

Australian Research Activities

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National R&D priority aims

Commonwealth Government funding of research is aimed at addressing four key National Priorities, namely:

- enabling Australia to be environmentally sustainable
- promoting and maintaining good health for Australians
- developing 'frontier technologies' for building and transforming Australian industries
- safeguarding Australia

National Research Funding Channels

Australia's funding of national research related to CCS is primarily distributed through four channels, the first two being of most significance:

- the Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- the Commonwealth Department of Education, Science and Training (DEST)
- the Commonwealth Department of Industry, Tourism and Resources (DITR)
- the Australian Research Council (ARC)

The Australian Research Council

The Australian Research Council (ARC) administers Commonwealth Government funding of research at Australia's universities and encourages specialist centres. There is a focus on 'blue sky' research and consequently energy-related centres are more concerned with technologies such as photovoltaics and photoconversion rather than with CCS

Geoscience Australia

Geoscience Australia (formerly the Australian Geological Survey Research Organisation) is a government-sponsored research and information agency, responsible for producing and providing spatial information to the Australian community. Its work brings economic, social and environmental benefits by providing information on the use of resources, management of the environment, and the safety and well being of Australians.

Geoscience Australia seeks to:

- enhance the global attractiveness of Australia's onshore and offshore exploration
- improve resource management and environmental protection
- help to achieve safer communities and transportation

Funding models

Like the DTI LINK and EC Framework programmes, there is a strong drive in many of the Australian funding models (eg the CRCs and CSIRO) to gain leverage and involvement from industry. The CRC's focus is primarily on near- to medium-term R&D and demonstration, while CSIRO's National Research Flagship Programme provides a medium- to long-term strategic focus.

CSIRO

CSIRO is a major R&D resource for Australia with around 6,500 staff located on sites across the country. Its work covers most aspects of the Australian economy including agriculture, energy and transport, natural resources, information and communication services, manufacturing, mineral resources, health and the environment.

CSIRO-energy

Energy forms a major component of CSIRO's portfolio with a budget of around A\$25-30m per year. This covers:

- new energy sources
- energy storage
- energy efficient industrial processes.

Fossil fuel portfolio includes;

- coal preparation and utilisation,
- gas utilisation
- environmental impacts associated with energy industries.



CSIRO Energy Transformed Flagship

Recently, CSIRO launched a new ‘flagship’ project – Energy Transformed – under the CSIRO National Research Flagship Programme with an overall goal of achieving a cost-effective reduction in GHG emissions from the energy sector through activities under four themes:

- Energy Futures (modelling)
- Low Emission Electricity
- Low Emission Distributed Generation
- Low Emission Transport

The Co-operative Research Centres (CRC) Programme

Must address:

- research
- education – aimed at developing ‘industry ready’ graduates and post-graduates
- external communication
- commercialisation/technology transfer

Currently over 70 CRCs.

5-7 year duration. Can be renewed.

At least 30 full time researchers. Average annual budget of A\$7.

Average 20% contribution from industry

CRC-industrial partner fiscal incentives

Industrial participants in CRCs benefit from Australia's ongoing 125% R&D Tax Concession. First introduced in 1985, it is the Government's principal initiative to increase the amount of business investment in R&D and allows companies to deduct up to 125% of eligible expenditure on R&D activities when lodging their corporate tax returns. In 2001, "Backing Australia's Ability" established a 175% Premium (Incremental) Tax Concession for additional investment in R&D and an R&D Tax Rebate for small companies making a tax-loss.

CRC organisational models

2 basic models;

- incorporated company (under the Corporations Act 2001)
- unincorporated joint venture.

Commercialisation of CRC intellectual property is seen as vital and can be managed by spin-off companies from the CRC itself. Most of the CRCs are members of the CRC Association, established in 1994 to represent members' views on issues of generic importance to CRCs and their operation.

