



Planning &
Environment

Coal Innovation Fund NSW ANNUAL REPORT 2016-17

Income, Expenditure and Project Evaluation

Author

Coal Innovation NSW
Secretariat, Sydney, NSW

CM9 reference: INT17/236849

The Coal Innovation NSW Fund Income and Expenditure, and Evaluation of Projects Report 2016-2017 was produced and printed within the Department of Planning and Environment. No external costs were incurred in the production of this report.

ISBN: 978-0-9954207-6-2

Copyright notice

© State of New South Wales through the Department of Planning and Environment 2017.

This work is copyright. In keeping with the NSW Government's commitment to encourage the availability of information, you are welcome to reproduce the material that appears in this report for personal, in-house or non-commercial use without formal permission or charge. All other rights are reserved. If you wish to reproduce, alter, store or transmit material appearing in this report for any other purpose, request for formal permission should be directed to: **Email:** information@planning.nsw.gov.au

Access

The Coal Innovation NSW Fund can be contacted c/-:
Department of Planning and Environment
Level 22, 320 Pitt Street, Sydney NSW 2000

Phone: 1300 305 695

Email: ccs.info@industry.nsw.gov.au

Business hours for the Department are
9am to 5pm Monday to Friday.

Disclaimer

Whilst every reasonable effort has been made to ensure that this document is correct at the time of publishing, the State of NSW, its agents and employees, disclaim any and all liability to any person in respect of anything or the consequences of anything done or omitted to be done in reliance upon the whole or any part of this document.

For any updates to this publication, check
<http://www.resourcesandenergy.nsw.gov.au/energy-consumers/energy-sources/coal-innovation-nsw/about-coal-innovation-nsw>

First published November 2017 by the Department of Planning and Environment.

Contents

A. Background.....	4
B. Payments Received.....	5
C. Expenditure	5
<i>C1: Coal Innovation NSW Ministerial Advisory Council and Study Council</i>	<i>5</i>
<i>C2: Coal Innovation NSW Secretariat salaries and costs</i>	<i>6</i>
<i>C3: Research & Development (R&D) projects funded under 2009 Expressions of Interest</i>	<i>6</i>
<i>C4: Research, Development & Demonstration (RD&D) projects funded under 2015 Expressions of Interest</i>	<i>7</i>
<i>C5: NSW CO2 Storage Assessment Program</i>	<i>7</i>
<i>C6: Future of NSW Coal Fired Electricity Generation Industry Study.....</i>	<i>7</i>
<i>C7: Audit Fees.....</i>	<i>8</i>
D. Evaluation	8
D1: Coal Innovation NSW (CINSW).....	8
D2: Coal Innovation NSW Secretariat	8
D3: 2009 Research and Development (R&D) Projects	10
<i>D3.1: Project: UCC Fired Diesel Engines in the generation of electricity Grantee: UCC Energy Pty. Ltd</i>	<i>10</i>
<i>D3.2: Project: Fugitive emissions abatement from ventilation air Grantee: Centennial (Coal) Mandalong Pty Ltd</i>	<i>10</i>
<i>D3.3: Project: Further development of Post Combustion Capture (PCC) Grantee: CSIRO Energy Technology.....</i>	<i>11</i>
<i>D3.4: Project: Reducing Fugitive Emissions -Enhanced Drainage techniques Grantee: The CSIRO Centre for Environment, Social and Economic Research.....</i>	<i>11</i>
<i>D3.5: Project: A Novel Chemical Looping Based Air Separation Technology Grantee: The University of Newcastle Priority Research Centre for Energy.....</i>	<i>11</i>
<i>D3.6: Project: Managing Project Risk: The Role of Public Awareness Grantee: University of Newcastle</i>	<i>11</i>

D3.7: Project: Site Trials of Novel CO ₂ Capture Technology Grantee: CSIRO Coal Technology	11	D4.7: Project: Energy Harvesting from CO ₂ capture process Grantee: CSIRO	16
D3.8: Project: Development and Optimisation of the Direct Carbon Fuel Cell Grantee: University of Newcastle Discipline of Chemistry	11	D4.8: Project: Combining Redox Energy Storage with coal-fired power generation Grantee: University of Newcastle	17
D3.9: Project: Permanent Large Scale CO ₂ Storage by Mineral Carbonation Grantee: Mineral Carbonation International Pty Ltd ..	12	D5 : NSW CO2 Storage Assessment Program	17
D3.10: Project: A Simple Heat Engine for Sustainable Coal Generation Grantee: ourSUN Pty Ltd – application WITHDRAWN December 2010	13	D6 : Future of NSW Coal Fired Electricity Generation Industry	19
D4: 2015 Research, Development and Demonstration (RD&D) Projects	13	E. Conclusion	20
D4.1: Project: Membrane Gas-Solvent Contactors Demonstration Project Grantee: CO2CRC Pty Ltd	14	F. Financial Report	21
D4.2: Project: Rotating Liquid Sheet Contactor pilot scale testing project Grantee: CSIRO	14	Tables	
D4.3: Project: Third Generation Membrane Material Development Grantee: University of NSW	15	Table 1: CINSW Fund Income	5
D4.4: Project: Aerosol Formation Case Study Grantee: CSIRO	15	Table 2: CINSW meetings and Peer review costs	5
D4.5: Project: Advanced aqueous ammonia-based carbon capture technology Grantee: CSIRO	15	Table 3: CINSW Secretariat costs	6
D4.6: Project: Direct Carbon Fuel Cell (DCFC) Demonstration Grantee: University of Newcastle	16	Table 4: Project expenditure from R&D Round 2009	6
		Table 5: Project expenditure from RD&D Round 2015	7
		Table 6: NSW CO2 Storage Assessment Program	7
		Table 7: Consultancy expenditure into Future of NSW Coal Fired Electricity Generation Industry Study	7
		Table 8: Audit Fees	8
		Table 9: R&D Projects 2009	10
		Table 10: RD&D Projects 2015	13

A Background

The Coal Innovation NSW Fund (the Fund) has been established and is governed under the *Coal Innovation Administration Act 2008* (the Act).

Section 5 of the Act establishes the Purpose of the Fund, as follows:

- (a) to provide funding for research into, and development of, low emissions coal technologies,
- (b) to provide funding to demonstrate low emissions coal technologies,
- (c) to provide funding to increase public awareness and acceptance of the importance of reducing greenhouse gas emissions through the use of low emissions coal technologies, and
- (d) to provide funding for the commercialisation of low emissions coal technologies.

Section 7 of the Act, details Payments out of the Fund, to include:

- (1) There is payable from the Fund:
 - (a) payments approved by the Minister for the purposes of the Fund,
 - (b) administrative expenses incurred in relation to the Fund or CINSW, and
 - (c) payments directed or authorised to be paid from the Fund by or under this or any other Act or law.
- (2) Any money paid into the Fund on the condition that is to be used only for a specified purpose, including any proceeds of the investment of that money in the Fund, is only payable from the Fund for the specified purpose and a proportionate share of the administrative expenses payable from the Fund.
- (3) The Minister is to produce an Annual Report detailing fund allocations and the projects and other activities that received funding under this Act during the year.
- (4) The Annual Report is to include an evaluation of the effectiveness of each of the projects and other activities that received funding under this Act.
- (5) The Annual Report is to be tabled in each House of Parliament within 6 months after the end of the financial year to which it relates.
- (6) The Minister is to publish each Annual Report, so as to promote low emissions coal technologies to the NSW public.

Section 10 of the Act, prescribes the Membership of CINSW, as follows:

- (1) CINSW is to consist of the following members appointed by the Minister:
 - (a) an independent person appointed by the Minister to be the Chairperson of CINSW,
 - (b) two persons, each of whom is employed in or by a government agency,
 - (c) two persons who are nominated jointly by the Australian Coal Association and the Minerals Council to represent the New South Wales black coal industry,
 - (d) such other persons (up to a maximum of 4) as the Minister may appoint from time to time, being persons whom the Minister considers have qualifications or experience relevant to the functions of CINSW.

Section 11 of the Act establishes Coal Innovation NSW (CINSW) and prescribes its functions.

- (1) The functions of CINSW are as follows:
 - (a) to give advice and make recommendations to the Minister concerning the funding from the Fund of projects and other activities for the purposes of the Fund, including advice about priorities for funding and recommendations concerning applications for funding,
 - (b) to advise the Minister on policies to encourage the development and implementation of low emissions coal technologies,
 - (c) to make recommendations to the Minister concerning opportunities for involvement by private and public sector entities in interstate, national and international research projects involving low emissions coal technologies,
 - (d) to advise the Minister on such other matters concerning low emissions coal technologies as the Minister may refer to the CINSW,
 - (e) such other functions with respect to low emissions coal technologies as the Minister may from time to time direct.
- (2) CINSW may give its advice and make its recommendations either at the request of the Minister or without any such request.
- (3) CINSW has such other functions as are conferred or imposed on it by or under this or any other Act.

