National Committee
for Earth Sciences
Australian Academy of Science

Review of:
National strategic plan for the geosciences 2003

Geoscience — unearthing our future

The National Committee for Earth Sciences has conducted a review of the 2003 Strategic Plan to examine how far the strategic issues have been addressed, what remains to be done and what further developments are needed.

The material is organised around the goals specified in the 2003 Plan accompanied by their critical factors, with commentary against the recommendations under each heading.

January 2010

National strategic goals and critical factors for the geosciences

Goal 1: Education

A sustainable and wealthier Australia through more effective geosciences education

Critical factors

The critical factors associated with this goal are listed below, with links to the NRP and/or structural objectives (SO) identified by bracketed text.

1. Strong general support for science, engineering and technology disciplines (NRP 1, 3, 4 and SO 2, 3, 4).

2. A funding model for higher education that recognises the national significance, and education costs, of geoscience, emphasises quality over quantity, and facilitates effective development of core and specialist geoscience skills (NRP 1 and SO 1, 2, 5)

3. A stronger focus on world-class research and graduate centres, networked with smaller departments (SO 1, 2, 3, 4, 5).

4. Geoscience-scholarships that encourage students to fill skill-gaps in the nation's ability to address the NRPs (NRP 1, 3 and SO 2).

5. Awareness by Australia's decision-makers of: the value of geoscientific knowledge when making decisions that involve Australia's natural resources; and how the geoscience community can contribute to the effectiveness of their decision-making processes (NRP 1 and SO 4, 5).

6. Motivation of school students to pursue geoscience careers (NRP 1, 3, 4 and SO 1, 2, 4).

Recommendations:

The NCES recommends the following.
1. That government moves to a funding model for higher education that recognises the national significance, and education costs, of geoscience so as to ensure the long-term viability of geoscience education and training, including:

- *relocation of the geosciences from Cluster 8 to Cluster 10;*
- *extension of funding under the Higher Education Innovation Program for a further five years; and*
- *strong support for science, engineering and technology disciplines in general.*

Government initiatives have provided additional support for Science through, e.g., the National Cooperative Research Infrastructure Strategy (NCRIS) and the 2009 Super Science Initiative
There have also been adjustments to the Higher Education funding bands, but this has not advantaged the geosciences

2. That government and universities collaborate to modify the university funding model and its implementation, ensuring:

- *provision for stable, base-level funding to maintain viability of a diverse group of university geoscience departments, despite cyclicity in undergraduate enrolments — specifically, implementing the 'variable rate learning entitlement' funding model proposed in the Higher Education Review, to give direct recognition to the costs and significance of geoscience, as an area of national priority, and of small but vital disciplines such as geophysics;*
- *investment in critical core-skills, including those highly specialist skills where the need is critical but is satisfied by a small number of highly competent graduates;*

- *provision of scholarships by industry, government and other employers, particularly geoscience-scholarships that encourage students to fill skillgaps in the nation's ability to address the NRPs; and*
- *increase incentives for universities to create graduates with the multidisciplinary and inter-disciplinary skills necessary to address the NRPs.*

The approach taken by different Universities has been varied but financial viability in many cases has only been achieved within a larger cluster incorporating geographical studies.
Funding to secure the future of topics like geophysics with small numbers has been difficult to find, but a number of Universities are working to strengthen their offerings. National coordination and networked teaching could help for the future, e.g., by video conferencing or by making use of free infrastructures such as iTunes U by Apple Computers.

3. That the geoscience community expand and broaden existing and emerging networked geoscience centres (e.g. Victorian Institute of Earth and Planetary Sciences, Sydney Universities Consortium for Geology and Geophysics, Earth Systems Dynamics Network) in order to establish world-class graduate centres, networked with smaller departments. Specific initiatives associated with this strategy are:

- *provision of dedicated personnel for networking with smaller departments, state government agencies, Geoscience Australia, CSIRO and industry;*
- *use of infrastructure for networking;*
- *geoscience promotion, by a dedicated geoscience teacher in each centre, to schools and to the general public;*
- *establishment of new chairs, particularly in areas of national priority (including geophysics and marine geoscience);*
- *introduction of a '50 early career explorer' scheme for new graduates and doctorates, with staff to be rotated between government research agencies and industry; and*
- *increased research and teaching collaborations between geosciences departments, and those in environmental science, geomorphology, meteorology, geoinformatics, engineering, commerce and social science.*

The networked science centres have less presence than in 2003. However, infrastructure initiatives such as AuScope have provided some linkages between Universities and across sectors – but by no means widespread.
The geosciences have so far seen little benefit from the Future Fellowship scheme. Closer links with the geodetic community have been fostered to some extent through AuScope.

