The Rio Tinto Foundation for a Sustainable Minerals Industry

Annual report
January 2006 – 30 June 2007

Rio Tinto

Overview - A government and business research and development alliance

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The Rio Tinto Foundation for a Sustainable Minerals Industry was established in 2002. The Foundation reflects Rio Tinto's commitment to the Australian Government to find ways in which the minerals industry can contribute to sustainable economic development.

The Foundation supports research and technical development that will help the minerals industry to meet environmental challenges. Equally, it supports projects that address the social and cultural effects of resource development on isolated communities.

The aim is to develop practical innovations. To this end, the Foundation conducts a variety of programmes using Rio Tinto staff and links to researchers and technology providers around the world.

The Australian Government is funding the Foundation with a loan of $35 million, with Rio Tinto contributing a similar amount. The Foundation commitment was agreed as part of the Australian Government's assistance for the establishment of the Yarwun Alumina Refinery in Gladstone, Queensland.

Foundation objectives were met in 2007 when expenditure on approved commitments achieved the target level of $70M. This, therefore, is the final report on RTFSMI activities.

For an abridged version of this report go to www.riotinto.com

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Chairman's report

This report covers the final 18 months of the Rio Tinto Foundation for a Sustainable Mining Industry which formally concluded in mid 2007. It is a larger document than its predecessors because it gives a brief description of all the projects that the Foundation has funded in its five year existence.

The challenge of making the minerals industry a contributor to a sustainable global society is immense. No one pretends that the Foundation has done more than encourage the industry to undertake what will be a long and arduous journey. However, there is no doubt in my mind that the Foundation has helped Rio Tinto to take important steps in that journey. And, I am equally sure that the experiences of the past five years will be used to shape the nature and direction of Rio Tinto's ongoing efforts to conduct its mining and mineral processing activities in an increasingly sustainable fashion.

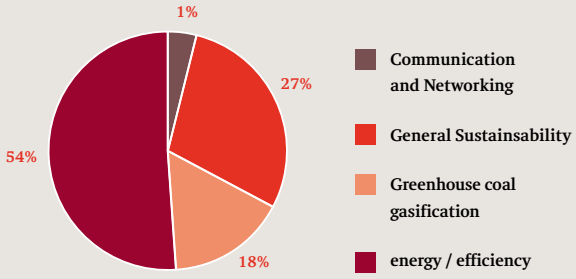
The Foundation was funded by a $35 million loan from the Commonwealth Government that was to be matched by a corresponding amount from Rio Tinto. As the Report shows, those monies were fully expended and Rio Tinto continues to fund a number of the ongoing projects.

You will also see that the Foundation has had some signal successes. These are gratifying, but it is the promise revealed by progress in some of the longer term projects that suggests that the Foundation's legacy will be felt for years to come.

Whatever successes eventuate from the Foundation they are due, in part, to the composition of its advisory board. I'd like to acknowledge the valuable insights provided by the eminent representatives from government, academia and industry. Their breadth of experience and objectivity helped anchor the Foundation's activities in the real world; a world that – while it recognises the need for economic growth and resource development – has other, very real, concerns and hopes.

This is also an appropriate time to thank the secretariat, led by the executive directors, and the members of the working group. The latter were drawn from across the Rio Tinto Group and it was their preparation of project submissions and reporting that enabled the advisory board to make sound choices.

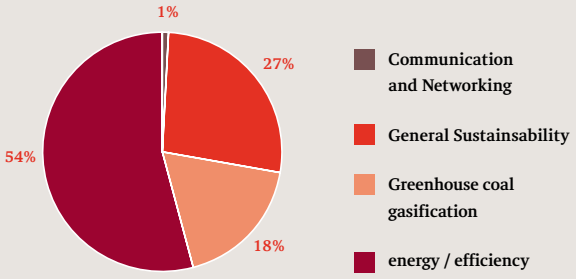
Where funds were allocated



Where project funds were allocated:

Foundation Loan Funded	$35,000,000
Rio Tinto Funded	$40,439,000
Total allocations	$75,439,000
Communication and networking	$2,500,000
General sustainability	$19,527,921
Greenhouse coal gasification	$11,033,780
Energy/efficiency	$34,879,391

Where funds were spent



Where project funds were spent:

Foundation Loan Funded	$35,000,000
Rio Tinto Funded	$36,793,000
Total allocations	$71,793,000
Communication and networking	$505,181
General sustainability	$17,922,957
Greenhouse coal gasification	$12,156,650
Energy/efficiency	$35,916,685

In reading the Report, one is struck by the variety of projects. Many, such as those to do with mineral processing or smelting, involve very large capital sums spent on complex technology. They are pretty close to the frontiers of science, and quite difficult for the non technologist to comprehend. Others, such as those that deal with water or energy management, or those that seek to mitigate the noise and waste that were once accepted as an inevitable consequence of mining, are easier to understand. Yet others that look at the relationship between the obvious economic and environmental consequences of mining and its less apparent long term impact on the social and cultural values of affected communities are novel. They are a belated acknowledgement that, ultimately, sustainability is a concept that requires a comprehensive approach.

If sustainable mining is to be a reality, miners will need to continue reinventing their industry – both in terms of its technology, and in terms of how the world views it. This will not happen overnight, nor will the transformation be easy. Nevertheless, that change must happen if generations to come are to enjoy the security and material comfort that the developed world takes for granted.

I think that history will show that the Rio Tinto Foundation for a Sustainable Minerals Industry, in its short existence, served to concentrate the effectiveness of a global company's efforts in this vital area. Moreover, through its collaboration with partners in Australia and overseas, the influence of the Foundation will be felt throughout the industry and, eventually, throughout society.

Charlie Lenegan
Chairman

I think myself privileged to have been Executive director of the Rio Tinto Foundation for a Sustainable Mining Industry for the past three years. I was able to build on the good work of my predecessor, Dr Mike Hollitt, and was in the role long enough to witness the changes that have expanded the original vision of those who conceived the Foundation.

The task of the working group has been to vet the projects proposed by Rio Tinto's operations in Australia. The working group has examined the contribution those projects might make to increasing the sustainability of our industry. After screening for practicality, fit with agreed sustainability criteria and potential return, the best were presented to the Foundation's board. Those that were eventually chosen and funded by the Foundation have been carefully monitored, assessed and reported on at regular intervals. This has been an onerous and exacting task carried out by busy people with major responsibilities outside the Foundation.