The membership of the Ministerial Advisory Council to Coal Innovation NSW (CINSW) expires on 31 December 2017.

The purpose of this report is to fulfil the requirements of sections 7(3) to 7(6) (inclusive) of the act. That is, to produce an Annual Report detailing CINSW Fund allocations and to provide an evaluation of the effectiveness of each of the projects.

The Fund was established as a fund in the Special Deposits Account under section 4 of the Act. The Fund receives funds

and expends monies in accordance with the Act. The Fund has prepared a special purpose financial report for the year ended 30 June 2017 containing: statement of net assets; statement of comprehensive income; and associated note disclosures.

NSW Treasury has requested that the Auditor-General audit the special purpose financial report under section 27B (3) (c) of the Public Finance and Audit Act 1983.

The signed Financial Report is included (Section F).

B Payments Received

During the 2016-17 financial year the Fund received:

- Interest earnings of \$1,280,261 which went directly into Coal Innovation NSW Fund's bank account. The interest is calculated under the Treasury Banking System (TBS) on the daily balance in the bank account and paid twice yearly. Funds earning interest within TBS are paid at the Reserve Bank of Australia cash rate.

The payment schedule will change from July 2017, as interest will be paid at the cash rate or a rate as determined by NSW Treasury on a monthly basis, using the Westpac Interest Apportionment Service.

The table below summarises the income calculated as follows:

Table 1: CINSW Fund Income

Description	Value \$
Interest	1,280,261
Total income 2016-17	1,280,261

C Expenditure

Coal Innovation NSW has dispersed funds received across the key areas, set out as follows:

C1: Coal Innovation NSW Ministerial Advisory Council and Study Council

For the financial year ending 30 June 2017, the following funds in Table 2 have been expended in relation to the costs of Coal Innovation NSW meetings, sitting fees and research peer reviews conducted.

Table 2: CINSW meetings and Peer review costs

Description	Value \$
Total cost of Coal Innovation NSW (Council).	20,533
Future of NSW Coal Fired Electricity Generation Industry Study (Council)	548
RD&D Hai Yu project –Advanced aqueous ammonia-based project (Peer review)	1,400
Total	22,481

C2: Coal Innovation NSW Secretariat salaries and costs

For the financial year ending 30 June 2017 the following funds in Table 3 have been expended for the secretariat administration:

Table 3: CINSW Secretariat costs

Description	Value \$
Secretariat costs including salaries and on costs, professional fees not listed elsewhere, travel, and office supplies (Audit costs not included here, and disclosed separately)	919,642
Total	919,642

The increase in the Secretariat expenses of \$115,800, from previous year is due to:

- \$65,000 increase in the Partnership Agreement charges with the Department of Industry for administration fees and office rent
- \$26,800 for participation in the CO2CRC CCS Roadmap project
- \$24,000 for increases in legal costs, CPI salary increases and travel expenditure.

C3: Research & Development (R&D) projects funded under 2009 Expressions of Interest

For the financial year ending 30 June 2017 the following funds in Table 4 have been expended in relation to the R&D Round 2009 projects:

Table 4: Project expenditure from R&D Round 2009

Applicant	Project description	Value \$
UCC Energy P/L	Project cancelled at end of Stage 1	terminated in previous years
Centennial Coal (Mandalong) P/L	Fugitive Emissions (ventilation)	milestones deferred
CSIRO (Feron)	Capture Testing Solvents	completed in previous years
CSIRO (Connell)	Fugitive Emissions (open cut)	terminated in previous years
Uni of Newcastle (Moghtaderi)	Chemical Looping – oxyfuel	completed in previous years
Uni of Newcastle (Webb)	Social Research/Public Awareness	completed in previous years
CSIRO (Shu Su)	Novel Capture & Energy Efficiency	completed in previous years
Uni of Newcastle (Scott Donne)	Direct Carbon Fuel Cell	21,061
Uni of Newcastle (GreenMag)	Mineral Carbonation	634,416
Total		655,477

C4: Research, Development & Demonstration (RD&D) projects funded under 2015 Expressions of Interest

For the financial year ending 30 June 2017 the following funds in Table 5 have been expended in relation to the RD&D Round 2015 projects:

Table 5: Project expenditure from RD&D Round 2015

Applicant	Project description	Value \$
CO2CRC (Qader)	Membrane Gas-Solvent Contactors	486,803
CSIRO (Wardhaugh)	Rotating Liquid Sheet Contactor	573,320
Uni of NSW (Chen)	Third Generation Membrane Material Development	301,981
CSIRO (Halliburton)	Aerosol Formation Case Study	105,838
CSIRO (Hai Yu)	Advanced aqueous ammonia-based carbon capture technology	500,000
Uni of Newcastle (Donne)	Direct Carbon Fuel Cell (DCFC) Demonstration	Commencement July 2017
CSIRO (Feron)	Energy Harvesting from CO ₂ Capture process	144,748
Uni of Newcastle (Moghtaderi)	Combining Redox Energy Storage with coal-fired power generation	98,048
Total		2,210,738

C5: NSW CO₂ Storage Assessment Program

For the financial year ending 30 June 2017 the following funds in Table 6 have been expended in relation to the NSW CO₂ Storage Assessment Program:

Table 6: NSW CO₂ Storage Assessment Program

Description	Value \$
Total NSW CO ₂ Storage Assessment program – Stage 1B	812
Total NSW CO ₂ Storage Assessment program – Stage 2- seismic survey and hydraulic conductivity and sampling	84,497
Total	85,309

Note: The CO₂ Storage Assessment Program, Stage 1 was a jointly funded agreement, previously expended.

C6: Future of NSW Coal Fired Electricity Generation Industry Study

For the financial year ending 30 June 2017 the following funds in Table 7 have been expended in relation to the Future of NSW Coal Fired Electricity Generation Industry Study.

Table 7: Consultancy expenditure into Future of NSW Coal Fired Electricity Generation Industry Study

Description	Value \$
Consultancy (Ernst & Young) and other professional service	281,899
Total	281,899

C7: Audit Fees

For the financial year ending 30 June 2017 the following funds in Table 8 have been expended in relation to Audit Fees.

Table 8: Audit Fees

Description	Value \$
Audit Fees for FY 2016-2017	26,950
Total	26,950

D Evaluation

Evaluation of the effectiveness of each of the projects & other activities that received funding under the *Coal Innovation Administration Act 2008* (Act):

D1: Coal Innovation NSW (CINSW)

The Act requires the formation of Coal Innovation NSW (CINSW), a Ministerial Advisory Council. As prescribed in section 10 of the Act, CINSW is to comprise an independent Chair, and up to eight members appointed by the Minister, consisting of two appointed members from government and two nominees from industry to represent the NSW black coal industry, and up to four additional members appointed by the Minister.

As at 1 July 2016 the membership of CINSW comprised:

- Prof. Jim Galvin, Chair
- Prof. Michael Dureau, Deputy Chairman, Warren Centre for Advanced Engineering
- Prof. Mary O’Kane, NSW Chief Scientist & Engineer
- Dr. Chris Yeats, Executive Director, Geological Survey NSW
- Mr Michael Buffier, Group Executive, Glencore
- Mr John Richards, Managing Director, The Bloomfield Group
- Prof. Dianne Wiley, Head of School, University of Sydney
- Dr. Noel Simento, Managing Director, Australian National Low Emissions Coal R&D
- Mr Greg Everett, Managing Director, Sunset Power International (Delta Electricity).

CINSW held four meetings in the 2016/17 financial year:

- 13 September 2016 – the 16th meeting
- 4 November 2016 – the 17th meeting
- 23 March 2017 – the 18th meeting
- 8 June 2017 – the 19th meeting.

Of the Coal Innovation NSW & Peer review expenditure of \$22,480: \$20,000 was paid to the Chair as remuneration; \$1,400 was paid for the peer review of stage gate report for a RD&D Round 2015 project; and the remaining \$1,080 were paid as sitting fees for other Council members and related administration costs.

