

# Low emission coal technology

April 2009





## Background

- Queensland is a leader in the research, development and demonstration of new low emission coal technology.
- In June 2007, the Queensland Government formalised a flagship partnership with the coal industry to fund accelerated research, development and deployment of low emission coal technology in Queensland.
- This partnership and the associated \$900 million funding by the Queensland Government (\$300 million) and coal industry (\$600 million over 10 years) is the most significant commitment in the region towards the development and deployment of low emission coal technology.
- The objective of the Clean Coal Fund is to leverage investment partnerships to achieve the accelerated development and deployment of low emission coal technology to significantly reduce greenhouse gas emissions from the use of coal.
- This long-term energy solution aims to secure Queensland's future energy needs, support the continued development of the state's coal industry and reduce greenhouse gas emissions.
- With growing electricity demand and an abundant supply of low-cost, high-quality thermal coal, Queensland is well placed to pioneer low emission coal technology.
- When combined with the capture and storage of carbon dioxide, low emission coal technology will be capable of achieving greenhouse gas emissions cuts of more than 75 per cent.
- Queensland is partnering with researchers in Europe, China, Japan and the United States on low emission coal technology research and development.

The Department of Mines and Energy is responsible for the implementation of the Queensland Government's *Smart Energy Policy* to reduce greenhouse gas emissions from energy generation. The policy was outlined in the Queensland Government's climate change strategy, *ClimateSmart 2050*.

Other sectors responsible for significant greenhouse gas emissions in the state are land use, agriculture and transport. Initiatives to reduce emissions from these sources are also being addressed by relevant Queensland and Federal Government agencies.



## Low emission coal technology

Low emission coal technologies ensure the use of coal as a sustainable energy generation fuel source, typically by:

- improving thermal efficiency to reduce coal consumption in electricity production
- ultimately, significantly reducing emissions of carbon dioxide by capturing and then storing the carbon dioxide.

Low emission coal technologies being explored in Queensland include the range of technologies for capture of carbon dioxide by pre-combustion capture treatment (as in Integrated Gasification Combined Cycle (IGCC)), post-combustion capture treatment and oxyfuel (a specific post-combustion technique). It also includes the capability to safely store the carbon dioxide in specific geology deep underground. These technologies will achieve near zero emissions from power generation.

The Queensland Government is investing in a portfolio of low emission coal technologies, rather than investing in one technology as the low emission coal solution.

## Timeline

Various low emission coal technologies are expected to be commercially operational by 2020.

At the 2008 G8 Summit, participants agreed to plan the accelerated development of technologies with the potential to reduce carbon dioxide emissions from stationary energy sources. The G8 strongly supported the launch of 20 large-scale carbon dioxide capture and storage (CCS) projects around the world by 2010, and broad development and deployment of CCS by 2020.

To help achieve this objective, the Australian Government has established the Global Carbon Capture and Storage Institute, as a coordination point for low emission coal research and development and project development on an international scale.

The institute's effectiveness will depend on the continued commitment of governments and industry across the globe to work together on the ongoing development of existing projects, such as those already underway in Australia.

## Demonstration projects

Queensland's commitment to low emission coal technology is underscored by demonstration projects of national and international significance.

The projects will use integrated carbon dioxide capture and storage, the key technology recommended by the Intergovernmental Panel on Climate Change to achieve deep cuts in greenhouse gas emissions.

### ZeroGen

ZeroGen is undertaking a feasibility study to demonstrate Integrated Gasification Combined Cycle (a form of pre-combustion capture) with carbon capture and storage. The feasibility study is the forerunner to a commercial-scale plant that could be deployed as early as 2017, capable of capturing up to 90 per cent of carbon dioxide emissions.

### Callide Oxyfuel Project

The \$206 million CS Energy led Callide Oxyfuel Project at the existing Callide A Power Station in Central Queensland, has the potential to significantly reduce the cost of capturing carbon dioxide from conventional coal-fired plants.

Oxyfuel, or oxyfiring, is an example of post-combustion capture where a concentrated stream of carbon dioxide is produced from the boiler by using oxygen, instead of air, to burn the coal.

The technology is of particular importance to the coal and electricity industries because it can be retrofitted to existing boilers. It is supported by the Asia Pacific Partnership (APP) on Clean Development and Climate and by a diverse consortium of global partners.

The Callide project is funded by CS Energy, the Queensland Government, the Australian Coal Association Low Emissions Technologies Ltd. (ACALET), the Commonwealth Government, Schlumberger, Xstrata Coal, and a consortium of Japanese parties which comprises IHI Corporation, JCOAL, JPower and Mitsui and Co.

## Tarong Post-combustion Capture

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) recently entered into a collaboration agreement with Tarong Energy to host a Post-combustion Capture pilot plant based on amine technology at the Tarong Energy power station.

Post-combustion Capture techniques will be an important capability to retrofit to existing power stations to reduce greenhouse gas emissions.

The project will form part of the CSIRO led Asia Pacific Partnership (APP) program to deploy multiple Post-combustion Capture pilot plants for use with black coal. Plants will be deployed in New South Wales, Queensland and China utilising different capture techniques and processes to obtain process data, and practical experience. Performance results will be shared between program participants.

## Research and development

Queensland is on the cutting-edge of global low emission coal technology development and offers exciting prospects for international investors and strategic partnerships. Queensland research and development capability for low emission coal technology includes the following projects and initiatives.