I would like to express my gratitude for their sterling work.

The Foundation's working group and secretariat represent the administrative machinery that makes possible the scientific, technological and other advances that are the Foundation's justification. Yet, the very act of bringing together experts from throughout the Group's businesses for a common purpose, itself led to a heightened consciousness of sustainability and issues such as climate change.

Everyone involved in the organisation of the Foundation's work has, I think, learned from the experience. We have returned to our work places with a greater appreciation of the challenges our industry – indeed, the world faces. We have learned that sustainability has a human dimension. Our understandable concern for technological progress must not blind us to the importance of winning community support for our efforts. It was this appreciation that saw the Foundation's remit expand to include projects that required input from the social sciences.

The Foundation has spent and accounted for the funds allotted to it. A handful of projects returned a negative result and were terminated earlier than expected. Conversely, other projects opened up new lines of enquiry.

In November 2006, the Board was invited to a special ceremony to celebrate the opening of the world's first official HIsmelt® plant in Kwinana, Western Australia. HIsmelt® is a direct smelting technology that produces a premium product in a way that has significant environmental and economic advantages. Rio Tinto's research into this technology began a quarter of a century ago and it has been Australia's largest research and development project at a cumulative investment of around A$1 billion.

From its inception in 2002, the Foundation has recognised that HIsmelt® was a 'flagship' project, that is one where success has potentially global ramifications. This report contains a brief study of a research project aimed at enhancing the effectiveness of the HIsmelt® project carried out under the auspices of the Foundation.

It was particularly pleasing to hear the Foundation's contribution acknowledged at the opening, which was performed by the then Federal Minister for Industry, Tourism and Resources, the Hon Ian MacFarlane MP.

Not all the Foundation's projects have the scale or potential to put the industry on the path to sustainability that is embodied in HIsmelt®. Yet scale is not everything, nor is the size of an investment a dependable guide to the ultimate worth of a project. By strategic partnering with governments, universities, other research institutions, non-government organisations and civil bodies it has proved possible to leverage the Foundation's contribution.

I would like to conclude this final Executive director's report by expressing my thanks to the board members and to my colleagues on the working group and the Secretariat. And, I'd particularly like to thank the Rio Tinto project managers for their support.

Bruce Kelley
Executive director

Foundation structure and processes

The Rio Tinto Foundation for a Sustainable Minerals Industry is governed by an advisory board of six members, including one representative each from Government, academia and industry and three from Rio Tinto. The advisory board directs the Foundation in compliance with the Foundation's charter and rules.

The advisory board is supported by a working group that links into Rio Tinto's businesses. The working group prepares project submissions, ranking their contribution to sustainable development.

The advisory board meets four times a year to consider the project submissions from the working group. Individual reports on previously approved projects and the secretariat are reviewed and the project portfolio is assessed.

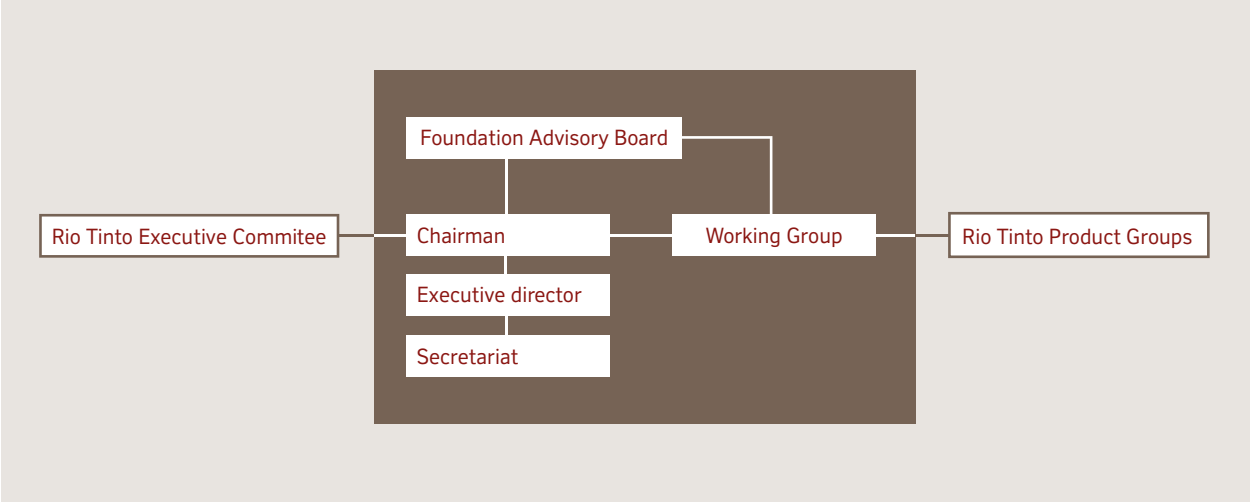
A secretariat, led by the Executive director, prepares advisory board papers, keeps records and compiles and prepares reports. The Executive director is not an advisory board member.

The advisory board allocates funds to the Foundation's projects. Rio Tinto's business units and the Technology group manage approved projects within guidelines and limits set by the advisory board.

Innovative project proposals having sustainable development merit that meet Rio Tinto's tests of business practicability are reviewed. Funding is reserved for projects with the best potential for producing positive impact and which best meet sustainable development criteria.

Government loan funding is allocated to qualifying projects that have no other form of Government funding. Rio Tinto contributions to collaborative projects for which Government funds are separately provided, for example Cooperative Research Centres, are recognised as part of the Rio Tinto expenditure contribution.

Each financial year the Foundation produces a report of its activities. The report is audited according to the requirements of the charter and rules of the Foundation.



Foundation advisory board

Mr Charlie Lenegan was appointed Chairman of the Rio Tinto Foundation for a Sustainable Minerals Industry in March 2004. Mr Lenegan is Managing Director of Rio Tinto Australia, responsible for Rio Tinto's corporate activities in Australia. Previously his responsibilities have covered the Group's marine business and Kelian Equatorial Mining as well as senior roles in Rio Tinto businesses in Indonesia, Australia and Zimbabwe. Mr Lenegan's directorships include Coal & Allied Limited, ERA Limited, Dampier Salt Limited and various industry bodies.

Mr John Ryan is Deputy Secretary of the Department of Industry, Tourism and Resources. His responsibilities included resources and energy policy, energy market reform and sustainable development. Previously, Mr Ryan was the head of Invest Australia, the government agency responsible for investment attraction and facilitation and head of The Industry Policy Division, responsible for policy advice on finance, taxation, small business, innovation and general industry issues.