Evaluation:

The 16th meeting of CINSW, held on 13 September 2016, received a presentation from Ernst & Young (EY) on Stage 2 of the *Study on the future of NSW coal electricity generation industry* (the Study). Council found the Stage 2 report to be comprehensive, however requested additional sensitivity modelling work to be carried out to ensure the report’s findings could be tested against other reports. Council was also updated on the current seismic strategy and access agreements required for Stage 2 of NSW CO₂ Storage Assessment Program that will revisit the prospective sub basins of the Darling Basin. A CO₂ transport via pipeline options study for NSW was presented outlining possible pipeline routes and preliminary comparative cost-estimates.

The 17th meeting of CINSW, held on 4 November 2016, received a comprehensive final presentation from EY on the Study’s Stages 1 and 2. As the study employed a least cost optimisation model, Council considered further

work would be required to determine the wholesale electricity costs from the study's scenarios and also the effect on the broader economy from some of the scenarios. A subcommittee was formed to draft a concise CINSW overview and context report, including recommendations to the Minister on the work undertaken for this and a possible future Study. Council also discussed options for a future round of grant funding.

The 18th meeting of CINSW, held on 23 March 2017, received a presentation from NSW Chief Scientist & Engineer on the work of the NSW Energy Security Taskforce. Council recommendations on future work for the Study were submitted to the incoming Minister for Resources and Energy, following new administrative arrangements. Council also considered the merits of future work on a power station upgrade study to advanced ultra-super critical technology. Council discussed future research grants options and established a sub-committee to reprioritise RD&D funding options. Professor Chris Greig, a lead author of *Energy Security & Prosperity in Australia: Roadmap for CCS* provided a presentation to members on the report.

The 19th meeting of CINSW, held on 8 June 2017, considered the re-profiling of the CINSW Fund forward expenditure to 2020-21. Council also received project updates from the Centennial VAMRAB Research project and accepted the final report from the Direct Carbon Fuel Cell project from the University of Newcastle. Council considered a discussion paper on the future round of funding for RD&D projects and agreed to recommend to the Minister the development of a further RD&D round for Expressions of Interest with an allocation of \$8.5 million.

D2: Coal Innovation NSW Secretariat

Coal Innovation NSW Secretariat employs six staff:

- Program Director
- 2 Senior Project Officers (Economist and Scientist)
- Project Officer (Finance)
- Geoscientist
- Graduate Officer / Research Administration Officer.

Evaluation:

Employment at the Secretariat has continued to be stable. The graduate rotation completed in February 2017. At that time the graduate gained a temporary position of Assistant Research Officer, within Coal Innovation Secretariat. Staff stability has allowed the Unit to maximise its efforts in utilising the staff's skills.

Significant tasks for the financial year have centred on:

- managing existing projects, including working with researchers in the development of final R&D reports and engaging independent peer reviewers
- finalising contract negotiations with research commencing from the latest Expressions of Interest (EOI) Round
- planning for the next stage of the drilling program, commencing with a 200km seismic project in the Darling Basin
- finalising the Future of NSW Coal Fired Electricity Generation Industry Stages 1 & 2 and the development of terms of reference for a continuation of the Study based on a recommendation from CINSW Ministerial Advisory Council
- ongoing work with the Chair in developing options for the CINSW Fund's budget and future programs
- consultation with industry and the Commonwealth on future research options
- involvement in the policy debate at a national level
- continued upgrade of the CINSW website.

Overall the Secretariat has met its goals and timelines, recommended by Council, in establishing the new research and Study programs.

D3: 2009 Research and Development (R&D) Projects

A “Call for Expressions of Interest under the NSW Clean Coal Fund” closed on 4 December 2009, with 29 applications received and assessed. In May 2010, the then Minister approved 10 projects as shown in Table 9. After negotiations of funding agreements, some of the awarded amounts varied slightly:

Table 9: R&D Projects 2009

Applicant	project description	Awarded funding up to (\$)	Duration	restructured funding agreements	Amount expended at closure (\$)
Uni Newcastle / GreenMag	Alternative CO ₂ storage	3,040,000	4 yrs	3,040,000	on-going project
UCC Energy ⁽¹⁾	Combustion	2,581,000	4 yrs	closed early	38,174
Centennial Coal	Fugitive emissions	2,200,000	2 yrs	2,200,000	on-going project
CSIRO	Capture technology	1,300,000	3 yrs	1,582,319	1,582,319
CSIRO ⁽²⁾	Fugitive emissions	1,000,000	2 yrs	closed early	39,451
Uni of Newcastle	Combustion alternative	886,618	3 yrs	851,618	851,296
Uni of Newcastle ⁽³⁾	Social research	618,930	2 yrs	661,946	655,795
CSIRO	Capture technology	613,711	1.5 yrs	613,711	613,711
Uni of Newcastle	Carbon fuel cell	608,719	5.5 yrs	564,748	564,748
OurSun P/L	Combustion technology	did not commence			
Total Funding Awarded		12,848,978			
Total Funding Committed				9,514,342	
Total Funding Expended (as at 30 June 2017)					4,345,494

Notes:

1. UCC Energy received \$50,000 in their first instalment to carry out a greenhouse gas life cycle assessment of their process. On a 1:1 shared costs basis for this study, \$11,826 was returned to CINSW Fund as unspent monies on this study.
2. CSIRO received \$115,000 in their first instalment for this project. The Department terminated this agreement because the project was no longer viable without an industry partner. As a result \$75,549 in unspent monies was returned to the CINSW Fund.
3. The University of Newcastle completed this project without incurring the costs associated with publications, and so \$6,151 was retained by the CINSW Fund.

A detailed evaluation of each project follows:

D3.1: Project: UCC Fired Diesel Engines in the generation of electricity
Grantee: UCC Energy Pty. Ltd

Project closed.

See report 2012-13 for details.

D3.2: Project: Fugitive emissions abatement from ventilation air
Grantee: Centennial (Coal) Mandalong Pty Ltd

Centennial Mandalong Pty Ltd has received initial grant funding to trial a new technology termed a VAM-RAB (Ventilation Air Methane Regenerative After Burner) that has potential to mitigate fugitive methane emissions escaping from underground coal mines. These emissions are notoriously difficult to abate because this naturally-

occurring gas becomes diluted by the large volumes of ventilation air that is flushed through a mine during standard mining operations. As methane typically constitutes less than 1% of the ventilation air expelled from the mine, the gas concentration is too low to burn off (often referred to as flaring) or process for electricity generation.

The VAM-RAB system overcomes this problem by directing the ventilation air through what is essentially a large industrial oven where it is heated to approximately 1000° C. By using this oxidation technique almost all of the methane (> 99%) is converted to carbon dioxide and water. A key feature of the technology is the ability to be self-sustaining without the need for additional energy to maintain the temperature in the combustion chamber. This is accomplished by preventing the heat from migrating out of the chamber via a periodic change in direction of the flow of the ventilation air through the system; hence the title 'Regenerative After Burner'.

Evaluation:

The remediated VAM-RAB plant was heated in August/September 2016 with an objective of carrying out a flow test at full operating temperature to confirm all systems were operating correctly and that the VAMRAB was capable of undertaking the experimental plan. Analysis of the data collected during the testing had shown that the stability of the Plant was much improved and together with the new instruments, had provided a sound basis to modify the heat profile which the heat up process targets. However, this testing had also found that a number of further changes to the Plant were still required in order for the VAMRAB to perform the test as defined in the experimental plan. A meeting of stakeholders was held in March 2017 to discuss the options for this project in going forward. A costing estimate of options and work program was requested to make a more informed decision on the future of this project. At the 8 June meeting, CINSW agreed to consider funding this work from the remaining allocation of funding for this project, upon the presentation of detailed budgets, timelines and work programs.

D3.3: Project: Further development of Post Combustion Capture (PCC) Grantee: CSIRO Energy Technology

Project successfully completed.

See 2014-15 report for full details.

Five projects from the Research, Development and Demonstration (RD&D) Projects Expressions of Interest (EOI) Round 2015, will be utilising this Post Combustion Capture pilot plant test facility throughout 2017-18 to run their various CO₂ capture projects and experiments on real flue gas.

D3.4: Project: Reducing Fugitive Emissions -Enhanced Drainage techniques Grantee: The CSIRO Centre for Environment, Social and Economic Research

Project closed December 2012 and unspent moneys returned.

See 2012-13 report for full details.

D3.5: Project: A Novel Chemical Looping Based Air Separation Technology Grantee: The University of Newcastle Priority Research Centre for Energy

Project successfully completed.

See 2014-15 report for full details.

D3.6: Project: Managing Project Risk: The Role of Public Awareness Grantee: University of Newcastle

Project successfully completed.

See 2014-15 report for full details.

D3.7: Project: Site Trials of Novel CO₂ Capture Technology Grantee: CSIRO Coal Technology

Project successfully completed.

