

Beijing looks to provide the right conditions for private investment in the CCS sector as Canberra eyes A\$2bn funding awards this year

# Commercial roadblock in way for China

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CHINA recognises that carbon capture and storage is a critical option to help it reach its target of reducing carbon intensity by 40% to 45% by 2020 compared with 2005 levels.

However, there are many challenges on the road to commercialisation.

Despite being the world's largest coal consumer, with 70% of its electricity generated by the fossil fuel, China needs to come a long way before large-scale commercial CCS initiatives can move forward without government regulatory and financial support, as well as international co-operation.

Zhang Dongxiao, associate dean of the College of Engineering at Beijing University, says that China's current CCS projects are policy-driven instead of market-driven.

Only with proper regulation and supportive policies, such as taxing those plants that do not introduce CCS technology for emission reductions, could CCS become a self-financing initiative by power developers, he says.

"The key now is to reduce the cost," he says, adding that once the cost is down, China can expect large-scale CCS development.

He says China has made headway in the CCS sector, leading the world in some pilot projects.

Zhang's team now provides technical support for China's first CO<sub>2</sub> storage project built by Shenhua Group in Inner Mongolia. Before that, the only coal-based CCS projects in China involved CO<sub>2</sub> capture without storage.

He says CO<sub>2</sub> will soon be injected into a deep saline aquifer through two wells at the Shenhua facility in Inner Mongolia.

The Shenhua coal-to-liquid plant is the first of its kind to go into operation in China. It is expected to produce 3 million tonnes of oil products from coal in 2015, expandable to 11 million tonnes by 2020, up from 500,000 tonnes in 2010.

China's first post-combustion CO<sub>2</sub> capture demonstration project, sponsored by power producer Huaneng Group, went into operation in Beijing in 2008 with capacity to capture 3000 tonnes per annum of CO<sub>2</sub>.

The CO<sub>2</sub> is refined to a purity of 99.997% and meets the requirement for food processing.

According to Li Zheng, director of Tsinghua BP Clean Energy



Storage effort: the Shenhua CCS pilot site in Inner Mongolia, China

Centre, Huaneng's Beijing project cost is \$25.30 for each tonne of CO<sub>2</sub> captured.

To develop a full CCS project including storage in China could likely cost between \$70 and \$100 per tonne, according to research by Beijing University's Zhang.

As well as the cost of capture, another US\$20 per tonne is needed for commercial applications, according to Jiang Minhua, director of Huaneng's Technology Department.

Chinese media has reported that CO<sub>2</sub> is now sold at about 1200 yuan (\$181) per tonne for food processing in China. Li says

China's CO<sub>2</sub> demand for food processing and other commercial needs stands at 1 million tonnes per annum.

Huaneng's second CCS project was built at Shidongkuo in Shanghai with capture capacity of 100,000 tpa in 2009.

Again, the 150 million yuan project is only for capturing CO<sub>2</sub> with no storage facility. Project manager Xu Shisen says the Shidongkuo project capture rate is above 80% with CO<sub>2</sub> purity registered at 99.6%.

China Power Investment Group commissioned a CCS facility in January 2010 in Chongqing in

south-west China. The Shuangwei Thermal Power Plant is able to capture 12,000 tpa of CO<sub>2</sub>.

GreenGen, a joint initiative by China's Huaneng Group and other major state-owned power giants, is building a 250-megawatt power project, combining Integrated Gasification Combined Cycle technology with CCS in Tianjin, northern China.

Xu says that CCS projects are energy-intensive, accounting for 30% of the power plant's total energy needs, which will raise power generation costs by up to 30% and cut efficiency by 10%.

The additional cost cannot be

passed on to electricity consumers as a result of government controls of electricity tariffs. The price policy has incurred huge financial losses to thermal power plants over the years, making it a challenge for them to initiate any CCS programme.

However, China has initiated several CCS research and development projects with the help of international organisations such as the Energy Foundation of the US and the European Union through the China-EU-UK programme.

The schemes are for developing and demonstrating near-zero coal emission technology through CCS

in China and the EU and for exploring options and building CCS projects in China.

One of the latest projects involves co-operation between Hong Kong-listed Enviro-Energy International and Toronto-listed Petromin and China United Coalbed Methane Corporation on a carbon dioxide sequestration and enhanced coalbed methane pilot project at the Shizhuang North block in the Qinshui basin in Shanxi province.

Since late November 2010, the SX-001 well at the Deep Unmineable Project has begun de-watering in preparation for injecting CO<sub>2</sub> into the target coal seams to confirm their suitability for CO<sub>2</sub> sequestration and long-term storage while piloting enhanced CBM production from the coal seams in which the CO<sub>2</sub> is stored.

Also in November, Australia's Commonwealth Scientific and Industrial Research Organisation and Huaneng launched a joint study towards a commercial-scale CCS project in China.

The study will look at site selection, capture technology, storage, finance and timelines. It will complement existing areas of co-

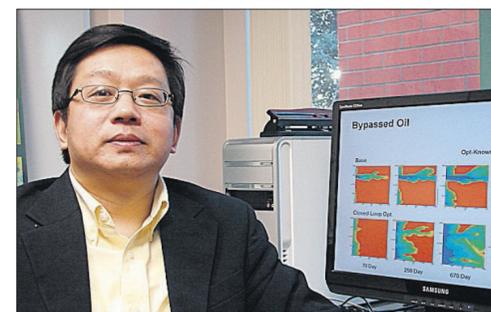
operation between Australia and China in CCS, including Geoscience Australia's China-Australia Geological Storage project and work under Australia-China Joint Coordination Group on Clean Coal Technology (JCG).