Professor Vicki Sara is Chancellor of the University of Technology, Sydney. She is also Chair of the Australian Stem Cell Centre and a Director of the Australian Centre for Plant Functional Genomics and the Australian Institute for Commercialisation. She is a Fellow of the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering. She has been Chair and Chief Executive Officer of the Australian Research Council, Vice-chair of the OECD's Global Science Forum and a member of the Prime Minister's Science, Engineering and Innovation Council and CSIRO Board.

Mr Bernard Wheelahan is chairman of the Bass Strait Oil Company Limited, Pacific Hydro Pty Ltd and The Council on Australian Latin American Relations. He is also deputy chairman of Transfield Services Ltd. Until mid 2003, he was the Chair of the Co-operative Research Centre for Sustainable Resource Processing. Mr Wheelahan has been a director of a number of companies and joint ventures including Normandy Mining Ltd., Shell Venezuela, Woodside Energy, Shell Australia, The Gribbles Group and the North West Shelf Gas Project Joint Venture.

Dr Robin Batterham is Global Practice Leader – Innovation of Rio Tinto. He joined Rio Tinto in 1988 following a research and management career in CSIRO. His qualifications are in chemical engineering and he gained his PhD from Melbourne University in 1968 where he is now also a Professor in the Department of Chemical and Biochemical Engineering. His current role covers emerging scientific and technical issues, external R&D and the delivery of major step change technologies into the operations. From 1999-2005 he was Chief Scientist of Australia and his leading role with the Government helped facilitate investment of an extra $8.3bn for science and innovation in Australia. Dr Batterham is presently President of the Australian Academy of Technological Sciences and Engineering (ATSE).

Mr Phillip Strachan is the chief financial officer of Rio Tinto Alcan. Phillip joined the Rio Tinto Group in 1981 and has held a number of positions at Hamersley Iron, Rio Tinto Aluminium, and in head offices in London and Melbourne. He was general manager Finance at Rio Tinto Indonesia for five years before being appointed to his present position in 2000. A Bachelor of Commerce and a CPA, Mr Strachan is a director of the Great Barrier Reef Foundation and a member of the National Executive of the Group of 100, an association of Australia's senior finance executives.

Directors' attendance at advisory board meetings in 2006-2007

Board Members	Number of advisory board Meeting Scheduled	Number of Meetings Attended	Number of Meetings Alternate Attended
Charlie Lenegan	4	4	–
Bernard Wheelahan	4	3	–
Vicki Sara	4	4	–
John Ryan	4	3	1
Phillip Strachan	4	2	1
Robin Batterham	4	3	–

Foundation working group in 2006-2007	
Mr Jonathan Moodie working group chairman	Chief adviser – Research and Development Technology & Innovation
Dr Bruce Kelley Executive director	Chief adviser – Environment Health, Safety and Environment
Mr Matthew Gurr	Marketing manager – HIsmelt® Corporation
Dr Ray Shaw	Chief adviser - Technical Opportunities Technology and Innovation
Ms Alexis Cairo	General manager – Communications and Sustainable Development Rio Tinto Aluminium
Mr Ian Head	General manager – Corporate Relations - Rio Tinto
Mr Andrew Stokes	General manager – Automation and Control Technology and Innovation
Mr Allan Jackson	General manager – HS&E Pilbara Iron
Mr Chris Lloyd	Manager Investment Projects, Resources Division Federal Department of Industry, Tourism and Resources
Mr Rod Dry	Manager – Technology Development – HIsmelt® Corporation
Mr Murray Swyripa	General manager –HS&E Rio Tinto Aluminium
Ms Meity Mandagie	Senior adviser – Rio Tinto Foundation for a Sustainable Minerals Industry

Outcomes of the Rio Tinto Foundation for a Sustainable Minerals Industry

This is the final Annual report of the Rio Tinto Foundation for a Sustainable Minerals Industry whose five year term officially ended in mid 2007.

When the Foundation started in 2002, it was a way for Rio Tinto to demonstrate to the Federal Government the minerals industry's commitment to sustainable economic development. That commitment, in turn, was instrumental in getting approval for the construction of the Yarwun alumina refinery in Gladstone, Queensland.

This is, therefore, an appropriate time to ask whether the Foundation fulfilled its purpose. Did it justify the investment of more than $70m, $35m provided as a loan by the Federal Government and the balance from Rio Tinto?

In 'Value Added by the Rio Tinto Foundation for a Sustainable Minerals Industry' at the end of this section, we have listed some of the benefits from the Foundation. The research on which that list is based suggests that the broad answer is yes. As you will read there, seven of the Foundation's many projects are already estimated to have made substantial savings. When projected, those savings exceed the total cost of the Foundation's establishment and activities.

Other projects will continue to completion, funded by Rio Tinto. They hold the tantalizing promise of making significant reductions in energy consumption and emissions in, for example, the smelting of aluminium and iron ore.

A handful of projects proved valuable insofar as they showed which paths not to follow. Yet others produced results that will benefit not only Rio Tinto Group businesses, but also other companies within the minerals industry as well as other industry sectors – farming for example. Ultimately, all Australians will reap the benefits. Nor will the knowledge and technology gains be confined to Australia. Many of the advances that take us closer to our goal of operating sustainably undoubtedly have global applications.

One of the reasons that it is not possible to quantify precisely how closely the Foundation has come to fulfilling its original charter is that, in its five year existence, the Foundation's view of what constituted a sustainability project evolved. At the start, the emphasis was very much on finding technological solutions to the challenge of mining sustainably. Projects focussed on minimising energy and water consumption, reducing emissions, pollutants, noise, dust and waste, as well as adopting a smaller operational footprint. Many of the projects resulted in economies that could be calculated as tonnes of CO_2e or hectares of land disturbed and gigalitres of water consumed. This meant that different approaches could be tested and outcomes compared. It soon became apparent, however, that the path to a sustainable minerals industry had to include the social and cultural impacts of resource development. In order for technological solutions to be effective, they have to be accepted by those whose lives they affect. It's now understood that winning public trust and acceptance is an essential part of any sustainability strategy.

The Foundation therefore began to balance its portfolio with a leavening of projects that examined the regional impact of operations on the wealth, health and well-being of its employees and neighbours.

