

## Biofuels

China expects biofuels to meet 15 per cent of its transportation energy needs by 2020, with a call for a combined ethanol and biodiesel output of 12 million tonnes. Ethanol output is currently around four million tonnes, and biodiesel some two million tonnes. Currently, more than 75 per cent of China's ethanol

output is sourced from corn, with the remainder coming from wheat and sorghum. Guildford-based TMO Renewables has signed deals with two Chinese state firms to develop pilot plants producing cellulosic ethanol. The aim is to use a process using enzymes to break down cassava crop waste to produce cellulosic, or second-generation biofuel, an alternative transport fuel meant to be more efficient than biofuels made from corn.

## Geothermal Power

According to the Ministry of Land and Resources, geothermal power is expected to provide 1.7 per cent of China's total energy requirement by 2015. China began utilising geothermal energy in the 1970s, with the first power station in Tibet. The industry has been held back due to the high capital investment requirements, the geographical spread of hotspots and technological immaturity.

In 2011, China will begin exploration of shallow-lying hotspots in 29 provincial capital cities, including Shijiazhuang, Shenyang, Changsha and Zhengzhou.

## Biomass

Since biomass energy is renewable, clean and environmentally friendly, and derived from organic raw materials like animals, plants and microorganisms as well as their discharges and wastes, it is an ideal solution for China's rural farmers. It is also convenient to store and transport and is abundant in supply, particularly in the eastern regions of China, which are distant from the major coal-producing areas.

Cities identified as having strong local government support for the development of biomass energy include: Changchun, Changsha, Daqing, Hefei, Jinan, Ningbo, Tianjin, Wuhan, Nanning, Quanzhou and Zhongshan.

## Hydro Power

China envisages hydro power as the most important source of renewable energy in the foreseeable future. It aims to have 300 GW of hydro power generation installed by 2020, utilising 75 per cent of the nation's hydro power potential. Expansion beyond this is unlikely to be commercially viable.

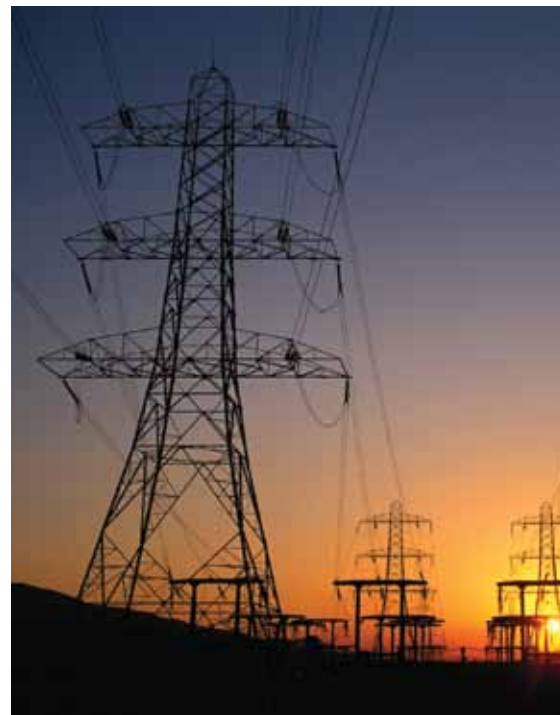
## SMART GRID

China's ambitious plan to invest RMB3.45 trillion to build a strong and smart grid by 2020 ensures that it will be one of the world's largest smart-grid markets. Each of the cities covered in this report have announced upgrade plans in this area.

Ambitious renewable energy and energy-efficiency targets, as well as growth projections for electricity demand, require a more advanced grid than exists today. State Grid, the world's largest utility and provider of 80 per cent of China's electricity, released its Smart Grid Plan in 2009, providing a roadmap through 2020 that ensures the country will remain one of the world's largest smart-grid markets. Smart-grid solution providers face difficult market conditions, where low-cost solutions and strong relationships with local grid companies define success.

Nearly all completed wind farms are now connected to the grid. The problem has shifted to excess intermittent supply. New UHV power lines will partially address the problem by shifting power elsewhere; by 2015, China will invest RMB500 billion to construct 40,000km of UHV transmission lines. Management and forecasting tools that maintain grid stability are also needed, such as active and reactive power-flow control and low-voltage ride-through (LVRT) technology.

Plans to install 500 million low-cost Automatic Meter Readers (AMR) before 2015 will lead to a requirement for more sophisticated Advanced Meter Infrastructure (AMI) meters to be installed within the same period. China's meter market is restricted to a handful of already-present players. Grid companies rely on suppliers with low prices, a quality track record, local after-sale customer service, and relationships with internal grid company departments.



## COAL

Coal makes up 79 per cent of China's energy mix. In addition to coal-fired power generation, coal is critical to the development of China's metallurgical, building materials (cement) and chemical industries, as well as residential use.

The vast majority of coal mining equipment used in China is produced domestically. Chinese companies are developing the capacity to manufacture high-tech mining equipment, such as super-power electric

haulage shearers, hydraulic support systems, and armoured face conveyers. Nevertheless, most of the mining equipment produced in China still remains behind that of other countries with respect to mining efficiency, equipment quality, environmental protection of mines, and safety.

Though few of the cities in this report include coal mining or coal fired power stations as a priority within the next 5 years China will still need to continue to invest heavily in

coal production and power generation. Likely areas of investment will be development of new mines, improvement of coal mine safety, clean coal processing technology, coal conversion technology and coal bed methane capture. Cities that have stated developments in the coal sector include Weifang and Wuhan which are promoting clean coal processing, Urumqi to adopt methane capture, and Changsha, Tangshan, Hohhot and Datong which plan to develop new mines and expand production.