See 2014-15 report for full details.

D3.8: Project: Development and Optimisation of the Direct Carbon Fuel Cell Grantee: University of Newcastle's Discipline of Chemistry

The University of Newcastle's Discipline of Chemistry has received grant funding to research and develop a Direct Carbon Fuel Cell (DCFC). This technology is yet to be commercialised but is widely promoted as being the 'holy grail' of coal-fuelled electricity generation as it has the capacity to generate electricity with much higher thermal efficiencies (~70-80%) than engines and turbines (~35-55%). The higher efficiencies equate to substantial reductions in greenhouse gas emissions as less fuel is used per unit of electricity generated. In addition, the fuel cell emissions are almost entirely pure CO₂ which is therefore ready for capture and sequestration without the need to firstly separate out other gases such as nitrogen, which are present in the flue gases emitted from power plants.

In a DCFC, electricity is generated directly from coal through the chemical oxidation of coal which has been ground and purified of ash and other contaminants. This differs substantially to the way electricity is traditionally generated – coal is burnt to boil water to make steam to turn a turbine, to turn a generator, to produce electricity. In essence, a fuel cell can be compared to an electrochemical battery. They differ in that a battery stores electrical energy chemically whilst a DCFC relies on the external supply of a fuel (in this case coal) which must be continually replenished.

The overall objective of this project is to obtain proof of concept for the technology and progress towards commercialisation of the DCFC through further development and optimisation of bench-scale and then pilot-scale systems.

Evaluation:

This project was successfully completed during 2016. The project met its technical aims and reached all its milestones according to the project plan. An extensive fundamental study on key behavioural characteristics and factors affecting the performance of DCFC has been delivered. More importantly, a functioning pilot DCFC system has been successfully developed by implementing findings from fundamental study from this project.

A draft final report was submitted and an independent peer review was carried out to assess the scientific rigour, methodology and experimental design, data acquisition and analysis, and interpretation of this report. The reviewer considered the quality of the results and associated interpretations to be sound, and that a significant amount of laboratory work generated a large amount of novel data and results that have improved the fundamental understanding of the functioning of a DCFC.

The fundamental research investigation provided several avenues for improving performance of a bench and pilot scale DCFC. One of the breakthrough findings was the discovery of cheap and abundant clay catalyst which has a profound effect on performance. Another significant outcome of this project was the design and construction of the bench and pilot scale DCFC systems overcoming many technical challenges. The achievements from this project were published widely in scientific literature and provisional patents were secured with a number of commercial partners approaching showing strong interests.

CINSW accepted the final report and will make recommendation to the Minister to publish the report on the CINSW website on acceptance by the Minister in the next financial reporting year.

With the successful completion of this project, the further development of DCFC technology has been supported by CINSW through a new project as one of the eight successful projects under CINSW Fund EOI Round 2015 (see item D4.6 for details).

D3.9: Project: Permanent Large Scale CO₂ Storage by Mineral Carbonation Grantee: Mineral Carbonation International

The GreenMag Group and University of Newcastle Priority Research Centre for Energy was awarded grant funding, contingent on the receipt of matching Commonwealth and industry funding, to develop and optimise a promising method of storing carbon dioxide gas emitted from NSW coal-fired power stations. GreenMag and the University of Newcastle formed Mineral Carbonation International Pty Ltd (MCI) with a commitment from Orica to match funding as the industry partner. This joint venture will undertake further research into mineral carbonation technology and establish a CO₂ mineral carbonation pilot plant at the University of Newcastle. The project aims to transform captured CO₂ emissions into forms of carbonate rock that will be trialled as new green building materials for the construction industry.

The Mineral Carbonation process takes advantage of a natural process whereby CO₂ is captured in mineral deposits resulting in it being stored in rocks. A key advantage of this process is that the CO₂ is permanently stored in the rocks. It would only re-enter the atmosphere if the rocks were subjected to extremely high temperatures.

The Project is intended to take existing known processes for mineral carbonation from bench scale to demonstration plant scale and to conduct complementary R&D activities, which each could reduce the overall cost of mineral carbonation that could eventually operate at industrial scale. The major goal for the Project is to reduce the cost of existing mineral carbonation processes from the current \$70 per tonne of CO₂ sequestered to \$40 per tonne (with potential for further reduction) and to demonstrate that the process involved can be scaled up from the laboratory to this pilot scale and beyond.

The MCI project extends over a four-year period and encompasses three main strands including:

- 1) pilot plant construction and operation,
- 2) intensive research and development, and
- 3) program governance, communication and commercialisation.

The project was officially launched 23 August 2013 by Minister for Mineral Resources at the Newcastle Institute of Energy and Resources, University of Newcastle (NIER).

Evaluation:

This project continued to produce pilot scale mineral carbonation material from its batch research pilot reactor for characterisation and testing by a construction materials company. In addition, the project completed and commissioned a novel semi-continuous research pilot plant for the high pressure, high-temperature carbonation process. Promising progress has been made in lab scale experiments in the development of concurrent grinding techniques and mineral carbonation of heat active materials, as well as initiated commercialisation activities and engagement with venture capitalist. This project has

also received a six month extension from the Steering Committee (CINSW, Commonwealth & Orica) to allow for the construction and delivery delays that occurred in the previous financial year. With the new milestones in place, the project is on time and on budget. Initial research results have been within expected parameters and the aim now is to extend the research into improvements in manufacture, utilising less energy.

D3.10: Project: A Simple Heat Engine for Sustainable Coal Generation Grantee: ourSUN Pty Ltd – application WITHDRAWN December 2010.

Application withdrawn December 2010.

See 2010/11 Report for full details.

D4: 2015 Research, Development and Demonstration (RD&D) Projects

In 2015, CINSW Ministerial Advisory Council recommended to the Minister that a \$10 million CINSW Research, Development & Demonstration (RD&D) Projects Expressions of Interest (EOI) Round 2015 be conducted. On 18 July 2016 the Minister approved the awarding of up to \$8,646,655 (GST exclusive) in grant funding from the Coal Innovation Fund to be distributed to eight successful project applicants to the 'Expressions of Interest' (EOI) Round 2015 for RD&D projects (see Table 10).

The eight projects span across different investigations into low emissions coal technologies, and five of these eight projects will be tested on real flue gas at the Vales Point Power station.

Table 10: RD&D Projects 2015

Applicant	project description	Awarded funding up to (\$)	Anticipated Completion date	Amount expended at 30 June 2017 (\$)
CO2CRC Pty Ltd	Membrane Gas-Solvent Contactors	1,216,900	Dec 2018	486,803
CSIRO (Wardhaugh)	Rotating Liquid Sheet Contactor	1,274,045	Dec 2018	573,320
Uni of NSW (Chen)	Third Generation Membrane Material Development	862,803	Dec 2018	301,981
CSIRO (Halliburton)	Aerosol Formation Case Study	687,252	Dec 2018	105,838
CSIRO (Hai Yu)	Advanced aqueous ammonia-based carbon capture technology	2,000,000	Dec 2018	500,000
Uni of Newcastle (Donne)	Direct Carbon Fuel Cell (DCFC) Demonstration	1,643,001	Dec 2018	Commencement July 2017
CSIRO (Feron)	Energy Harvesting from CO ₂ Capture	578,991	Dec 2018	144,748
Uni of Newcastle (Moghtaderi)	Combining Redox Energy Storage with coal-fired power generation	383,663	Dec 2018	98,048
Total Funding Awarded		8,646,655		2,210,738

One of the successful applicants from the first Round of grants for R&D projects in 2009-10 received grant funding to relocate and refurbish a post combustion pilot plant from Munmorah Power station to Vales Point station. This pilot plant is now a critical piece of infrastructure that has established a test facility that can stage many different experimental campaigns on real flue gas under real power station operating conditions.

The other three projects will be conducted at the University of Newcastle and CSIRO Energy Centre at Newcastle. All eight projects started in 2017 and are intended to be completed by the end of 2018.

D4.1: Project: Membrane Gas-Solvent Contactors Demonstration Project
Grantee: CO2CRC Pty Ltd

This project will pilot trial Membrane Gas-Solvent contactors, which are a combination of gas separation technologies, for the capture of CO₂ from flue gas in a pilot plant at the Vales Point Power Station. The project will establish the viability of this new hybrid technology and provide the necessary data to enable design scaling to support a potential large-scale CO₂ capture demonstration.

The aim of the project is to commission a membrane contactor pilot plant at the Vales Point Power Station to capture 100,000 kg of CO₂ per day with up to 20-30% reduction in capital cost compared to current solvent based CO₂ capture systems. If this was achieved on scale, it would enable this technology to be cost competitive and help drive down the costs of capturing CO₂ for Carbon Capture and Storage (CCS).