Rio Tinto has always understood that technological research and development plays a vital part in keeping its operations globally competitive and profitable. It has, at any one time, numerous projects underway that are intended to improve some aspect of the Group's economic, environmental and social performance. What the Foundation did for a Sustainable Minerals Industry did was to bring many of these disparate projects into a single process that rated them and permitted some form of comparison. It helped to inject a sense of discipline and priority.

The fact that the board included eminent representatives from government, academia and other industries proved especially valuable in ensuring that proposals were subjected to a rigorous selection process by people with an unusually wide breadth of experience.

The multi-disciplinary working group, drawn from a range of Rio Tinto's Australian operations, was asked to select projects for the board to consider. In carrying out this task, the working group became a central repository of information and a point where knowledge of what worked and what didn't work was exchanged between Rio Tinto's internal product groups. This was a particularly timely development, given that it coincided with the rapid growth in concern for the potential impacts of climate change that occurred over the life of the Foundation.

The very existence of the Foundation drew attention to the importance of research within the Group. In some cases, this heightened profile helped a new project to get management support. Becoming part of the Foundation's portfolio was an assurance that a project would meet high governance standards, possibly build useful links with Government and external institutions, and be conducted in a prudent and rigorous manner.

Rio Tinto businesses do not want to lose the benefits that the Foundation has created. Therefore, we are examining ways that the Group's Sustainable Development Leadership Panel can maintain the impetus and focus created by the Foundation. Greater collaboration between business units and between Rio Tinto and other companies is one such benefit.

Another is the way in which the Foundation has helped operations to align their research and development more thoroughly to the theme of sustainability and the need to anticipate the consequences of climate change. And yet another, the realisation that the social and cultural impacts of resource development deserve the same analytical and long term thinking that marks the technical and environmental aspects of our businesses.

A quick survey of the case studies, project reports and snapshots contained in this report show the multiple fronts on which the minerals industry is waging its campaign to reinvent itself in terms of sustainability.

The Rio Tinto Foundation for a Sustainable Mining Industry may have concluded, but its influence will continue to be felt for many years to come.

Charlie Lenegan
Chairman

Value added by the RTFSMI

- For Rio Tinto and the wider Australian community:

- Environmental returns are estimated to be A$30 million to date.
- Social returns are estimated to be A$280 million for gross regional product and almost A$30 million for employment.
- Economic returns to Rio Tinto are estimated to be almost A$10 million to date, and over A$70 million once future returns are included. This is equivalent to approximately A$1.00 for every dollar invested in the overall portfolio, or A$1.40 for every dollar invested in the portfolio when environmental benefits are included.

- Across Rio Tinto:

- Identified opportunities to reduce greenhouse gas emissions by 400,000 tonnes annually and energy savings of 2.7 Petajoules.
- Devised a water management diagnostic currently being used on 30 sites.

- At the regional level:

- Help to improve the skills and find employment for 176 Indigenous people in the East Kimberley region of Western Australia.
- Trialled enterprise facilitation models at three operations.

- In aluminium smelting:

- Identified potential energy savings of between 10 and 15 per cent.
- Demonstrated a 30 per cent reduction in fluoride emissions.

- In iron ore:

- Demonstrated how to recover 1.2 billion tonnes of Pilbara iron ore currently situated below the water table.
- Found ways to reduce CO_2 emissions at the HIsmelt® direct smelting plant by between 50 to 90 per cent per tonne of pig iron produced.

- Across the resources industry:

- Demonstrated how to reinject mined water into an aquifer.
- Participated in the FutureGen Alliance that aims to build the world's cleanest, full scale fossil fuel power plant.

- Beyond the minerals industry:

- Promoted commercialisation of a floating module system that reduces evaporation from dams and water storages by 90 per cent.
- Promoted sustainable farming practices on land adjoining the Northparkes copper mine with the result that between 40-50 per cent of local farmers have adopted precision farming techniques.

- To Rio Tinto's sustainable development goals:

- The 'Excellence in energy management' project identified practical ways to reduce energy consumption and greenhouse gas emissions.
- The drained cathode cell projects and those associated with HIsmelt® identified ways to significantly reduce energy use and greenhouse gas emissions.
- The 'Excellence in waste management' project identified practical ways to reduce water usage at many sites.
- The floating module project, mentioned previously, has dramatically reduced evaporation losses at the Northparkes mine.
- The Argyle regional development and community economic development projects have contributed to a stable social regional environment.

Advanced energy efficient smelting technologies

Case study

Drained Cathode Cell Project

Aluminium smelting is energy intensive and contributes substantial green house gas emissions, particularly when using fossil fuelled electricity. Drained Cathode Cell (DCC) technology would enable aluminium smelters to make energy savings of between 10 and 15 per cent and reduce other greenhouse gas emissions.

The RTFSMI approved $8.5 million for the first stage of the DCC project, which started in 2004 at the Rio Tinto Alcan (RTA) Bell Bay smelter. In July 2005, a further $9 million was approved for stage two. Foundation funding finished in September 2006, and the project has continued with RTA Smelting support.

The DCC project involves the development, testing and demonstration of aluminium reduction cells that have a much reduced energy consumption and, possibly, higher process intensity (amperage), than conventional reduction cells. A DCC loses less heat than a conventional cell because it has additional sidewall insulation, reduced molten liquid levels and has eliminated the aggressive metal pad/bath interface next to the sidewall of the cell. Voltage can be lower because a solid cathode is not prone to high and low frequency metal pad height fluctuations. It does not, therefore, constrain the anode to cathode distance (ACD) to avoid shorting. A DCC uses a special wettable coating that protects the carbon cathode from rapid corrosion by the molten bath.

The DCC project proposed to build two prototype drained cells in stage one using the existing coating formulation and isostatic pressing technology. Stage one also involved developing vibrocompaction technology to coat cathodes with the latest wettable coating formulations. Stage two plans involved building a further five DCCs using the vibrocompacted coatings to establish a small boosted amperage group of cells capable of providing reliable performance data.

As a result of delays in the design, construction and commissioning of the novel vibrocompaction press, the first four DCCs were manufactured using isostatic pressing techniques. The vibrocompaction press was recently commissioned and has commenced production of the first full specification Mk II design cathodes. Figure 1 shows the new vibrocompaction press.

Testing has demonstrated that eliminating the metal pad results in the projected heat loss savings. Cells can operate efficiently using much less energy, provided the coating and composite components remain undamaged.