Six research projects totalling \$3.2 million have also been funded by the Australian government under JCG to enhance collaboration between Australian and Chinese research institutions.

However, China-based industry

officials say that, despite the progress that has been made by the country in CCS, it still must overcome a number of hurdles to move forward on initiating further pilot projects and commercial developments.

These include a lack of CCS-specific regulations and issues that arise from the costs, as well as the high-risk investment that is required to ensure safe and effective long-term CCS programmes.



Costs hurdle: Zhang Dongxiao, associate dean of the College of Engineering at Beijing University

Photo: XU YIHE



Coming to fruition: Australia's Resources Minister Martin Ferguson says new flagship CCS projects are on the way

Photo: BLOOMBERG

## Gorgon monster is stirring in Australia

AUSTRALIA may be reviewing its plans for an ambitious carbon trading system but like other developed nations it is pushing forward with plans for carbon capture and storage, writes Amanda Battersby.

Today, three flagship Australian CCS projects remain in the race to secure A\$2 billion (US\$2 billion) worth of federal funding that will be announced this year.

Those competing are:

- The Collier South West Hub project in Western Australia, which aims to store up to 3.3 megatonnes of carbon dioxide annually, captured from surrounding industries including coal-fired power plants
- The Wandoan power plant project in Queensland, which is based on integrating General Electric's existing technologies with CO<sub>2</sub> storage, in the Surat basin
- The CarbonNet project in Victoria, which aims to store between 3 and 5 megatonnes per annum of CO<sub>2</sub> captured from coal-fired power plants in the region.

"I expect to be in a position to announce the next significant stage in the development of CCS flagships in the first half of 2011," says federal Resources Minister Martin Ferguson.

Another CCS project, ZeroGen, that was promoted by the Queensland state government — and was also a short-listed contender for the federal cash — was written off last year.

ZeroGen, into which the state government had sunk about \$150 million, envisaged using integrated combined cycle gasification. Japan's Mitsubishi Heavy Industries was touted as a potential investor in ZeroGen, which sources say bit the dust not least because it had become apparent that the underground reservoirs destined for CO<sub>2</sub> storage at this Bowen basin clean coal project were not large enough.

However, in terms of getting

CCS up and running in Australia it is the multi-billion dollar Chevron-operated Gorgon LNG project that incorporates what is being touted as potentially the world's largest CCS scheme.

The Gorgon CCS proposal represents the biggest single investment to date contemplated purely for the management of greenhouse gas emissions, according to project partner ExxonMobil.

The Gorgon CO<sub>2</sub> injection project has a price tag of about \$2 billion.

The co-venturers plan to separate CO<sub>2</sub> from Gorgon's produced gas and inject it into a deep containment reservoir about 2.5 kilometres beneath Barrow Island where the liquefaction facilities are being built. This CCS project will reduce the project's total greenhouse gas emissions by about 40%.

When injection operations are at full capacity in 2015, the project plans to inject between 3.4 million and 4 million tonnes per annum of carbon dioxide.

The CO<sub>2</sub> injected will be carefully monitored via a number of surveillance wells and repeated seismic surveying, says Chevron.

Australian Petroleum Production & Exploration Association chief executive Belinda Robinson says: "Gorgon will be the first commercial project in Australia to significantly reduce emissions by injecting carbon dioxide underground and will be one of the largest greenhouse gas storage projects in the world."

Gorgon is the only project that has moved into construction and satisfied the seven criteria established by the G8 nations at their meeting in L'Aquila in 2009.

These criteria were developed to assess whether the G8 goal of having 20 CCS projects in operation by 2020 is achievable.

## Maturing oilfields raising the prospects for enhanced recovery

ENHANCED oil recovery, as in other parts of the world, is fast emerging as a sector in China that could make significant use of carbon capture and storage, writes Xu Yihe.

Most of China's big mature oilfields have reached their production plateaus and require enhanced recovery techniques to maintain production.

However, Zhang Dongxiao, associate dean of the College of Engineering at Beijing University, says that CCS is yet

to be extensively applied at Chinese fields due to the difficult geology and the lack of CO<sub>2</sub> supply in the right places. Not all the fields are CO<sub>2</sub>-prone, he says.

PetroChina began building China's first CO<sub>2</sub>-based enhanced oil recovery project at the Jilin oilfield in north-east China in 2006.

The combustion facilities are being built at the Jilin site following a pilot test programme carried out at blocks

Hei 79, Hei 59, Hong 87-2 and Qian'an.

At the Dagang field in the north, PetroChina has resumed production at the deserted Kongdian block through CO<sub>2</sub> injection.

The block is now producing about 22 barrels per day of oil and water cut has been reduced to 60% from 90%.

China's second-largest oil producer Sinopec has been experimenting with CO<sub>2</sub> EOR projects at its Shengli field

and Zhongyuan oilfields with total injection capacity of 63,000 tonnes per annum.

Sinopec has installed a CO<sub>2</sub> capture facility at an offsite power plant at Shengli. The CO<sub>2</sub> captured is expected to raise Shengli's oil recovery by 20% and cut CO<sub>2</sub> emissions by 30,000 tpa.

At Zhongyuan, Sinopec has been capturing CO<sub>2</sub> from refinery furnaces and injecting it into wells to enhance oil recovery.