CCS relevant CRCs

With regard to CCS there are currently four key CRCs:

- The CRC for Greenhouse Gas Technologies (CO2CRC) (developed from the GEODISC™ Project in the Australian Petroleum CRC)
- The CRC for Coal in Sustainable Development (CCSD)
- The CRC for Cleaner Power from Lignite
- The CRC for Greenhouse Accounting

Green House Gas accounting CRC

- increase understanding of the terrestrial carbon cycle and the forces driving change
- predict responses of biophysical systems to global change
- develop methods for measuring terrestrial carbon fluxes, sources and sinks
- develop innovative ways to manage the carbon cycle to achieve national GHG reduction objectives

Green House Gas Accounting CRC

6 research programmes:

- Measurement and spatial estimation of carbon pools and their turnover
- Projecting changes in the carbon cycle
- Systems development and support
- Science applications and outreach
- Education
- Non-CO₂ GHGs

GEODISC™ (1999-2003)

GEODISC™ fell within the activities of the former Australian Petroleum Co-operative Research Centre (APCRC). Other 'core participants' included CSIRO Petroleum, Curtin University, Geoscience Australia, the Australian School of Petroleum and the School of Petroleum Engineering. APCRC contributed some A\$625,000 to the Programme, with other sponsors (namely the Australian Greenhouse Office, BP, BHP Billiton, Chevron International, Shell Australia, Chevron/WAPET, Woodside and TotalFinaElf) each contributing about A\$100,000/annum to the programme.

GEODISC™- project structure

The programme was divided into 11 thematic projects, all of which have been transferred (in an Oracle database form) to CO2CRC, which now supersedes the APCRC and, particularly, the GEODISC activity.

GEODISC™ Projects

1. Regional Analysis
2. Site specific studies
3. CO₂ reactions & coupled model development
4. Geomechanics & petrophysics
5. Reservoir simulation
6. Monitoring CO₂ injection
7. Risk Assessment
8. Economic modelling
9. International collaboration
10. Natural Analogues
11. Education and training

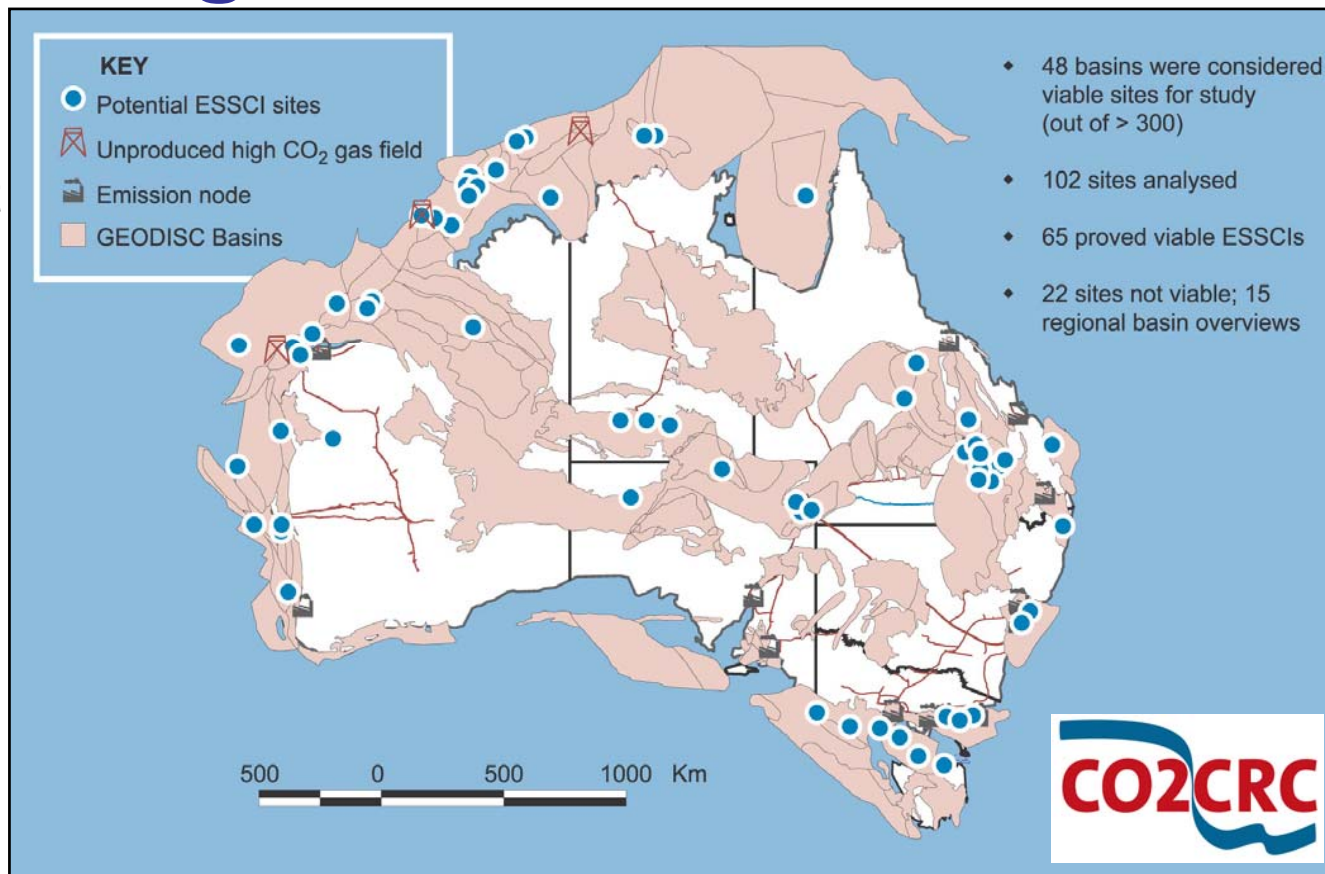
What GEODISC did not address were the issues relating to capture and separation of CO₂ from power generation or other industrial processes.