As usually happens in highly innovative programmes like this, unforeseen issues, surprising results and problems have appeared. Some of these are very valuable and have taught us what works under the demanding conditions within a cell without a metal pad.

Other issues have arisen from changes in the external operating environment in the smelter. Sometimes, it has been difficult to determine the real cause of a particular event.

Nevertheless, the testwork to date has provided tremendous experience and insight to both drained and conventional cells. This understanding now covers such areas as:

- the impact of the cathode slope
- operation and design of high current density cells at minimal ACD
- operation and design of highly insulated cells
- the use of slotted anodes

Figure 1 : Recently commissioned large scale vibrocompaction press

To further improve the technology, work is now underway to:

- use the vibrocompacted composite coatings to produce a higher quality and better performing composite coating that will reduce cathode wear problems.
- improve metal and bubble drainage by changing the cathode shape.
- improve anode carbon behaviour to restore cell performance.
- modify the anode design to improve bubble drainage and bath flows.

Not all these initiatives can be completed in 2007. RTA will construct MkII a, b & c cells and develop a further prototype in 2007, incorporating some of the initiatives described above.

Composite development activities at RTA Technology and at the Bell Bay smelter have helped to explain the widely varying composite strengths produced within a monolithic component. They identified ways to increase composite strength without impacting its propensity to crack by optimising the binder composition. Material testing has recommenced in composite test cell four.

Despite setbacks and delays to the programme, the DCC team is confident that the above programme will resolve outstanding problems. Success would lead to a drained cell with practical operational features, reduced greenhouse gas generation (associated with a lower anode effect frequency) and significant energy savings.

TiB_2 coated cathode development

Titanium diboride has excellent wear resistance properties and can be used to coat conventional aluminium reduction cells. Increasing cathode life, reduces waste from reacted cathode linings in spent cells.

The project demonstrated the coated cell technology at the Rio Tinto Alcan (RTA) managed Boyne Island Smelter (BSL). The intention was to establish a licence agreement with a cathode supplier who would then supply coated cathodes to the industry. RTA installed coated cells on the BSL AP30 cells and assessed the merits of applying the technology to other RTA managed reduction lines.

The coating technology has been successfully tested on Kaiser P57 cells at the Bell Bay smelter and P69 cells at its Tiwai Point smelter in New Zealand. It has also been successfully trialled by a third party at the Voerde smelter in Germany.

When this project was proposed to the Foundation in 2003, two TiB_2 composite coated cells had been operating at BSL since 2001. This project involved building a further eight TiB_2 composite coated cells.

Overall, the performance of the BSL coated cells was unsatisfactory. The reasons were unclear and researchers conducted a series of three programmes to find out why.

In the first programme, two coated normal cells showed symptoms of operational instability and suffered from significant de-bonding and subsequent failure of the composite coating over a large area of the cathode surface. Investigations indicated that the failure might have been due to a weakening of the bond between the composite coating and the parent cathode material, possibly caused by a heating cycle associated with the casting of the collector bars.

The second programme planned to start-up a further eight cells without subjecting the composite coating to this heating cycle. Initially, cell stability was favourable. However, after six of the eight cells were started up, cell performance deteriorated and five were found to have suffered composite de-bonding from the cathode surface. It was postulated that oxidation damage that may have occurred during bake.

A different bake out process was used on the final two cells in the third programme. It utilised burners with much less excess air (stoichiometric combustion) and limited the maximum surface temperature during the bake to 850°C.

The last two cells started-up successfully using the alternative gas bake equipment, however, eventually these too developed high levels of instability.

Currently, six coated cells are still operating in Line 3. They are exhibiting higher instability and lower current efficiency than normal cells. Monitoring the remaining cells will continue.

Two cells failed through the sidewall prematurely. An autopsy showed that most of the composite had disappeared and most of the remainder had de-bonded. However, the cathodes had suffered very little erosion.

It is not clear why the composite failed to remain attached to the BSL cathodes when it was successful in the six cell Voerde trial using identical materials with a similar cathode length. The Voerde cells have a similar width but are considerably shorter than the BSL cells. Therefore, the problem may be the length of the cell and/or the width of the cathode. The fact that the BSL cells are magnetically compensated (the NZAS, Voerde and Bell Bay cells are not magnetically compensated) may explain the unstable operation when the composite is debonded.

This failure has implications for the drained cell programme. While the eventual aim is to retrofit coated cell technology to large, magnetically compensated cells, initial applications for drained cells are likely to be restricted to smaller conventional cells and purpose built drained cells (which don't require magnetic compensation) until this issue is resolved.

Anode current energy loss reduction

This project aimed to achieve voltage savings in the stub to carbon (STC) connection of the consumable anode in the reduction smelting process. The project exceeded the main objective of one per cent improvement in energy efficiency. Savings of 55mV were made at the Tiwai Point, New Zealand operation (NZAS) through a series of design modifications and process improvements. The power saving is translated into extra metal production and energy efficiency has consequently improved from 14.43kWh/kg to 14.26kWh/kg (2006).

The use of a common STC methodology across the group permits detailed comparative studies and gap analysis. Funds were approved to upgrade the RTA Technology laboratory to better understand the STC connection and to apply this knowledge to the cathode to collector bar (CTC) connection. Work on the CTC connection may deliver a further energy efficiency gain of about one per cent.

RTA smelters have used the STC measurement methodology to acquire baseline data and/or validate specific trial targets. Future work will automate the data collection, minimising both labour costs and the potential for transcription errors. Research is underway to incorporate fracture mechanics aspects into the finite element analysis modelling methodology, which will improve STC and CTC connection design.

Each site has been advised what STC connection improvements can do for their operations and the recommended path to take.

Inert anode fundamentals

This project examined critical issues relating to a combined inert anode /wettable cathode technology (Rio Tinto Alcan's TiB_2 composite) and to the electrochemical behaviour of cermet and metallic inert anodes. The aim was to identify whether the Rio Tinto Alcan (RTA) wettable cathode technology could be used with inert anodes.

The project found RTA's TiB_2 composite functioned satisfactorily as a wettable cathode in combination with an oxygen-evolving inert anode. RTA successfully tested composites as vertical cathodes (plates) between carbon anodes in the company's Bell Bay smelter.

Alcoa's cermet inert anode development programme has not resolved key technical issues. There has been little progress in developing metallic anodes so it has not been possible to trial this technology with external developers of inert anodes. However, the project demonstrated that RTA's composite cathode (flat, sloped or vertical) works and commercialisation will be pursued when an inert anode technology becomes available.