Evaluation:

The project commenced in January 2017 following the execution of contract on 20 December 2016. The first stage was to assess an existing pilot plant located Hazelwood Power Plant VIC and to modify it for current project before relocating to Vales Point Power Plant NSW for pilot trials. The pilot plant was safely relocated to an engineering workshop in Victoria and underwent detailed assessment and modifications designed for the current project.

In preparation for the pilot testing, a process concept design was carried out with the development of a process simulation model. The preliminary modelling result was very encouraging with all parameters reaching performance targets. This information is important in supporting the lab testing and screening on selected membrane contactors for next steps. A Stage Gate assessment will be conducted in Q3 2017 before the relocating/commissioning of pilot plant and onsite testing campaign.

D4.2: Project: Rotating Liquid Sheet Contactor pilot scale testing project
Grantee: CSIRO

This project is designing and testing a new and potentially more efficient type of gas separation technology referred to as a "Rotating Liquid Sheet contactor" for the capture of CO₂ from the flue gas of a power station. The aim of the project is to validate the design, costs and performance of the Rotating Liquid Sheet contactor in a post combustion CO₂ capture cycle using real flue gas in a pilot plant at the Vales Point Station.

The Rotating Liquid Sheet (RLS) contractor is a rotating device that sprays out a continuous thin liquid sheet which would contact and absorb the CO₂ emitted in the flue gas from a coal-fired power station. One of the project's objectives is to provide a liquid surface area for the CO₂ for contact that is equivalent to that of conventional CO₂ capture technology but with less equipment and fewer process steps, which would significantly reduce capital and operating costs. If proven, this novel technology could then be incorporated into a conventional CCS process and be retrofitted to existing coal fired power stations to reduce their carbon emissions by more than 90%.

The Rotating Liquid Sheet contactor can be considered a 'platform' technology in that it could be applied to a number of applications and industries. Such 'spin-off' applications may have the potential to pay for the commercial development prior to its application to post combustion capture of CO₂.

Evaluation:

The project began in January 2017 and has made steady progress on all milestones and passed its first Stage Gate review. Stage One of this project focused on a preliminary laboratory experimental program to evaluate the design and performance of the RLS Contractor compared to a conventional packing column. All four performance targets under Stage One were met in providing sufficient confidence in RLS Contractor's potential performance under laboratory conditions before moving to the pilot scale testing.

As part of the Stage Gate report, a detailed plan for the next stage was developed with two parts of research. One part will be the design, construction, commissioning and experimental testing of a pilot scale RLS module with real flue gas at Vales Point Power Plant. The other part will include the parallel development of a Flow Visualisation Facility which will provide back-to-back measurements under ideal conditions against conventional packing materials, spray columns etc. at the same scale at the pilot module.

D4.3: Project: Third Generation Membrane Material Development **Grantee: University of NSW**

This project is developing a new method of CO₂ capture through the use of new high-performance membrane material that physically separates or sieves out CO₂ from flue gas in a pilot plant at the Vales Point Power Station. The objective of the project is to provide an accurate technological and economic assessment of high performance membranes for CO₂ capture based on pilot testing results under various operating conditions. It will undertake an economic and competitive evaluation of the membrane for use in carbon capture technology and explore its scaling-up potential for commercialisation.

Membrane technology is a physical separation process somewhat akin to sieving currently used in the gas industry for separating gas mixtures into different gas components. This project aims to develop a new generation of high performance membranes for capturing CO₂ that will reduce CO₂ capture costs. This trial is considered of critical importance as the crucial technical information from the few similar field tests globally is not readily available.

A unique feature of this project is that all of the materials used for membrane development are commercially available and therefore the process developed in this study is amenable to existing large-scale fabrication used in membrane production. This project has the potential to provide a pathway for translating membrane technology for carbon capture into industrial scale manufacturing in NSW.

Evaluation:

This project commenced in January 2017 and has progressed well and met all milestones according to timelines set in the project plan. The focus during this period was synthesising high performance hollow fibre membranes and selecting the best performing candidates for pilot testing. Ten membrane candidates with different composites were fabricated in-house at the UNSW laboratories and four of them were selected as preferred candidates in passing the benchmarking performance test.

Parallel to the lab testing, the construction and testing of the first modulated membrane unit was completed and it functioned as designed. Other two identical units were under construction and the entire onsite test facility will be ready for testing in lab early in 2017-18 before moving to Vales Point Power Plant for pilot testing. A Stage Gate assessment is scheduled at the end of 2017 and the outcome will be reported in 2017-18 annual report.

D4.4: Project: Aerosol Formation Case Study **Grantee: CSIRO**

This study is evaluating the potential for pollutant emissions being produced whilst using a post combustion capture process on coal fired power stations. The aim of this project is to provide an understanding of the generation of aerosol emissions to address any knowledge gaps or potential environmental issues in CO₂ capture plants that use an amine based absorbent.

This project will aim to answer the question of where, and under which conditions, are aerosols formed in the conventional CO₂ capture process. The findings of this study will provide new information on whether aerosol emissions are a potential issue and potentially lead to techniques for reducing airborne emissions and consequential reductions in the cost of plant operations.

Evaluation:

This project started in January 2017 and one of its initial steps was to review the current state of knowledge regarding aerosol genesis and absorbent loss in Post Combustion Capture (PCC) processes. A Stage 1 report was submitted which presents a state-of-the-art review based on the available literature and expert opinion generated. By reviewing the effectiveness and limitations of aerosol sampling methodologies, the most appropriate research approaches were selected for next stage. With the acceptance of Stage 1 report, the project moved forward to conducting laboratory scale experiments with outcomes to be reported in the next financial year.

D4.5: Project: Advanced aqueous ammonia-based carbon capture technology **Grantee: CSIRO**

This project is focused on demonstrating an advanced aqueous ammonia based post-combustion CO₂ capture process, developed by CSIRO, and its benefits, through the use of the pilot plant located at Vales Point Power Station. Parallel to the pilot plant trials, lab based research will develop proof of the concept and prototyping of an entirely new "Trimonia Process", that utilises high concentration aqueous ammonia as a CO₂ capture medium.

The pilot stream of this project aims is to demonstrate an advanced aqueous NH₃-based PCC technology can be applied to new and existing coal-fired power stations in NSW to significantly reduce CO₂ emissions in an affordable and environmentally benign way. The technology uses a cheap, stable and locally available chemical as the chemical solvent to remove CO₂, SO₂ and other pollutants from the flue gas in power stations and other industries. It aims to

deliver a concept of locally developed carbon capture technology based around a locally available solvent that suits NSW power plants.

If successful the will help prepare the technology for large-scale demonstration in NSW and ultimately benefit the NSW coal industry by providing a cost-competitive, low-emission coal technology for capturing CO₂ emissions, for the carbon capture and storage.

Evaluation:

This project started in January 2017 with Stage 1 of the project needing to establish a roadmap for the aqueous ammonia based post combustion process. This included a preliminary techno-economic assessment to demonstrate that a positive benefit for Australia exists in pursuing the development such technology over other PCC technologies.

The Stage Gate report, established a four staged technology roadmap with sufficient information on goals, technical challenges and key performance targets and deliverables towards the development of commercialisation. The techno-economic assessment was considered sufficient to show economic benefits for Australia to develop the technology over other PCC processes at this stage.

After passing the Stage Gate assessment, the work on the pilot stream focused on plant modification and baseline testing preparation. In parallel, the project team of lab stream commenced working on the design and commissioning of lab scale facility for the 'Trimonia Process' with all milestones progressing well on track and within budget. Economic models were defined for costing studies and will be reported in the next Stage Gate report.

D4.6: Project: Direct Carbon Fuel Cell (DCFC) Demonstration Grantee: University of Newcastle

This project will build on previous studies on the Direct Carbon Fuel Cell (DCFC) — funded from the 2009 R&D Round— with further fundamental studies to support the ultimate development of a 10 kW DCFC demonstration plant. This project will aim to develop a first-of-kind fuel cell that converts the chemical energy from coal into electricity through an electrochemical reaction. If proven, this will be one of the most efficient ways of producing electricity with significantly less CO₂ emissions.

The aim of the project is to deliver a technology package capable of being licenced as a 10 kW DCFC module with

a projected cost of \$10,000/unit based on laboratory findings and pilot plant optimisation.