GEODISC™-Pioneered Australian CCS R&D

Followed and developed BGS (UK) led EC funded Joule 2 project model (W. Europe) to produce the first continental scale source sink matching study in the world.

GEODISC™ source-sink matching at continental scale

Estimates indicate that Australia currently has the potential to store up to 115MTPA of CO₂, with the total capacity being sufficient to store Australia's total CO₂ emissions for the next 1,600 years.



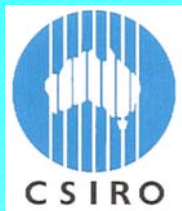
CO2CRC

CO2CRC started in July 2003.

It brings together researchers and users from a wide range of industries that have much to gain from ensuring that a considered and science-based approach is taken to the potential application of appropriate CCS technology to decrease Australia's levels of CO₂ emissions. These include oil and gas production and refining, power generation, coal and minerals extraction and processing, aluminium and steel production, pulp and paper manufacturing, cement and chemicals industries.

CO2CRC Core Participants

Research Parties



CSIRO
Curtin University
Geoscience Australia
Monash University
University of Adelaide
University of Melbourne
University of NSW

Industry Parties



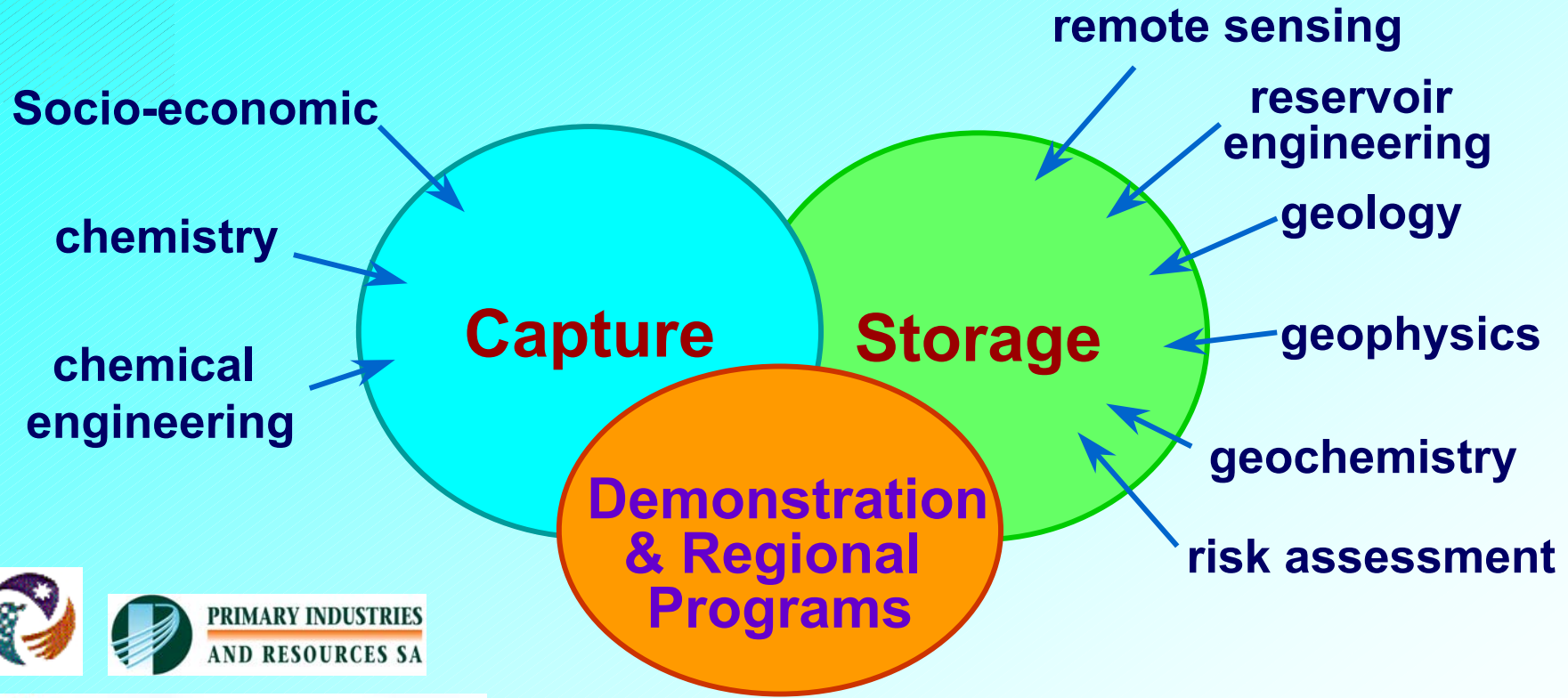
Australian Coal Research
BHPBilliton
BP Amoco
Chevron Texaco
RioTinto
Schlumberger