## The Queensland Centre for Advanced Technologies (QCAT)

QCAT is a collaboration between the CSIRO and the Queensland Government. The centre's aim is to expand and diversify the research and development activities of the CSIRO in Queensland.

The centre has a world-class reputation in the areas of:

- low emission coal technology
- mineral exploration
- geophysics
- coal mining, processing and utilisation
- metalliferous mining and processing
- minesite rehabilitation
- foundry technology.

QCAT is the main CSIRO centre in Queensland for low emission coal research. It hosts a Pressurised Flow Entrain Reactor (PFER) to study coal gasification along with laboratories for high temperature coal gas cleaning. It also hosts CSIRO projects for the Centre for Low Emission Technology and some projects originally undertaken by the now concluded Cooperative Research Centre for Coal in Sustainable Development.

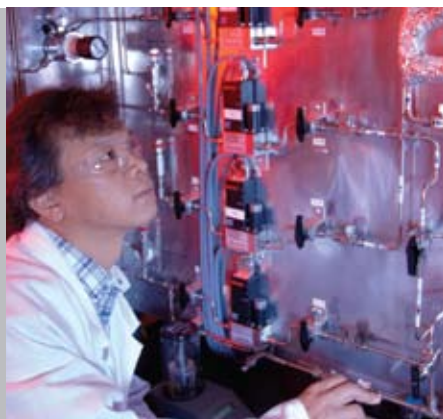
## The Centre for Low Emission Technology (cLET)

cLET is a \$26 million joint venture between the Queensland Government, CSIRO, Stanwell Corporation, Australian Coal Research Limited, Tarong Energy and the University of Queensland.

Based at QCAT, the centre's work focuses on five program areas:

- gasification of coal
- gas cleaning
- gas processing
- gas separation
- social and economic integration of these technologies.

The Queensland Government committed \$9 million in funding to cLET over four years, and has supported cLET to undertake a scoping study and to develop a Research and Development Plan for a 5MW coal gasification research and development facility. The Federal Government has committed \$50 million to establishing such a facility in Queensland.



## The University of Queensland Centre for Coal Energy Technology

The University of Queensland is establishing a Centre for Coal Energy Technology (CCET) to coordinate and strengthen low emission coal research at the university.

The centre will link to the Australian Institute of Bioengineering and Nanotechnology (AIBN), the Australian Research Council Centre for Functional Nanomaterials (ARCCFN) and the Sustainable Minerals Institute (SMI). Both the AIBN and the ARCCFN research the use of nanotechnology for clean energy applications, whilst the SMI focuses on the sustainable aspects of energy production.

The Centre for Coal Energy Technology is expected to draw on 66 researchers and additional support staff. The range of research projects includes:

- sequestration of carbon dioxide in deep coal seams
- coal bed methane extraction
- enhanced recovery of coal seam methane
- coal gasification
- gas processing, cleaning and separation of carbon dioxide
- thermodynamics of ash slag in gasification
- simulation, control and diagnostics
- converting gas to liquid fuels
- air separation techniques and oxyfuels
- adsorption of carbon dioxide and methane to coals
- adsorption of carbon dioxide in nanomaterials
- formation of ultra clean coal.

## International collaborations

Queensland has specific collaboration links with Germany, the People's Republic of China, the United States of America (USA) and Japan based on their strengths and policies associated with adoption of low emission coal technology.

In particular, the Queensland Government signed a Memorandum of Understanding (MoU) with the North Rhine Westphalia Government (Germany) in June 2008 to collaborate on advanced power generation technologies.

The University of Queensland and a German research institute (Forschungszentrum Julich) have received a \$1 million grant from the Queensland Government to progress research into nano membranes for hot gas separation in the gasification process for low emission coal technology.

The University of South Carolina has a MOU with the University of Queensland on hydrogen and is discussing low emission coal collaboration opportunities with cLET.

The University of Queensland and the University of Wyoming held a joint workshop in April 2008 with industry and government representatives to foster collaboration in low emission coal technology. Wyoming is the major coal producing state in the USA and the site for a possible 5MW coal gasification research facility based on GE technology—similar to the facility being sought for Queensland.

There are several MOUs between the Queensland Government and Chinese organisations that include collaboration in low emission coal technology. In addition, the Queensland Government is providing nearly \$2 million for a Queensland China Alliance in Nanomaterials for Clean Energy Technologies led by the University of Queensland and the Chinese Academy of Science.



These important relationships will promote increased future collaborations through coordination of research capabilities and activities, the exchange of postgraduate students and faculty, and the promotion of joint workshops and conferences.

## New low emission coal-fired generation

While low emission coal and next generation renewable energy technology projects are being demonstrated, coal and gas will continue to provide base-load power generation in Queensland.

Under the Smart Energy Policy any new base-load electricity generation application will be required to balance economic and environmental outcomes. New coal-fired generation projects will only be considered if they can demonstrate:

- how the generator represents a technology and efficiency improvement over other existing plant
- how the generator would integrate with carbon dioxide capture and storage technology
- it is tied to foreign investment in trade-exposed energy-intensive projects which would otherwise be attracted to a country with less-stringent emission standards for electricity generation, or
- Queensland's energy supply security is compromised and alternative energy sources are not economical in the timeframe.

Drilling image supplied courtesy of ZeroGen—all other images supplied by CSIRO

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### Further information

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