4. That all national and state geoscience bodies (government agencies,professional and peak industry associations and lobby groups) work with the Australian Academy of Science, the Academy of Technological Sciences and Engineering and the Australian Science Teachers Association to provide professional development to teachers and schools with inspiring K-12 teaching resources. This should:

- *include excellent geoscience-based learning experiences for primary andsecondary students, underpinned by affordable professional development in how to use them;*
- *ensure program gaps, specifically including at the K-3, 4-6, 7-10 and 11-12 levels, are effectively targeted through cooperatively funded strategies; and*
- *provide geoscience-based learning experiences, including case studies that can be used by non-geoscience disciplines.*

The AAS Primary Connections material now includes a module on Earthquakes, with broader geoscience background

5. That the geoscience community encourage government to:

- *undertake a more rational distribution of existing funds to university-based geoscience programs to reduce the large amount of time lost in applying for funding of research positions; and*
- *increase the general level of science education funding so that Australia is internationally competitive.*

The Australian Geoscience Council have made efforts to reinvigorate university geosciences with a discussion paper produced in February 2008 and subsequent follow up. The Australian Society of Exploration Geoscientists have also undertaken a survey of geophysical capability for the Minerals Council of Australia. The recommendations from these efforts however have so far had no effect – despite the high international profile of Australian Geoscience funding is still very weak by international standards.
The Geological Society of Australia (GSA) and the Australian Institute of Geoscientists (AIG) undertook merger discussions to try to strengthen the national presence, but AIG has withdrawn from the negotiations.

6. That government, universities and industry collaborate to:

- *determine and implement degree structures that will maximise the effectiveness of the geosciences, particularly in addressing the national research priorities;*
- *ensure that a geoscience component is in undergraduate and post-graduate courses for primary and secondary science-teacher trainees; and*
- *establish effective, affordable, programs and incentives that encourage teachers and trainee teachers, at all levels and across specialist areas, to acquire the knowledge and skills they need to effectively teach the geosciences.*

Little progress!

7. That, whenever it is practical and feasible to do so, the geosciences community adopts a coordinated and integrated promotion of the geosciences and their relevance.

The AuScope approach to infrastructure has involved extensive community consultation linking also to the geodesists

8. That government reinstate its support for the Mineral Council of Australia's Mineral Tertiary Education Council program and support other similar private sector initiatives.

Funding has not been forthcoming and MTEC support to Universities has significantly diminished

Goal 2: Research

A vibrant, world-leading, geoscience research community

Critical factors

1. An inspirational research program that contributes strongly to future geoscientific knowledge and skills and attracts high-quality researchers and adequate funds (NRP 1, 3, 4 and SO 1, 2, 3, 4, 5).

2. An improved funding model for major research facilities and infrastructure to ensure effective use of the significant capital investment and to facilitate access (SO 2, 3, 5).

3. Development of an effective oceanographic research capability (NRP 1, 3 and SO 1, 2, 3, 4, 5).

4. Investment in a major geotransect to gain fundamental information about the Australian plate, from its basic structure and evolution through to its mineral and petroleum systems and surficial processes (NRP 1, 4 and SO 1, 3).

5. Relaxation of restrictions on recognition of government appropriation funds in granting schemes (SO 4, 5).

Recommendations:

The NCES recommends the following.
1. That the ARC continues to support excellence, diversity and innovation in funding basic research including new opportunities detailed in this section.

ARC Grant funding for the solid Earth Sciences has seen a decline, but more broadly funding levels have been approximately maintained.

2. That the ARC supports the basic, strategic and applied research outlined in sections 5 and 6.

ARC LIEF is the major contributor to the IODP subscription and there has been continuing investment in geochemical infrastructure.

3. That government provide strong and continuing support for major research infrastructure, particularly ensuring more effective use of the significant capital investment in national research facilities, by:

- *providing predictable opportunities for capital acquisition;*
- *funding operational support, maintenance, and top quality technical support; and*
- *funding travel and accommodation so that qualified researchers are able to access the facilities.*

The NCRIS AuScope funding secured for the Earth Sciences provided valuable capital investment together with operational and maintenance funds.
However, the latest Infrastructure rounds have reverted to the narrow definition of capital investment with co-investment expected for operation and maintenance – this is becoming increasingly difficult to secure.
It is to be hoped that the review of the NCRIS scheme will lead to a renewal of this effective approach to support.