The project is a one-of-a-kind and will be the first demonstration unit of this scale to be built. The technology has undergone a major boost in international research interest in recent years, however technical barriers have meant commercialisation has not occurred at this early stage. This project will bridge a crucial gap between research and commercialisation of DCFC technology.

Evaluation:

While the other seven projects under CINSW EOI Round 2015 commenced in December 2016/January 2017, the commencement of this project was conditional upon successful completion of the previous project funded under 2009 EOI Round titled 'Development and Optimisation of the Direct Carbon Fuel Cell'. With the acceptance of final report of previous project by CINSW (See Item D3.8 for full details), this project will commence in reporting period 2017-18 following the execution of contract on 26 June 2017.

The project will undergo a Stage Gate assessment by the end of Q1 2018 to review key performance measures under both streams.

D4.7: Project: Energy Harvesting from CO₂ capture process Grantee: CSIRO

This project aims to develop a CO₂ capture process that generates electricity through direct electrochemical conversion of the products of the reaction between CO₂ and amines (solvents used in the process). This project will attempt to develop a conceptual design of the CO₂ capture and energy harvesting process and provide anticipated process performance data based on laboratory experiments and process modelling.

This project explores the potential of harvesting low grade thermal energy by adding an electro-chemical energy conversion step to the conventional carbon capture process. The energy conversion will be achieved by reaction between CO₂ and the simplest and most robust of amines (i.e. ammonia).

This CO₂ capture and energy harvesting process could provide a technological breakthrough for post combustion carbon capture by significantly reducing the energy required to capture CO₂.

Evaluation:

This project commenced in January 2017 and has progressed well and met all milestones within specified timeframes. The highlights during this period were the completion of literature study on metal-ammonia-CO₂-H₂O chemistry and design and manufacture of electrochemical cell. The literature study evaluated 10 potential metals for the energy harvesting from the ammonia-based carbon capture system and selected three candidates as the focus of next steps. Different 3-D printed electrochemical cells were designed, manufactured and assembled with other accessories for lab testing. Experimental assessment of power and energy performance for the selected metal candidates commenced and preliminary process modelling and initial results were encouraging.

A Stage Gate review will be conducted in 2017-18 to provide CINSW with sufficient confidence in the energy harvesting concept before moving to further laboratory experiments and process modelling as proposed for Stage 2.

D4.8: Project: Combining Redox Energy Storage with coal-fired power generation Grantee: University of Newcastle

This project is developing an energy storage unit termed "Redox Energy Storage" that can help power stations to better manage their load by storing energy in off-peak periods for later dispatch. The aim of the project is to determine the key underlying science and engineering issues that underpin the performance of the Redox Energy Storage unit for energy storage

The premise of the project is that a Redox Energy Storage unit may store large amounts of electricity at off-peak time when electricity demand is low, which can then be supplied back to the grid during peak time when demand is high.

The Redox Energy Storage unit has potential to provide flexibility to coal-fired power plants to operate in the cycling mode without disrupting its baseload operation. This would reduce the need for more high cost capital generation equipment for serving times of peak electricity demand only, whilst reducing greenhouse gas emissions.

Evaluation:

This project commenced in January 2017, with a scoping study comparing a Thermochemical Energy Storage (TES) unit against other competing technologies for addressing grid-scale variable load management and a techno-economic assessment in evaluating technical performance characteristics and estimating costings of TES unit.

Upon a successful Stage Gate assessment on the scoping study and techno-economic assessment scheduled in early 2017-18, the focus of next stage will be bench-scale studies using a proof-of-concept prototype to be fabricated based on Stage 1 outcomes and findings.

D5: NSW CO₂ Storage Assessment Program

The drilling program has been developed in 3 stages as follows:

- Stage 1A – Sydney Basin (4 wells)
- Stage 1B – Darling Basin (2 wells)
- Stage 2 – further data acquisition in the Darling Basin.

Evaluation:

Having commenced in 2008, the Program is expected to run until late 2019 / early 2020. Program status is as follows:

- Stage 1A – Sydney Basin data acquisition and assessment (completed)
- Stage 1B – Darling Basin data acquisition and assessment (completed)
- Stage 2 – further data acquisition in the Darling Basin (planning phase).

The 2014 drilling campaign in the Darling Basin (Stage 1B) met its aims and objectives and was successful in discovering the first prospective site in NSW for the storage of CO₂ captured from coal-fired power stations and other industrial sources. Specifically, analysis of data from the Mena Murtee-1 well in the Pondie Range Trough, north-west of Cobar (see yellow marker in Figure 1 below), revealed multiple reservoirs with the potential to store hundreds of millions of tonnes of CO₂ overlain by competent top seals. Preliminary computer modelling showed that the reservoirs could potentially store about one quarter of the CO₂ emitted over a 50 year period from the State's coal power sector (based on 2015-16 emissions data¹).

1. <http://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/electricity-sector-emissions-and-generation-data/electricity-sector-emissions-and-generation-data-2015-16#Electricity-sector-emissions-and-production-data-201516>

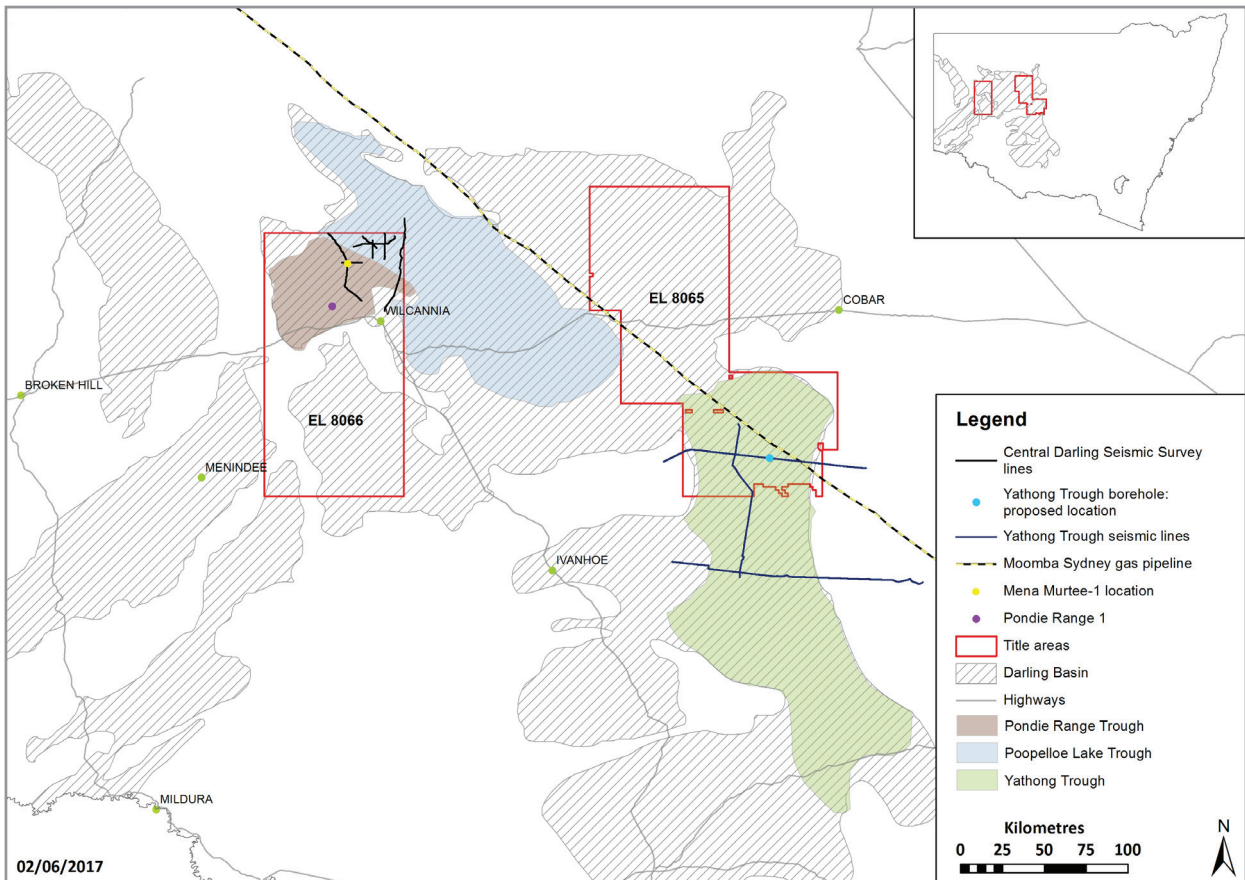


Figure 1: The Darling Basin in central-western NSW depicting the areas to be targeted in Stage 2 of the NSW CO₂ Storage Assessment Program.

