CSIRO is working to reduce the cost and improve the efficiency of carbon dioxide capture and storage so it is a viable option in the future.

Carbon capture and storage

Carbon dioxide capture and storage (CCS) technologies have the potential to make deep cuts in Australia's greenhouse gas emissions from coal-fired power stations. CSIRO is working to reduce the cost and improve the efficiency of CCS so it is a viable option in the future.

Research is focused on deploying large-scale demonstration projects that enable substantial reductions in emissions and provide a pathway for industry to adopt the technologies at commercial scale.

With significant activities in both capture and storage, CSIRO has a strong track record in both the underpinning science of CCS and working with industry on demonstration projects.

Post combustion capture

Post combustion capture (PCC) technology could reduce emissions from coal-fired power stations by more than 80 per cent by capturing carbon dioxide (CO_2) from flue gases.

CSIRO has partnered with industry and government in the development, commissioning and operation of four PCC pilot plants – three in Australia and one in China – with more planned for roll out.

This work is supported by an extensive laboratory research program aimed at the development of novel solvents, ionic liquids and novel processes that are applicable in Australia.

CSIRO's extensive PCC research and pilot plant program will lead to the staged development, demonstration and implementation of new and more cost-effective capture technologies.

Storing CO_2 underground

CSIRO's CO_2 storage research is finding ways to safely and economically store CO_2 underground. CSIRO has committed significant resources and research to find suitable storage sites, minimise the risks of storing large volumes of CO_2 and provide cost-efficient monitoring technologies for storage systems.

CSIRO is involved in Australia's first underground CO_2 storage project – The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) Otway Project – located in south-west Victoria.

The project boasts one of the world's most comprehensive monitoring and verification programs for CO_2 storage and is demonstrating that CO_2 can be safely transported, stored and monitored in the deep subsurface under Australian conditions.

Approximately 60,000 tonnes of CO_2 has already been successfully injected two kilometres below the earth's surface and scientists have demonstrated that the CO_2 has been successfully contained.

Research contact:

Dr Lincoln Paterson
Research Leader
CO_2 Capture and Geological Storage
CSIRO Coal Technology
Phone: +61 3 9545 8350
Email: lincoln.paterson@csiro.au

> CSIRO is developing safe and effective ways to store carbon dioxide deep underground.

Working with CSIRO Coal Technology

CSIRO Coal Technology has the capability and capacity to undertake long-term research and development that will underpin more efficient, safer and lower environmental impact coal mining and utilisation.

This research will help secure the future of Australia's energy requirements, while helping our nation reach its targets to reduce greenhouse gas emissions and combat anthropogenic climate change.

CSIRO Coal Technology works with industry, government and research organisations across Australia and the world.

For further information:

CSIRO Coal Technology:

Dr John Carras
Director
Phone: +61 2 9490 8644
Email: john.carras@csiro.au

Dr Soozy Smith
Business Development Manager
Phone: +61 2 4960 6066
Email: soozy.smith@csiro.au

Contact Us
Phone: 1300 363 400
+61 3 9545 2176
Email: enquiries@csiro.au
Web: www.csiro.au

www.csiro.au

Your CSIRO

Australia is founding its future on science and innovation. Its national science agency, CSIRO, is a powerhouse of ideas, technologies and skills for building prosperity, growth, health and sustainability. It serves governments, industries, business and communities across the nation.

CSIRO

CSIRO Coal Technology

CSIRO is researching and developing technologies to improve the safety, efficiency and environmental impact of coal mining and to accelerate the deployment of low emission coal-based power technologies.

Working with industry, research organisations and government, CSIRO's coal technology research covers the entire coal value chain.

Securing Australia's coal and energy future

Coal is Australia's largest export and a major contributor to the national economy. It is the primary fuel for power generation worldwide and provides more than 80 per cent of Australia's electricity supply.

Coal is however a major contributor to the world's greenhouse gas emissions. Current coal-based power technologies account for more than one third of Australia's emissions alone.