The May 2009 Federal budget provided new funding of $48M over two years from the Super Science initiative of the Education Investment Fund (EIF) to extend NCRIS-funded work already under way by the Australian National Data Service (ANDS), with the objective of building an Australian Research Data Commons (ARDC). In mid October 2009, DIISR approved a Final ARDC EIF Project Plan1.

This Project Plan undoubtedly provides opportunities for Australian Geoscience in terms of building a Data Commons infrastructure for Geology and Geophysics. It is not yet clear how the Geoscience community should become engaged. In addition there is a reluctance on part of some Universities to permit their employees to contribute their data to Data Commons archives open to the public. This highlights some policy issues (University policies are out of sync with federal funding provided for Data Commons infrastructures).

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4. That government provide substantial new funding to develop Australia's marine geoscience capacity, ensuring:

- *development of a vital marine geoscience community;*
- *development of, and access to, a modern, effective national marine geoscience infrastructure, including a national shallow-coring facility; and*
- *collaboration with the Integrated Ocean Drilling Program.*

The announcement in the 2009 budget of funding for a new blue-water research ship is most welcome.
A successful ARC LIEF bid from a consortium for Universities and CSIRO has secured funding for a 25% IODP Membership from 2008 and now modest funds for research support for cruise participants.

5. That the nation invest in a major geotransect study to gain fundamental information about the Australian plate, from its basic structure and evolution through to its mineral and petroleum systems and surficial processes by:

- *universities and government research agencies developing and implementing a collaborative plan for the most effective geotransect considering the unique opportunities in Australia; and*
- *the ARC supporting this activity, including through its new Research Networks Program.*

A National Geotransects Working Group has prepared a concept of corridors across the country where investment is likely to have high return – this has helped planning but not funding.
Through AuScope investment has been made in reflection profiling (North Queensland, SA/NT, Western Victoria, NW WA –planned) mostly in concert with GA and State agencies that contributes to the transect concept. Areal coverage with passive seismic arrays has also been deployed to try to enhance 3-D structural resolution near reflection lines (SA, QLD).
There is no coordinated mechanism for transect work, and future reflection work is likely to be oriented towards potential economic rather than scientific targets.

6. That government free up restrictions on recognition of appropriation funds from government research agencies in granting schemes such as the ARC linkage grants.

The provisions regarding "dual funding" are imposed more severely than before. Geoscience Australia is regarded by ARC as a government Research Agency, despite the views of GA itself, because the word research enters in a departmental description.

7. That the recommendations of the House of Representatives Standing Committee on Science and Innovation, with respect to increasing business investment in R&D, are implemented.

Goal 3: Sustainablity

A sustainable Australian society through understanding the origin and evolution of Earth's life-support system

Critical factors

1. Investment in a modern, effective national marine geoscience capacity (NRP1, 3 and SO 1, 2, 3, 4, 5).

2. A national program to provide information on the geological controls of groundwater distribution, resources and quality, and determine the causes and mitigation of dryland salinity (NRP 1 and SO 1, 4).

3. Improved information on the rate of change of climatic conditions and landscapes and their effect on Australia's land resources and biodiversity (NRP 1 and SO 4).

4. Improved information on the feasibility, methods, and cost of safe long-term storage of greenhouse gases (NRP 1 and SO 4).

5. Increased investment in research, training, and provision of data and information that results in cessation of land and water degradation (NRP 1 and SO 1, 2, 3, 4, 5).

Recommendations

The NCES recommends the following.

1. *That government provide substantial new funding to develop Australia's marine geoscience capacity, ensuring:*
   - *development of a vital marine geoscience community;*
   - *development of, and access to, modern, effective national marine geoscience infrastructure;*
   - *establishment of a national shallow-coring facility; and*
   - *collaboration with the Integrated Ocean Drilling Program.*

The announcement in the Commonwealth Government 2009 budget of $120M funding for a new blue-water research ship is most welcome. This Super Science Initiative, funded through the Education Investment Fund (EIF), will deliver a state-of-the-art vessel to replace the Southern Surveyor. Construction and commissioning of the vessel will take four years, with an expected delivery date for the new vessel by 2012. The new vessel will be managed by the CSIRO.