Note: The seismic survey lines to be acquired to assist in finalising drill site locations are displayed as black lines within the Pondie Range and Poopelloe Lake troughs. The approximate location of the proposed borehole in the Yathong Trough is shown as a light blue dot.

Economically, the costs of transporting the CO₂ captured from NSW east coast power stations and storing it in the Pondie Range Trough has been recently estimated at a low \$21 per tonne².

Whilst the Darling Basin discovery is promising, the available data is currently insufficient to make NSW 'storage ready'. 'Storage ready' is a concept whereby potential basins are explored, drilled, assessed and characterised before being offered as precompetitive data to industry. This has always been the traditional role for government, filling a market failure void by providing pre-competitive data. Hence, the concept of 'storage ready' is not a commercial proposition; it is a precursor to an investor acquiring a site to establish an industry. It is, however, not possible with the current data for the NSW Government to have sufficient confidence to commit to the offer of CO₂ storage acreage for industry's consideration. More comprehensive exploration and site characterisation is required to confirm the favourable findings from the Darling

Basin. To assist in achieving the goal of making NSW CO₂ storage ready, the NSW CO₂ Storage Assessment Program has progressed to Stage 2. The aim of Stage 2 is to determine whether the Darling Basin has geologically viable CO₂ storage sites. This aim is to be met through two specific objectives including to:

- determine if the reservoir / seal units in the Ravendale Interval sediments of the Pondie Range – Poopelloe Lake troughs are of sufficient geological quality for the viable storage of CO₂
- geologically assess the underexplored yet promising Yathong Trough for prospective CO₂ storage sites.

Achievement of the project aim and objectives requires a comprehensive seismic survey and exploration drilling strategy coupled with a complementary program to analyse, model and interpret the new data and integrate it with existing information. This will allow a robust

2. Australian Power Generation Technology Report, CO2CRC, 2015

assessment of storage viability to be undertaken. Stage 2 is being financed through the CINSW Fund. A business plan has been drafted that details key elements of the exploration strategy and will be used to approach stakeholders to secure additional contributing funding support. Such support would considerably strengthen the program's outcomes by increasing the level of scrutiny required to confidently assess the targeted sites for CO₂ storage suitability.

Planning of the Stage 2 Darling Basin exploration program has progressed in line with a developed work plan based on the consolidation and synthesis of existing data, development of a peer-reviewed seismic acquisition program to fill existing data gaps, and the drilling of exploration holes located in key locations based on the outcomes of the new seismic acquisition.

A program of 2D seismic acquisition and processing has been planned as a precursor to the Stage 2 drilling. Planning is well advanced, with survey routes confirmed (includes seven lines totalling approximately 186 km in length), access agreements with relevant landowners secured, local government approval to access public roads, a procurement strategy with Geoscience Australia developed, and planning approval processes near complete.

Based on current projections, the seismic survey is forecast to take place in Q4 2017/Q1 2018. The results will assist in planning the drilling exploration campaign due to commence in the the 2nd half of 2018.

A \$2 million budget has been allocated to the seismic program.

D6: Future of NSW Coal Fired Electricity Generation Industry

In 2015 CINSW Ministerial Advisory Council recommended to the Minister that a *Future NSW Coal Fired Electricity Generation Industry Study* project be undertaken.

CINSW Secretariat undertook a procurement process to conduct a study which would provide the NSW Government with a technical and economic evaluation of future options for the role of coal in providing a sustainable, safe, reliable and competitive form of electricity generation for NSW, whilst reducing its carbon emissions and maintaining State economic growth.

A robust procurement strategy was developed in consultation with Department's Procurement and Governance Units. After undergoing a round of competitive tendering and a rigorous tender evaluation process, Ernst &

Young (EY), as the highest-ranked respondent, was awarded the contract to deliver a comprehensive study for a fee of \$246,000 (plus GST) and the study commenced in April 2016.

The Study has been developed in two stages. Stage 1 developed a comprehensive baseline data and examined two reference scenarios. Stage 2 modelled and investigate several options and scenarios that NSW could put in place to test outcomes under a carbon constrained future.

A Steering Committee of industry representatives has been established and a peer review panel will consider Reports at each Stage of the Project.

Evaluation:

Stage 2 modelling was completed in August 2016 and a Final Report was completed in October 2016. All Reports were reviewed by the Study Peer Review Panel (Commonwealth Office of Chief Economist and Australian Energy Market Operator). AEMO commented that the report was well considered and modelled and would only be improved with additional work building upon Stage 1 and 2. The Commonwealth Office of Chief Economist commented that the report results appeared to be robust and considered a wide range of possible variables that would affect long-term outcomes.

CINSW Ministerial Advisory Council sought sensitivity analysis on some assumptions, such as gas pricing, to build a more robust Report. Further sensitivity analysis on policy announcements such as the Hazelwood powerstation closure, State Renewable Energy Targets and NSW / SA interconnector was also undertaken. These sensitivity models were outside the original scope and cost estimate from EY. Therefore, based on hourly rates disclosed in the original EY bid, an additional fee of \$78,000 ex GST was approved and paid to EY.

In considering the reports CINSW established a subcommittee to investigate the modelled results and operational issues within the real grid, (such as inertia, frequency control and other relevant matters that may cause concern with the 2050 modelled outcomes). CINSW then provided a recommendation to the Minister for the Study to progress to Stage 3 *Wholesale electricity pricing modelling* and Stage 4 *Computable General Equilibrium (CGE) modelling and analysis* to consider the broader impact on the economy. It is intended that a report of the entire study will be published once stages three and four have been completed.

E Conclusion

The financial year 2016-17 was a successful year for CINSW, with progress on many fronts. The highlights of the financial year have seen several research projects concluding with significant achievements attained and the commencement of eight (8) new projects with a total grants value of \$8.64 million. These new projects are programmed to be completed by the end of 2018. Completed research projects have had their Final Reports assessed, peer reviewed and placed on the Department's website after acceptance from the Minister.

Significant planning work has been undertaken to develop Stage 2 of the drilling program to support the evidence of the potential for commercial-scale storage of CO₂ in NSW discovered during Stage 1.

2016-17 has continued to undertake significant forward project planning with emphasis on the development of new research programs and the continuation of the *Future of NSW Coal Fired Electricity Generation Industry Stages*.

These outcomes contribute to achieving the functions of CINSW and purpose of the CINSW Fund as outlined in the Act.

Expenditure for this year increased compared to last year, largely due to the release of new research grants, based on milestones achieved. Over the next two years, significant expenditure will occur with the RD&D program (\$10 million budget) and drilling (\$20 million budget) allocations.

Overall Financial Balance

(Extract from Financial Statements)	Value \$
Opening balance as at 1 Jul 2016 (credit)	85,079,152
Interest revenue	1,280,261
total	86,359,413
Less expenditure	(4,202,496)
TOTAL as at 30 June 2017 (credit)	82,156,917

Expenditure for financial year 2016/17

Major Expenditure incurred	Value \$
Coal Innovation NSW (Advisory Council) costs	22,481
Secretariat costs including salaries	919,642
R&D projects grants (round 2009 & 2015)	2,866,215
CO2 Storage Assessment Program Stage 1B (with adjustments) and Stage 2	85,309
Study of NSW Coal Fired Electricity Generation Industry Study	281,899
Audit Fees	26,950
GRAND TOTAL	4,202,496

Coal Innovation NSW Fund
Financial Report
for the year ended 30 June 2017
STATEMENT BY DEPUTY SECRETARY
Division of Resources and Geoscience
Department of Planning and Environment

I declare that in my opinion:

- a) The accompanying financial report provides details of the transactions of the Coal Innovation NSW Fund for the year ended 30 June 2017;
- b) The financial report has been prepared as a special purpose financial report in accordance with the basis of preparation described in Note 2; and
- c) The accompanying financial report exhibits a true and fair view of the net assets of the Coal Innovation NSW Fund as at 30 June 2017 and of its income and expenditure for the year ended on that date.

Further, I am not aware of any circumstances which would render any particulars included in the financial report to be misleading or inaccurate.