CSIRO's coal technology research is focused on maintaining the benefits that Australia's coal resources bring to the nation and world while minimising the adverse environmental impacts of coal mining and coal-fired power generation.

With coal use worldwide projected to increase significantly over the coming decades, it is imperative that we overcome the related challenges. Central to this is the accelerated introduction of low emission coal-based energy technologies that will reduce greenhouse gas emissions and combat global warming.

Working with industry, research organisations and government, CSIRO's coal technology research covers the entire coal value chain and includes:

- Technologies to increase the efficiency and safety of underground and surface mining while lowering fugitive emissions.
- New coal-based low emission power technologies for electricity generation.
- Financially viable carbon dioxide (CO_2) capture and storage technologies.

> CSIRO – in conjunction with its partners in government, research and industry – is investing in the development of innovative technologies which aim to deliver high efficiency, low emission energy from coal.

Safer, more efficient and lower environmental impact coal production

The future of Australian coal mining is facing multiple challenges ranging from a declining resource base and more complex geological and mining conditions; to skilled labour shortages, rising production costs and global competition.

CSIRO is developing a range of advanced coal mining and processing technologies that will deliver benefits to industry, the environment and the broader community.

Improving mining efficiency and safety

In 2007-08, Australia exported more than 326 million tonnes of thermal and metallurgical coal worth more than $52 billion. With such high production levels, even small improvements in efficiency and downtime reduction can produce very high dividends.

The adoption of CSIRO-developed longwall automation technology has the potential to create significant production gains for the Australian coal sector.

An Australian Coal Association Research Program study showed that the reduced downtime realised by incorporating CSIRO's system in a typical longwall mining operation would result in production of an additional 435,000 saleable tonnes of coal per year and a conservative five per cent increase in the cutting rate.

CSIRO signed non-exclusive worldwide licensing agreements with five of the world's major longwall equipment manufacturers in 2009, and the technology is now being integrated into their new equipment.

The longwall automation project team is now bringing its skills to bear on another of the key areas for automation in underground coal mining – the development of core roadway infrastructure.

The use of automation in the mining industry also has a positive impact on safety. Massive machines, noise and dust are all present at the mining face and increased automation means people can be removed from these hazardous areas without compromising production levels.

CSIRO has also helped reduce the risk of fires and explosions in underground coal mines through the introduction of optimum gas control strategies that replace oxygen with an inert gas in the collapsed area of a coal mine and keep methane levels, a common source of explosion, under control.

Minimising the environmental impacts of mining

Methane is released from coal seams during mining and needs to be removed from the underground environment to ensure the safety of mine workers and reduce the risk of fires and explosions.

The largest proportion of methane emissions from underground coal mines is from exhausted ventilation air. While the percentage of methane to air is low – often less than one per cent – the global warming potential of methane is approximately 23 times greater than CO_2 so its release to the atmosphere needs to be controlled.

CSIRO is developing a catalytic turbine that can run on very low concentrations of methane in air. The Ventilation Air Methane Catalytic Turbine (VAMCAT) not only burns the methane preventing its release to the atmosphere, but it also generates electricity that can be used to run the mine or be sold to the electricity grid.

CSIRO is also researching innovative ways to reuse flyash from power stations or washery rejects from coal processing plants to reduce subsidence caused by longwall mining. Slurries or paste made from the waste material and water will be injected through surface boreholes into fractures in the material above the coal strata. The process will not interfere with underground mining operations and will cause minimal disturbance to the surface environment. CSIRO is also expanding this research into the remediation of disused bord and pillar mines in residential areas to prevent subsidence.

Other environmental research involves understanding how mining impacts on ground water. This research is aimed at reducing any interference with subsurface aquifers and surface waters.

Enhancing coal cleaning

When coal is removed from a mine, it contains a variety of impurities that are then removed by various cleaning processes. CSIRO is examining new coal cleaning and preparation methods to improve the quality and competitiveness of Australian coal for export.