The Australian Government, through the ARC LIEF program, 15 University partners, ANSTO, AIMS, the CSIRO, and the 2009 Commonwealth budget, have made major progress in improving Australia's marine geosciences capacity. ARC LIEF Project LE0882854 provides funding (A$10.6 M) that enables a 5-year (2008-2012) membership to the international Integrated Ocean Drilling Program (IODP). The IODP membership enables Australian scientists to participate in international cruises aiming at studying the ocean floor and deep ocean environments, focusing on ecological and environmental research, climate change, solid Earth cycles and geodynamics. Additional funds for IODP membership was also provided through the ARC LIEF scheme in 2009, which also includes modest funds for research support for cruise participants.

A major initiative supporting marine science research also developed through the National Collaborative Research Infrastructure Strategy (NCRIS) program, -the Integrated Marine Observation System

The initiatives outlined above, complemented by A$19.5M EIF funding for the Sydney Institute of Marine Science, A$ 45M EIF funding for the Institute for Marine and Antarctic Studies at the University of Tasmania, Hobart, continuing funding for AIMS, and smaller initiatives at various universities in Australia have certainly contributed new funding to develop Australia's marine geoscience capacity.

An ongoing concern is maintaining momentum in Australia's marine geoscience capacity. Membership to the IODP is secure until 2012. The reliance of IODP membership on the ARC LIEF scheme may not be successful as a long-term strategy, since it depends heavily on matching support from individual university partners. Geosciences schools and departments in most Australian universities do not have a strong marine component. If resources are not available for Australian universities to expand marine studies programs through hiring of new staff and increasing undergraduate placements, these Universities may not have the capability of making full use of IODP membership and may opt out of any future LIEF initiative. Long-term IODP membership, therefore, depends on increasing marine science research and teaching capabilities within universities, or an independent funding model in the future.

2. *That government fund a coordinated national program involving government agencies, universities and other organisations that will provide information on the geological controls of groundwater distribution, resources and quality. Such a program should:*
   - *encompass remote regions, where the major potential use of groundwater could be for mining and mineral processing, and tourism, as well as for agriculture*
   - *determine the national stock of ground waters; and*
   - *determine the quality of the groundwater.*

In June 2009, The Australian Government announced the establishment of the National Centre for Groundwater Research and Training, a co-Funded Centre of Excellence of the Australian Research Council and the National Water Commission. The Centre promotes collaboration among twelve universities and eight industry and government organizations. The Centre, based at Flinders University, South Australia, has nodes in South Australia, New South Wales, Queensland, Victoria, Western Australia, and the ACT. New funding, amounting to A$55M (A$29.5M over five years from Commonwealth funds, plus A$15M over four years in cash plus additional in-kind contributions from research partners), represents a significant investment in groundwater research in Australia.

3. *That government agencies support a program to:*
   - *determine the causes and mitigation of dryland salinity;*

Dryland salinity research became the major focus of two CRCs: The Salinity CRC and the CRC for Landscape Environments and Mineral Exploration (CRC LEME). The Salinity CRC was primarily a plant science research initiative and it will not be discussed here. CRC LEME, on the other hand, was an Earth Sciences initiative, and started as the CRC for Landscape Evolution and Mineral Exploration in 1996; its renewal in 2002 change the focus from Landscape Evolution and Mineral Exploration to Landscape Environment and Mineral Exploration, where dryland salinity became an important topic. The main partners in CRC-LEME were Geoscience Australia, CSIRO (Divisions of Exploration & Mining and Land & Water), Australian National University, Curtin University of Technology, University of Adelaide, NSW

Department of Primary Industries, Primary Industries and Resources South Australia and the Minerals Council of Australia. It brought together 155 research scientists, drawn from both in-kind contributions and cash-funded positions in participating organisations. From 2001 to 2008, the Centre received in-kind salaries and resources of some $94 M, in addition to its original budget of A$38M of income from CRC grants, participant contributions and industry.

- *map and understand the surface and near surface geology and hydrology (regolith, soils, bedrock, water, vegetation) with high-resolution geophysical and spectral remote sensing techniques using airborne and space platforms, and targeted ground truthing;*

Significant additional funding to dryland salinity and water quality studies in the 2003-2009 period arose from the National Action Plan for Salinity and Water Quality (NAPSWQ), which included several Earth Sciences initiatives.

- *determine the range in, and rate of, change of climatic conditions, sea level and landscapes in geologically recent (deep) time and their effect on the size, diversity, location and migration of ecosystems (Australia's biodiversity);*

Climate-change research in the 2003-2009 period has been driven by Australia's participation in the IPCC. Other major initiatives on climate change arose through the Education Investment Funding Round 1 and current proposals in the sustainability round.