A second objective of understanding the electrochemistry of cermet and metallic inert anodes was partially achieved. Researchers gained a better understanding of the oxidation processes and concluded that an inert anode based on an oxide-coated metal or alloy was most practical for large scale systems. Some of the technology is currently being implemented.

The project showed that RTA composite cathode technology is suitable for use in inert anode/drained cell technology. RTA is making considerable progress with the drained cell. While inert anode development is stalled, it is probable that it will be developed and RTA is well placed to partner any developer of inert anodes.

Reports

Preheating and pre-reduction of iron ore and coal (Circofer project)

This pre-heating and pre-reduction project sought ways to treat coal and iron ore before injection into Rio Tinto's HIsmelt® ironmaking process. Pre-reducing the main feed materials improves overall process efficiency, lowers greenhouse emissions and increases hot metal output. When used in conjunction with the HIsmelt® process, this is a more environmentally responsible way of producing iron.

Outokumpu Technology's Circofer® is the preferred pre-treatment process. Circofer® uses circulating fluidized bed technology that is known to be robust and scaleable to large single-train capacities.

Outokumpu Technology's research centre in Frankfurt, Germany has conducted extensive pilot plant trials with various ores and coals. As a result, the core process is now well established. An ore/char separator was used to recycle char, thus providing an iron-rich product to feed to a smelting unit. Direct recycling of cyclone dust is currently being incorporated to further improve the process.

Options for commercialising Circofer® are under development. This technology's advantages include being able to use virtually any coal type - for example, normal steaming coals and low-rank coals. Since Circofer® is oxygen-blown, it lends itself to CO_2 capture and sequestration, which is becoming a key driver for its commercial implementation.

HIsmelt® multiple hot air blast lances

The steel industry is interested in an eight metre diameter version of the six metre diameter HIsmelt® plant at Kwinana, south of Perth. This involves scaling-up the Kwinana plant 2.5 times and raises questions about the use of a single, central hot blast lance, due to size and weight constraints.

An alternative is to use a number of smaller hot blast lances. The project investigated the benefits and the drawbacks of using multiple hot air blast lances as opposed to the single lance design.

The project was broken down into four elements:

- computational fluid dynamic (CFD) modelling to establish that multiple hot air blast (HAB) lances improve the HIsmelt® process.
- conceptual engineering and detailed design of a practical multiple HAB lance system for the smelt reduction vessel.
- using iterations of CFD and engineering to optimise design.
- identifying process efficiency improvements and changes to capital and operating costs.

Computational fluid dynamic simulation was a major part of this project. The team developed a scaled-up flow sheet and an eight metre diameter vessel design based on the HIsmelt®Kwinana plant, using the same raw materials and operating conditions. These conditions were used to stimulate a range of non-swirl and swirling multi-HAB configurations within the top space of an eight metre smelt reduction vessel (SRV).

The objectives of the project were met. CFD modelling of the multiple HABs compared to a single HAB for an eight metre vessel showed that:

- Multiple non-swirl lances provide comparable process performance to a single swirl lance at eight metre scale. The absence of swirl in the preferred multi-HAB case is significant. Alloy swirl vanes are susceptible to potential high temperature degradation leading to premature failure and poor process performance.
- Multiple swirl lances produce jets with insufficient downward momentum to generate the required heat transfer to the bath.
- Three or four non-swirl lances are likely to offer the most productive process design. Vessels with more jets do not produce the required heat transfer.
- The HAB jets need to point outwards toward the barrel walls to prevent the generation of a significant up-flow of hot process gas at the centre of the vessel.
- Inclination of the HAB jets from the vertical results in more efficient combustion of HAB oxygen, leading to higher metal productivity.

A typical CFD result is shown in the diagram opposite. Overall, CFD predicts slightly better process performance (2-3 per cent) for the multiple-HAB system compared with a single lance SRV. However, because this type of calculation involves uncertainties, HIsmelt® took the conservative option of assuming that both systems had the same process performance.

Quite apart from practical advantages afforded by easier maintenance and the absence of swirl vanes, cost analysis showed that multiple-HABs are around $US6m cheaper for an eight metre SRV. The height of the SRV building, for example, is lower due to reduced crane requirements.

As a result, HIsmelt® formally accepted the multiple-HAB approach as the best option for an eight metre SRV.

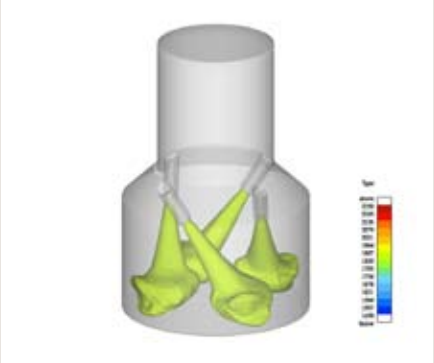
Patent rights that cover the orientation of multiple non-swirl HAB lances in a HIsmelt® vessel were filed in March 2006 as were patent rights directed to other aspects of the eight metre vessel design.

At the end of the HIsmelt® research and development facility phase of the HIsmelt® project, patents for an invention specifying the use of multiple HAB lances in a HIsmelt® vessel were filed.

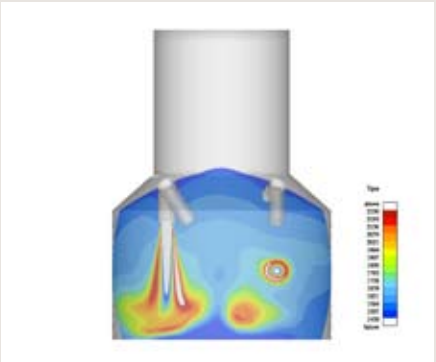
Multiple-HABs have been incorporated into the design of eight metre SRVs. Detailed cost estimates were developed for Kwinana, Australia in 2005. In addition, representatives of HIsmelt® have held discussions about licensing the eight metre plant technology with several overseas mills. Cost estimates were prepared for Chinese locations by January, 2007.