Researchers are developing technologies that will allow a coal processing plant to compare its operational performance with optimal standards in real-time. This means that the 'intelligent' plant can self correct and advise when problems occur, improving efficiency and reducing downtime. New tools and sensors are also being developed to improve the monitoring of operations in coal preparation plants.

CSIRO is also examining how it can develop new processes to better prepare coal for emerging low emissions coal utilisation technologies.

Research contact:

Dr Hua Guo
Research Leader
Coal Production Technologies
CSIRO Coal Technology
Phone: +61 7 3327 4608
Email: hua.guo@csiro.au

High efficiency, low-emission energy from coal

If Australia is to meet increasing energy demand and reach its emissions targets, new technologies are needed to increase the efficiency of coal-fired power generation and significantly lower greenhouse gas emissions.

CSIRO is developing a range of energy technologies that support a transition to high efficiency coal-based power systems capable of operating at near zero emissions.

Next generation energy from coal

Gasification is a key technology for advanced, high-efficiency, low-emission energy generation. The coal gasification process uses the reaction of coal with oxygen and steam to create syngas, a combustible mixture of carbon monoxide and hydrogen.

Integrated Gasification Combined Cycle (IGCC) plants combust this syngas in a combined-cycle turbine system to produce electricity. Next-generation IGCC systems will produce hydrogen for use as a fuel, for example in fuel cells. Syngas is also widely used as a feedstock for the production of chemicals and liquid fuels.

CSIRO's gasification research program performs fundamental and applied research to support and inform gasification plant development, and facilitate the adoption of high-efficiency power generation technologies by industry and government.

There are strong efficiency and cost drivers to develop advanced syngas cleaning, processing and gas separation technologies. CSIRO is developing technologies to create significant improvements in capital and operating costs; and to integrate these developments into next generation high efficiency systems that will produce hydrogen for power generation and capture the carbon dioxide in a form ready for sequestration.

CSIRO undertakes these research activities in partnership with coal and power generation industries and other research collaborators, both locally and internationally.

High efficiency, small scale energy systems

Using coal as a feedstock, The Direct Injection Coal Engine (DICE) and the Direct Carbon Fuel Cell (DCFC) have the potential to deliver electricity generation efficiencies of 50 percent and 65 percent respectively. A significant gain when compared to existing coal-fired power stations which operate at around 38 per cent.

Due to their high efficiency DICE and DCFC technology produce relatively low greenhouse gas emissions when compared with conventional coal-fired power stations. They represent a complementary technology pathway that can potentially minimise many of the barriers to uptake faced by current CCS technologies.

The technologies have applications for industrial and remote area power supply. Local generation using DICE and DCFC also presents an opportunity to reduce transmission losses associated with centralised power plants.

By providing additional security of supply to the electricity grid, these systems could play an important role in meeting growing energy demand and underpinning the development and uptake of renewable technologies, particularly those which are intermittent such as wind, solar and seasonal biofuels.

Alternative routes to liquid fuels

Transport is essential to the strength of Australia's economy, however domestic and international oil supplies are increasingly constrained. To ensure the security of our nation's fuel supply in the long term CSIRO is researching a number of complementary technologies that provide alternative routes to fuel production, including coal to liquids (CTL).

CSIRO's research is focused on direct CTL conversion, in which coal is reacted with hydrogen and a solvent under high temperature and pressure to produce a liquid. This product is then further refined to achieve high grade fuel characteristics.

Our work aims to achieve near-zero emissions CTL by improving process design; and integrating renewable technologies and carbon capture and storage. We are also striving to optimise CTL product quality, maximise fuel yield, increase process efficiency and reduce costs to facilitate larger scale production.

Research contact:

Dr David Harris
Research Leader
Coal Utilisation
CSIRO Coal Technology
Phone: +61 7 3327 4617
Email: david.harris@csiro.au