In addition, the ARC Discovery program was instrumental in funding a number of projects whose main topic was climate-change. These projects amount to ca A$ 33M in research investment on the topic.

CSIRO Land and Water also carried out significant research on climate and the consequences of climate change in Australia.

The establishment of the Department of Climate Change creates opportunities for intensifying the pace of climate-oriented research in Australia. So far, however, the Department has mainly concentrated on policy issues and has not developed its own research portfolio.

- *determine the feasibility, methods and cost of safe long-term storage of greenhouse gases created by power generation and by hydrogen manufacture for fuel cell technology;*

Greenhouse gas capture and storage is a major focus of research for government, academia, and industry. Several major initiatives in clean energy technologies, through the Education Investment Fund scheme, also focus on carbon sequestration and storage. Geosciences Australia and state geological surveys all have major initiatives in greenhouse gas sequestration. The Cooperative Research Centre for Greenhouse Gas Technologies (CO_2-CRC), a joint venture among industry, universities, and research agencies in Australia and New Zealand, has also focused on carbon dioxide capture and geological sequestration.

More recently, the Queensland Government established ZeroGen, a government-industry-academia joint venture to accelerate the development and deployment of low emission coal technologies.

- *determine a sustainable rate of use of groundwater. Specific initiatives are: to determine the rates of water withdrawal and resupply, the age of the groundwater, the climatic conditions prevailing when it was supplied, its residence time in the aquifer, and the effects (e.g. subsidence) of its withdrawal.*

4. That government agencies support a program to:

- *assess the quality, quantity and accessibility of sand, mineral and stone for the building industry near cities and sites of coastal development;*
  This recommendation has not been implemented and the assessment of the quality, quantity and accessibility of sand, mineral and stone for the building industry near cities and sites of coastal development is still carried out in an ad hoc way, with no concerted effort uniting industry, research organizations, academia, and government agencies.
- *determine the residence time and resupply rate of Australian soils;*
  Limited studies on the residence time and resupply rate of Australian soils have occurred as minor components of ARC Discovery projects, CRC LEME focussed research, and collaboration with international researchers working in Australia.
- *determine the extent and effects of dryland salinity in cities;*
  Limited studies on the effects of dryland salinity in cities have been carried out by the CRC LEME, and state geological surveys and natural resources departments.
- *identify building material and other resources and plan their extraction before they become inaccessible as a consequence of land-development;*
  This recommendation has not been implemented in any systematic way.
- *compare past changes in climate and ecosystems with the present effects of human occupation;*
- *determine what, if any, geological conditions were required to help ecosystems to recover and for natural origination of new species and investigate if such conditions can be recreated to sustain Australia's biodiversity;*
  The two recommendations above were implemented as a major initiative through the National Collaborative Research Infrastructure Strategy (NCRIS) for the 2005-2011 period - Terrestrial Ecosystem Research Network (TERN)
- *quantify possible climatic changes and their effect on supplies of surface water. Specific initiatives associated with this strategy are to determine the range of climatic change in Australia recorded in the recent, deep time, rock record and its effect on water supplies, determine the rates of climatic change in the recent rock record, and compare the results with present climate change to predict rate and magnitude of change in future water supplies.*

5. That government agencies support a program to:

- *investigate the enhancement of soil production and the creation of artificial soils; and*
- *determine the interaction of surface water with the substrate. Specific initiatives associated with this strategy are to determine residence time of water on the surface of Australia and in surface storages, determine substrate type for dams and irrigation to quantify and predict leakage, determine present interaction of water with the substrate and its effect on water quality, and predict interaction with eroded, and possibly salty, substrate to determine water quality in the future.*

  This recommendation has not been implemented in any systematic way.

Goal 4: Wealth

A wealthier Australia through discovery of new clean energy and mineral resources that fuel national and regional economies

Critical factors

1. Increased investment in developing pre-competitive information and data to stimulate resource exploration to find and develop large new mineral and oil deposits and provinces (NRP 1 and SO 1, 4).

2. New investment in Australian tertiary geoscience education, research and training systems to develop world's best facilities and global outlook that will support the exploration industries (NRP 1 and SO 1, 3, 5).

3. Introduction of new government initiatives, especially through R&D programs, that encourage development of prosperous and competitive resource service industries in Australia and overseas (NRP 1 and SO 1, 2).