CFD Images

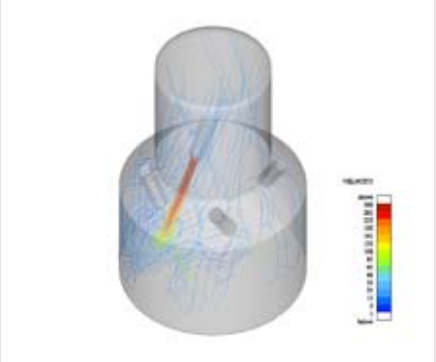
1 1900o C Isotherm of the multi-HAB



2 Temperature plot



3 Particle track



Snapshots

HIsmelt® collection, compression & sequestration of CO_2

This project looked at the costs and technical feasibility of collecting, compressing and geosequestrating CO_2 from HIsmelt®'s Kwinana plant. HIsmelt®'s Circofer pre-heat/pre-reduction module produces a CO_2-rich gas stream that lends itself to geosequestration. Such a combination would increase the energy efficiency of the smelter, reduce atmospheric emissions of CO_2 and assist the spread of HIsmelt® technology.

Progress has been made in establishing some capital costs and discussions have taken place with Geoscience Australia. One result has been to rule out onshore sequestration in favour of an order-of-magnitude study of the capital cost of offshore geosequestration. The outcome of this study, plus the resolution of some other issues, will determine the future of the project.

HIsmelt® hot metal utilisation in steel making

This project set out to develop HIsmelt® hot metal handling and operating practices for both the Basic Oxygen Furnace (BOF) and the Electric Arc Furnace (EAF) steelmaking routes. The goal was to maximise the benefits of HIsmelt® hot metal.

The HIsmelt® process results in many of the impurities typical of blast furnace hot metal being captured in the HIsmelt® slag. This produces a premium product but requires steel makers to change their production processes in order to realise the full benefits of the product. These benefits include:

- reduced oxygen consumption
- lower consumption of lime and dolomitic lime
- greater yield and productivity
- reduction in scrap usage of between five and ten per cent
- lower phosphorous
- improved refractory life of steelmaking vessel
- lower operating costs.

The project produced a series of integration solutions accredited by experienced iron and steel operators and engineers. These can be converted into specific engineering and process implementation studies that will assist the successful integration of a HIsmelt® plant with a BOF or EAF facility.

Funds applied to communications and networking project - to 30 June 2007

Project	Allocation	Expenditure
Integration with preheating process	$3,900,000	$3,695,828
CO_2 sequestration	$150,000	$61,263
Multiple hot air blast	$255,000	$1,250,000
Hotmetal utilisation in steel plant operations	$250,000	$250,000
Circofer pre-feasibility study	$2,000,000	$3,528,628
Drained cell technology	$18,155,000	$18,155,000
anode current energy loss reduction	$574,000	$549,014
Inert anode	$440,000	$528,204
Coated cell commercialisation	$925,000	$1,023,974
Total	**$26,649,000**	**$29,041,911**

Case Study

Excellence in energy management

The Excellence in Energy Management (EEM) project was set up to develop and apply diagnostic tools to identify and prioritise energy improvement opportunities across Rio Tinto operations and to monitor their implementation.

The aim was to develop and apply a rigorous process to manage and reduce energy use and greenhouse gas emissions for all Rio Tinto operations. The result was a process that systematically identified ways to reduce energy consumption and ways that such improvements could be sustained. The project dovetails with other Rio Tinto sustainability initiatives.

The key features of this EEM initiative are:

- Identifying energy related issues, using proven tools and an energy management diagnostic tool that engage management and operating staff at all levels. A systematic five-step approach ensures that the outcome is sustained.
- Identifying benefits and opportunities for improvement in energy efficiency through reducing power demand and the use of alternative fuels.
- Developing a database and case studies to demonstrate the effectiveness of energy and greenhouse gas reduction programmes.
- Sharing data and transferring experience and knowledge between business units.
- Changing the way energy use is considered and managed through effective training and awareness.
- Benchmarking across the Group and the industry to identify best practice targets.
- Establishing a comprehensive energy use and emissions breakdown across a business unit site in order to assess development impacts.

Since 2002, the project has tested an energy review methodology at a wide range of Rio Tinto sites in terms of both location and product. Product types have included aluminium, copper, gold and uranium.

The successful methodology has two distinct focuses:

- Managing energy and GHG emissions.
- Identifying technical opportunities to improve energy efficiency and reduce GHG emissions.

The EEM methodology is being used successfully at 36 Rio Tinto sites and its deployment continues.

At Rio Tinto, sites using the EEM process have identified energy reduction opportunities in the range of five to 15 per cent. These opportunities generally involve improvements to existing operating practices, or relatively minor capital investments with short pay-back periods. In total, the combined NPV of projects identified has been estimated at US$170 million. The associated annual reduction in GHG emissions is estimated at 403,000 tonnes CO_2 e.

Reports

Global energy technology strategy program – Phase II

Phase I of Batelle's Global Energy Technology Strategy Program (GTSP) established the key role that technology has in mitigating climate change risk while maintaining a healthy economy. Phase II of the GTSP brought together decision makers, scientists and technology experts from both the private and public sectors. The goal is to give an international perspective to priorities and risk management strategies when dealing with climate change.

In the first half of 2006, Batelle worked with the US Climate Change Science Program on a comprehensive revision of long-term global emissions scenarios. Batelle was also involved in the US Climate Change Technology Program and the formulation of a US national technology strategy. Among the areas covered were: energy efficiency, transport, and various aspects of the nuclear fuel cycle. Battelle also worked on the abatement of non-CO_2 gases and the value and process of energy R&D.

Core modelling and insights from GTSP II are completed. However, modelling continues in preparation for GTSP Phase III. A capstone carbon capture and storage report has been well received and another, dealing with modelling, technology R&D and non-CO_2 gases, as well as a general summary, is scheduled for mid 2007.

Rio Tinto distributed the carbon capture and storage report to relevant Australian State and Commonwealth Government departments, universities and to other interested parties. The GTSP remains one of the few integrated global climate change emissions abatement modelling programs. Its technological focus makes it particularly pertinent to the energy supply and end use sectors, and thus to the minerals and metal sectors.

GTSPII findings outline the magnitude and the uncertainty of the abatement challenge, the value of a broad technology portfolio in minimising abatement costs, and the cost benefits of research, development and demonstration projects.

FutureGen

FutureGen is an initiative to build a research plant with integrated CO_2 sequestration and hydrogen- based power production. The project is being developed by the FutureGen Industrial Alliance, Inc (an international, non-profit consortium of coal mining and coal-based utilities), with major funding from the U.S. Department of Energy. Rio Tinto Energy has been a member of the Alliance since 2002 and is represented on its board. Mattoon, Illinois was chosen as the site for the plant in late 2007- however, the U.S. DOE has indicated a desire to discontinue support for the project in light of the cost escalation seen in the power sector. The Alliance is currently seeking broad-based congressional support to continue U.S. federal government support for the project.