Kylie Hargreaves
Deputy Secretary, Division of Resources and Geoscience
Department of Planning and Environment

Date: 17/10/17

Beginning of the audited financial report

COAL INNOVATION NSW FUND
STATEMENT OF COMPREHENSIVE INCOME FOR THE YEAR ENDED 30 JUNE 2017

	2017	2016
	\$000	\$000
Revenue		
Interest revenue	1,280	1,658
Other revenue	-	(3)
Total revenue	1,280	1,655
Expenses		
Administration fees	90	25
Advertising and promotion	1	3
Auditor's remuneration – audit of financial report	27	26
Auditing – other services	-	10
Consultancy	349	101
Legal	24	17
Motor vehicle expenses	3	5
Other contractors (Refer note 2 (a))	62	51
Personnel services		
Salaries and wages (including recreation leave)	635	621
Superannuation	59	57
Payroll tax and fringe benefits tax	38	37
Research and development grants	2,866	739
Telecommunication	1	1
Training and staff development	8	10
Travel	33	25
Other operating expense	6	7
Total expenses	4,202	1,735
Net result	(2,922)	(80)

The accompanying notes form part of the financial report.

**COAL INNOVATION NSW FUND
STATEMENT OF NET ASSETS AS AT 30 JUNE 2017**

	2017	2016
	\$000	\$000
ASSETS		
Current assets		
Cash and cash equivalents	82,052	84,462
Receivables		
Department of Industry	2	-
Interest receivable	624	810
Net GST receivable	141	12
Total current assets	82,819	85,284
Total assets	82,819	85,284
LIABILITIES		
Current liabilities		
Payables		
Creditors	478	117
Department of Industry	4	88
Department of Planning and Environment	180	-
Total current liabilities	662	205
Total liabilities	662	205
Net assets	82,157	85,079

The accompanying notes form part of the financial report.

**COAL INNOVATION NSW FUND
NOTES TO THE FINANCIAL REPORT FOR THE YEAR ENDED 30 JUNE 2017**

1. COAL INNOVATION NSW FUND

Fund

The Coal Innovation NSW Fund (the Fund) is a not-for-profit fund (as profit is not its principal objective) and the Fund does not have a cash generating unit.

The Fund has been established and is governed under the *Coal Innovation Administration Act 2008* (the Act). Part 2 Section 4 of the Act establishes the Fund as a special deposits account.

As of 1 April 2017, responsibility for the Fund transferred from the Department of Industry to the Department of Planning and Environment.

The financial report has been prepared on the basis that the Fund is not a reporting entity under the Australian Accounting Standards. The financial report for the Fund is therefore a special purpose financial report with the financial year being from 1 July 2016 to 30 June 2017.

This financial report for the year ended 30 June 2017 has been authorised for issue by the Deputy Secretary on the date the accompanying Statement by Deputy Secretary was signed.

Key activities

Part 2 Section 5 of the Act establishes the purpose of the Fund as follows:

- (a) to provide funding for research into, and development of low emissions coal technologies, and
- (b) to provide funding to demonstrate low emissions coal technologies, and
- (c) to provide funding to increase public awareness and acceptance of the importance of reducing greenhouse gas emissions through the use of low emissions coal technologies, and
- (d) to provide funding for the commercialisation of low emissions coal technologies.

Funding sources for the Fund

Part 2 Section 6 of the Act states that:

(1) There is payable into the Fund:

- (a) all money advanced by the Treasurer to the Fund, and
- (b) all money appropriated by the Parliament for the purposes of the Fund, and
- (c) the proceeds of the investment of money in the Fund, and
- (d) all money directed or authorised to be paid into the Fund by or under this or any other Act or law, and
- (e) all money received for voluntary contributions to the Fund made by any person or body.

(2) A voluntary contribution to the Fund may be made on the condition that the contribution is to be used only for a specified purpose.

Payments out of the Fund

Part 2 Section 7 of the Act states that:

(1) There is payable from the Fund

- (a) payments approved by the Minister for the purpose of the Fund, and
- (b) administrative expenses incurred in relation to the Fund or Coal Innovation NSW (CINSW), and
- (c) payments directed or authorised to be paid from the Fund by or under this or any other Act or law.

(2) Any money paid into the Fund on the condition that it is to be used only for a specified purpose, including any proceeds of the investment of that money in the Fund, is only payable from the Fund for the specified purpose and a proportionate share of the administrative expenses payable from the Fund.

**COAL INNOVATION NSW FUND
NOTES TO THE FINANCIAL REPORT FOR THE YEAR ENDED 30 JUNE 2017**

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of preparation

This financial report is a special purpose financial report that has been prepared in order to account for the transactions of the Fund under the Act.

This financial report has been prepared in accordance with the significant accounting policies disclosed below. Such accounting policies are consistent with the previous period unless stated otherwise.

The statement of net assets and the statement of comprehensive income have been prepared on an accruals basis and based on historic costs and do not take into account changing money values or, except where specifically stated, current valuations of non-current assets.

All amounts are rounded to the nearest one thousand dollars and are expressed in Australian currency.

(a) Research and development expenses

The Fund engages contractors to conduct work for site preparation, drilling, engineering, project management and research activities. This activity is classified as in research phase for the project and no expenses have been capitalised. An asset will not be recognised until clear and quantifiable future benefit is established. However there is acknowledgement that any grant is from the Fund and any future economic benefits (assets) arising out of it may belong to NSW government and/or the research partner.

(b) Accounting for Goods and Services Tax (GST)

Income, expenses and assets are recognised net of the amount of GST, except that:

- (a) the amount of GST incurred by the Fund as a purchaser that is not recoverable from the Australian Taxation Office is recognised as part of the cost of acquisition of an asset or as part of an item of expense and
- (b) receivables and payables are stated with the amount of GST included.

(c) Income recognition

Income is measured at the fair value of the consideration or contribution received or receivable. Additional comments regarding the accounting policies for the recognition of income are discussed below.

(a) Grants and contributions

Grants and contributions include industry contributions and grants from Commonwealth and New South Wales government. They are generally recognised as income when the Fund obtains control over the assets comprising the grants and contributions. Control over grants and contributions are normally obtained upon the receipt of cash.

However, some revenue is recognised when the Fund issues invoices in relation to partnership agreements where work is completed and grants are based on actual expenses incurred in the previous quarter. The invoices are issued after the Steering Committee accepts the financial report and the actual expenses for the quarter.

(b) Interest Revenue

Interest income is recognised using the effective interest rate method. The effective interest rate is the rate that exactly discounts the estimated future cash receipts over the expected life of the financial instrument or a shorter period, where appropriate, to the net carrying amount of the financial asset.

(d) Receivables

Trade receivables and other receivables that have fixed or determinable payments that are not quoted in an active market are classified as receivables. Receivables are measured at amortised cost using the effective interest method, less any impairment. Changes are recognised in the net result for the year when impaired, derecognised or through the amortisation process.

Short-term receivables with no stated interest rate are measured at the original invoice amount unless the effect of discounting is material.

**COAL INNOVATION NSW FUND
NOTES TO THE FINANCIAL REPORT FOR THE YEAR ENDED 30 JUNE 2017**

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES (continued)

(e) Payables

Payables represent liabilities for goods and services provided to the Fund and other amounts. Short-term payables with no stated interest rate are measured at the original invoice amount where the effect of discounting is immaterial.

(f) Personnel services

The Fund does not have any employees and received administrative, secretarial support and operational assistance from the Department of Industry and the Department of Planning and Environment. The Fund has an arrangement with Department of Industry and the Department of Planning and Environment to reimburse them for personnel services expenses.

3. CASH RECEIPTS AND PAYMENTS

	2017	2016
	\$'000	\$'000
Opening cash balance	84,462	84,830
Cash receipts:		
The Fund is authorised to receive amounts in accordance with Section 6 of the Act.		
(1)(a) all money advanced by the Treasurer to the Fund	-	-
(b) all money appropriated by the Parliament for the purposes of the Fund	-	-
(c) the proceeds of the investment of money in the Fund	1,467	1,729
(d) all money directed or authorised to be paid into the Fund by or under this or any other Act or law	-	-
(e) all money received for voluntary contributions to the Fund made by any person or body.	-	-
(2) a voluntary contribution to the Fund may be made on the condition that the contribution is to be used only for a specified purpose.	-	58
BAS receipt	161	16
Cash payments:		
Payments from the Fund are in accordance with Section 7 of the Act.		
(1)(a) payments approved by the Minister for the purpose of the Fund	(3,182)	(1,307)
(b) administrative expenses incurred in relation to the Fund or CINSW	(856)	(864)
(c) payments directed or authorised to be paid from the Fund by or under this or any other Act or law.	-	-
(2) any money paid into the Fund on the condition that it is to be used only for a specified purpose, including any proceeds of the investment of that money in the Fund, is only payable from the Fund for the specified purpose and a proportionate share of the administrative expenses payable from the Fund.	-	-
Closing cash balance	82,052	84,462

4. EVENTS AFTER THE REPORTING DATE

There are no events subsequent to the balance date that affect the financial information disclosed in this financial report.

End of the audited financial report