4. A program or series of new initiatives that build awareness in the community and amongst decision-makers about the opportunities for geoscience to create great wealth for Australia (NRP 1 and SO 4).

5. Maximisation of Australia's ability to use geosequestration of carbon dioxide as an asset (NRP 1 and SO 4).

Recommendations:

The NCES recommends the following.

1. That ARC and government research agencies support a program to:

- *ensure seamless access to digital geological, geophysical and geochemical data regardless of State and Territory boundaries and offshore-onshore divides. Specific initiatives associated with this strategy are:*
    - *to promote exploration through improved pre-competitive information*
    - *including new regional gravity, magnetic, radiometric and reflection seismic datasets and their interpretation,*
    - *to audit existing geological maps and prioritise the ones for new mapping and upgrading, and*
    - *to develop and adopt national standards for the acquisition, digital conversion, storage, manipulation and online retrieval of all such data;*
- *develop new geochemical, geological and geophysical technologies, particularly gravity, magnetics, seismic and electromagnetic, for Australia's unique conditions to detect covered and deep ore-bodies;*
- *support a critical mass of researchers in Australia's world-class economic geology and exploration geoscience research centres;*
- *determine the 3D basin evolution, tectonics, structure and sedimentary fill for Australia's poorly known offshore basins, to assess prospectivity. A specific initiative associated with this strategy is to:*
    - *model the hydrocarbon generation, 3D migration and entrapment in offshore and onshore basins, particularly in frontier regions.*

- Substantial progress has been made towards these goals through continuing geophysical data (magnetic, radiometric, gravity) acquisition programs by Geoscience Australia (GA) and the State/Territory geological surveys that are substantially upgrading the quality and resolution of the national coverages. GA is also undertaking a major program of targeted wide-spaced AEM surveys with infill data funded by companies.

- Major advances include release of two major new national datasets with wide application - the seamless digital geology of Australia (compiled by GA in partnership with the States/NT) and the first national radiometric map and grid prepared by GA .
- The Predictive Mineral Discovery CRC and the CRCLEME (both concluded June 2008) made substantial contributions to knowledge on the distrubtion and regional and local controls on mineral deposits and developed new methods and tools for mineral exploration.
- The Minerals Down Under Flagship (CSIRO) is focussed on developing new technology for advanced mineral processing and discovery under cover.
- Continuing ARC CoE funding for CODES at the University of Tasmania
- The new CRC for Deep Exploration Technologies has been stabilised to support enhanced mineral discovery especially under cover,

2. That government agencies support a program to characterise the geological provinces of Australia. Specific initiatives associated with this strategy are to:

- *develop a regional scale understanding of the formation of mineral provinces;*
- *define areas to explore for mineral deposit types that are known elsewhere in Australia; and*
- *define terranes in which to explore for ore types currently unknown in Australia.*

The Predictive Mineral Discovery CRC made substantial contributions to knowledge on the distribution and regional and local controls on mineral deposits. Regional geological and minerals potential assessment by GA and the States/NT is ongoing.

3. That ARC and government research agencies support a program to enhance exploration for oil and gas. Specific initiatives associated with this strategy are to:

- *identify productive source rocks in frontier regions and understand the timing of oil and gas generation, and*
- *apply 3D visualisation and new technologies to extend existing oil and gas fields and trends.*

Funding to Geoscience Australia for the Onshore Energy Security Prgram and off-shore exploration has contributed to these goals, but is not on-going.

4. That ARC and government research agencies support a program to determine the feasibility, methods and cost of safe long-term storage of greenhouse gases created by power generation and by hydrogen manufacture for fuel cell technology. A specific initiative associated with this strategy is to determine the viability of geosequestration of carbon dioxide in Australia.

Substantial progress has been made in the Carbon Capture and Storage field (CCS). Australia is the first jurisdiction in the world to release acreage for CCS exploration. The pioneering work by the CO2CRC includes the country's first demonstration of the deep geological storage or geosequestration of carbon dioxide. This project provides technical information on geosequestration processes, technologies and monitoring and verification regimes that will help inform public policy and industry decision-makers while also providing assurance to the community. The Otway project is of global significance, being the world's largest research and geosequestration demonstration project. Over 65,000 tonnes of CO2 have been injected and stored in a depleted gas reservoir deep underground and further injections into different formations are being planned. It includes a monitoring program, which international and national scientists believe to be the most comprehensive of its type in the world.