



# CO2CRC/HRL MULGRAVE CAPTURE PROJECT

Demonstrating  
CO<sub>2</sub> capture



## Why is carbon capture important?

Brown coal is the cheapest source of fossil fuel for power generation in Australia, but it produces the highest level of the greenhouse gas CO<sub>2</sub> when burned in conventional boilers in power plants. Significant improvements in the efficient use of brown coal for power generation, as well as the ability to capture carbon dioxide from coal-fired power plants, will mean we can continue to use this abundant resource in a carbon-constrained future.

Improved efficiency can be accomplished in many different ways, such as overall energy integration in the power plant and/or adopting new technologies. Coal gasification at high temperature and pressure is one of the best routes to more efficient coal burning. Advanced technologies such as Integrated Gasification Combined Cycle (IGCC) will enable higher thermal efficiencies - up to 50 per cent in the future - through the combined cycle of gas turbine plus steam turbine to generate electricity. IGCC can be either air or oxygen blown.

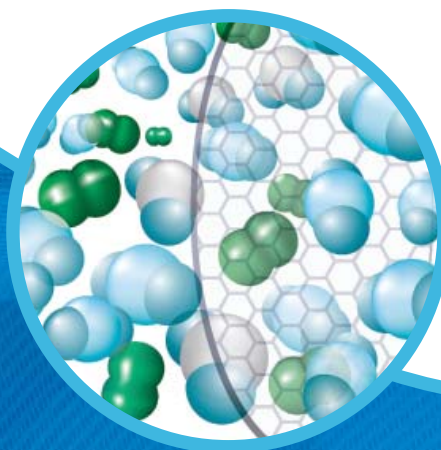
## Why pre-combustion capture?

Pre-combustion CO<sub>2</sub> capture is a good fit with IGCC power generation. The higher pressure and more concentrated CO<sub>2</sub> stream in syngas makes its pre-combustion capture simpler and lower cost than post-combustion capture from conventional plant flue gas.

In the process of gasification, coal is brought into contact with air at high temperatures, producing a combustible gas (known as syngas) which consists mostly of hydrogen, carbon monoxide and carbon dioxide. Syngas is used in the capture trials of the Mulgrave Project.

## Pre-combustion capture trials at the HRL Mulgrave gasifier

HRL operates a coal gasifier at their facility in Mulgrave, Victoria, which is supplying a stream of syngas to three CO<sub>2</sub>CRC experimental capture rigs. Each rig is evaluating a different CO<sub>2</sub> separation technology, with the aim of identifying the most cost-effective method of pre-combustion CO<sub>2</sub> capture for application to coal gasification power-generation technologies.



The capture technologies under evaluation are:

- Solvent absorption – the most mature technology and currently the method of choice for CO<sub>2</sub> separation in industry globally.
- Membrane separation – a promising stand-alone technology that can also be integrated with solvent systems.
- Pressure swing adsorption – a new technology that captures CO<sub>2</sub> using fixed beds of solid material and releases it by pressure changes.

The key objective of the Mulgrave Project is to reduce the technical risk and cost of pre-combustion capture for coal-fired stations that use gasification as the core technology.

This project is also allowing CO2CRC to build on existing capture research going on in Victoria. The University of Melbourne is responsible for developing solvent and membrane technologies while Monash University is developing adsorption technology.

In more detail, the program is:

- Identifying and quantifying the impact of the pre-combustion syngas contaminants of H<sub>2</sub>S, CH<sub>4</sub>, CO and water on the performance of each of the separation technologies.
- Identifying and quantifying the impact of pre-combustion gas temperature and concentration variations on the performance of the separation media and separation processes.
- Optimising process operating parameters.
- Developing engineering solutions at R&D scale in order to establish confidence for full scale plant design and assessment.
- Assessing the pre-combustion capture process and energy integration options.
- Reviewing the technical and economic viability of the commercial use of pre-combustion capture for new Victorian brown coal power stations using gasification as the core technology.

Experimental data from the trials, combined with numerical modelling, enables an assessment of the likely separation performance of each technology against commercial plant conditions.

## Future research

Once the technology found to be the most cost-effective in the preliminary trials has been identified, further work could include:

- Trials at plants with extra process steps to maximise the CO<sub>2</sub> capture including further reaction of syngas with water to produce extra hydrogen and CO<sub>2</sub> (a water gas shift reaction or WGS) as the hydrogen can be fired in a gas turbine or drive a fuel cell to produce power.
- Trials in a gasification plant where oxygen has been separated from air before being used in the gasifier, as in oxygen blown gasification.

## Who are the partners in the project?

The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) is conducting the trials in association with HRL Developments Pty Ltd, an HRL Limited group (HRL) company.

HRL is an Australian-owned public company with a focus on the development and operation of energy facilities, provision of specialist scientific and engineering services, technology development and environmental improvement.

HRL has developed a new technology called IDGCC which integrates the drying of wet coal with a gasification combined cycle process for power generation. The technology is particularly suited to Victorian brown coal and is well suited for pre-combustion carbon capture for sequestration.

CO2CRC is one of the world's leading collaborative research organisations focused on CCS.

CO2CRC is a joint venture between Australian and international industry, universities and other research bodies from Australia and New Zealand, and Australian Commonwealth, State and international government agencies.

Its resources come from the Federal Government's Cooperative Research Centres Program, other Federal and State Government programs, and CO2CRC industry and research partners.

### **CO2CRC is:**

- undertaking leading research into carbon dioxide capture and geological storage;
- demonstrating the practical application of CCS;
- assessing the scope for the application of CCS in different geographical, technical, and commercial settings around the world;
- collaborating globally and participating in international programs;
- developing new commercial opportunities based on CO2CRC intellectual property; and
- providing excellent education and training in greenhouse gas technologies.

The project has been supported by the Victorian Government, through their Energy Technology Innovation Strategy (ETIS) Brown Coal R&D funding.