Shell
Stanwell Corporation
Woodside



CO2CRC- aims

- provide cost-effective GHG mitigation options for industry and government
- decrease any future financial risk of long-term energy intensive investments arising from greenhouse actions
- produce real reductions in CO₂ emissions in Australia and worldwide
- help to provide a sustainable future for Australian fossil fuels and energy intensive products
- develop the concept of CO₂ as a useful resource
- enhance public confidence in the contribution that CCS technologies can make to decreasing CO₂ emissions to the atmosphere

CO2CRC Research



Funding- 7 years

Source	Cash (A\$m)	In-kind contribution (A\$m)	Total (A\$m)
Industry	14.1	13.9	28.0
Government	0.4	1.9	2.3
Research parties	3.1	54.9	58.0
International	-	7.0	7.0
Commercialisation	2.4	-	2.4
CRC Funding	21.8	-	21.8
Total			119.8
Demonstration projects (* subject to approval)	1.5*	10-100*	10-100*

CO2CRC R&D clusters

Geological Storage Technologies:

- Storing CO₂
- Technologies for assessing CO₂ storage sites
- Understanding sub-surface processes
- Monitoring and verification technologies
- Risk assessment
- Technical basis for a regulatory regime
- Communications
- Economic modelling of CO₂ storage systems
- International collaboration

CO2CRC R&D clusters

Geological Storage Demonstration Programme:

- Using CO₂
- CO₂ storage and enhanced oil recovery
- Using CO₂ to ameliorate environmental problems
- Adding value with CO₂
- Economic evaluation

CO2CRC R&D clusters

CO2 Capture Technologies:

- Selection of appropriate options for Australian conditions
- Enhanced solvent-based systems
- Innovative membrane systems
- Innovative pressure swing adsorption (PSA) systems
- Hydrate formation and cryogenic distillation systems
- Economic modelling
- International collaboration

Co-operative Research Centre for Coal in Sustainable Development (CCSD)



CCSD was established in July 2001 replacing its predecessor, the CRC for Black Coal Utilisation. Located at the Queensland Centre for Advanced Technologies (QCAT) near Brisbane, and central to the coal producing states of Queensland and New South Wales, it is a joint venture between 18 organisations drawn from a broad range of research organisations, black coal producers and black coal using industries located across Queensland, New South Wales and Western Australia.

CCSD is not working directly on CO₂ capture but several of its research programmes are complementary to the work of the CO2CRC and other research groups addressing CCS.



CCSD-R&D relevant to capture

- Environmental, social and economic (ESE) assessment – which has examined the scale, timing and cost of deploying CO₂ capture technologies
- Current power generation – concerned with improving the efficiency, emissions and environmental performance of existing facilities
- Transitional power generation – which is looking at advanced power generation systems and the performance of Australian coals in, for example, IGCC plant
- Future scenarios and technologies – concerned with evaluating emerging coal technologies and their implications for Australia

Co-operative Research Centre for Clean Power from Lignite

The CPLCRC is based in Mulgrave near Melbourne. Its R&D is focused on more efficient combustion of lignite and does not yet address capture directly. Perhaps of most relevance on our visit were the gasification trials of lignites from around the world (including the USA N. Dakota- which is the feedstock for the gasifiers producing the CO₂ for Weyburn)

State Initiatives

- Queensland Centre for Advanced Technologies (QCAT)- Center for Low Emission Technologies.

CSIRO/Queensland Government partnership.

Includes:

- University of Queensland
- 3 power generators – Stanwell Corporation, Tarong Energy and CS Energy
- Xstrata Coal (coal producer)
- Provisional budget of A\$27m over 4 years

CLET- R&D

The Centre for Low Emission Technologies will facilitate R&D and demonstration into key technologies that will lower GHG emissions from coal-based power generation and assess the technical, economic, environmental, social and other policy issues of low emission technologies including coal gasification and CCS.

CLET- R&D

The Centre will also focus on improving the environmental performance of existing coal-fired generation plants and assessing the performance of Queensland coals in gasification processes to further enhance coal export prospects. Examine the commercial potential for co-generation with renewable energy sources such as sugar cane waste.

University R&D on CCS

Curtin University of Technology, Perth

- Processing seismic data from the EC Framework 5 Saline Aquifer CO₂ Storage (SACS) Project
- Developing theoretical seismic models using a laboratory pressure chamber to investigate the seismic responses of CO₂ in saline aquifers
- Cryogenics and hydrates for CO₂ capture

University R&D on CCS

Monash University

- Adsorption (including new adsorbents)
- Process development of power generation cycles
- Novel use of mesoporous materials in various applications

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University R&D on CCS

The University of Adelaide

- CO₂ enhanced oil recovery
- Geological CO₂ storage
- Natural CO₂ accumulations as analogues for CO₂ storage

The University of New South Wales, Sydney

- Techno-economics of CO₂ capture
- Fabrication of capture membranes

University R&D on CCS

The University of Melbourne

- Capture solvents
- Gas absorption membranes
- Gas separation membranes
- Membrane evaluation capability (including mass transfer)
- Materials development (eg new polymers, carbon materials)
- Solvent/polymer interaction
- High temperature gas separation

University R&D on CCS

The University of Queensland, Brisbane

- Gas separation membranes
- Functional nanomaterials
- Crack propagation in pipelines
- Membrane reactors
- CO₂ storage on black coal

University R&D on CCS

The University of Adelaide

- CO₂ enhanced oil recovery
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