The project aims:

- to help the public understand carbon capture and storage (CCS) technologies.
- to validate the cost and performance of integrated near zero-emission coal-fuelled power plant technology.
- to establish groundwork for approaches to CCS siting and licensing, legal and policy considerations, CO_2 ownership and liability, as well as regulatory policies for measuring, monitoring, verification and siting.
- to provide practical insight into issues Rio Tinto customers will face when deploying CCS.
- to provide indications of the relative competitiveness of coal in meeting future energy demand.
- to share the cost and risk of advanced technology demonstration between the public and the private sector.
- to serve as a focal point for international collaboration on “zero emission” coal.

Snapshots

Funding – Cooperative Research Centre for Greenhouse Gas Technologies (CO_2CRC)

The CO_2CRC's objective is to develop, within Australia, the capacity to sequester CO_2 cost effectively. To this end, the CRC researches the logistical, technical, financial and environmental issues associated with capturing carbon dioxide from industrial systems and storing it in deep geological formations.

The CO_2CRC has ten industrial sponsors and the research participants comprise: CSIRO; Geoscience Australia; Curtin and Monash Universities and the Universities of Adelaide, Melbourne and NSW.

The CRC has been responsible for the successful development of the Otway demonstration project in Victoria – the first demonstration of CO_2 storage in Australia. It is also providing assistance to sequestration projects in Queensland and Western Australia.

Other achievements include: the benchmarking of capture technologies and the development of new capture solvents; research into deep saline aquifers and coal seam disposal, and the completion of the Latrobe Valley CCS study.

Having concluded the scoping studies phase of the Capture Program, the CO_2CRC is now conducting detailed studies of potential technologies.

Hydrogen generation and storage

This project was undertaken in collaboration with the University of New South Wales, the University of Wollongong and Monash University.

The purpose of the project was to develop better processes and new materials for the generation and storage of hydrogen. One part of the project examined the development of an improved titanium dioxide based material capable of direct photo-electrochemical generation of hydrogen.

The goal is a renewable energy resource suited for use in isolated locations where, currently, all fuel is imported. Another part of the project sought cost effective systems for hydrogen generation and storage suited to niche applications.

Progress so far has included the production of enhanced titania for solar photoelectro-chemical hydrogen generation, achieving good solubility of titanium in ionic liquids, and the production of a metallic coating. The latter is seen as an important finding and further research is being carried out.

Work continues on how best to use the improved understanding of titania structure and electrochemistry into a usable product and questions about multivalent titanium electrolysis have still to be answered.

HIsmelt® hydrogen production

This project, which began in 2003 and terminated in 2004, sought to establish whether HIsmelt® technology could be used to produce hydrogen using the Hydromax process.

The project terminated sooner than expected when it became obvious that HIsmelt® technology, as originally conceived, was not suitable for such production. However, HIsmelt® technology was shown to have significant value in a substantially modified and simplified Hydromax flow sheet.

As a result of these relatively early conclusions, some of the planned work, e.g. site planning approvals etc, was not considered necessary.

Another project outcome was an ongoing relationship with Alchemix, which gives that company the right to license HIsmelt®'s bath smelting processing and engineering technology for hydrogen or synthesis gas production.

Enhanced CO_2 biofixation via gene shuffling

The minerals industry's drive for "clean coal" energy production has driven investigation into carbon sequestration technologies. CO_2 biofixation in algae was considered a possible attractive alternative to geosequestration, particularly as the resulting biomass could be harvested and used as a fuel source in a power station, or converted to other fuels or products. Biological sequestration therefore potentially represented a process of providing carbon offsets for Rio Tinto coal, enabling coal sales to be maintained in a carbon-constrained economy. In addition, it was possible the technology could deliver a new business opportunity in renewable energy.

The RTFSMI project was an extension to a pre-existing Rio Tinto project that aimed to improve the productivity of microalgal CO_2 biofixation so that very large scale renewable energy production could be cost competitive with geological CO_2 sequestration as a CO_2 removal option. The project was a collaboration between Rio Tinto and Codexis, a subsidiary of Maxygen, a US-based biotechnology company specialising in gene shuffling. The original project had achieved some very promising yet unverified results, suggesting that new enzymes with a significantly increased CO_2 fixation activity had been identified in vitro. The RTFSMI provided the vehicle for conducting the additional research to either prove or disprove the alleged promising results. This extension project included independent analysis at the Australian National University to verify the performance of the faster CO_2 fixing enzymes. In the end, the results could not be reproduced which, although disappointing, was in itself an important outcome from the research work.

Pilbara wind power

This project looked at the feasibility of using wind generated electricity in place of diesel generated electricity or electricity from the grid. It involved establishing a network of recording stations and the systematic collection of data from October 2002 until December 2003. That data was used to carry out a conceptual study of using wind power at the Dampier Salt operations. Subsequently, a report was prepared on how wind power might contribute to the Pilbara region.

When the project concluded, on time and under budget, it had been established that wind power has the potential to be integrated into the Western Power grid. The major technical issue was finding aerogenerators sufficiently robust to withstand the high winds that have been recorded in the Pilbara.

Funds applied to sustainable energy projects - to 30 June 2007

Project	Allocation	Expenditure
Global technology strategy	$1,115,000	$1,012,735
CO_2CRC industry contribution	$1,400,000	$653,613
Hydrogen from metal bath reactor	$829,000	$829,000
Hydrogen generation and storage	$400,000	$445,006
Enhanced biofixation	$2,500,000	$1,981,113
Pilbara wind power generation	$186,391	$186,391
Excellence in energy management	$700,000	$703,086
FutureGen	$1,100,000	$1,063,830
Total	**$8,230,391**	**$6,874,774**

Case Study

Floating module cover system to reduce evaporation

Mine operations lose water through evaporation, especially from tailings ponds and water storage facilities. There is presently no simple cost effective method for reducing evaporation. This project aims to develop a cost effective floating module cover that will reduce losses through evaporation, allowing greater recycling and less reliance on new water.

The development stages of the floating module design have included:

- developing and testing a prototype module design as part of a PhD project to assess the module's stability and potential to reduce evaporation;
- developing small scale models of the floating module for wind tunnel testing;
- using a 3D flow model of the die used in the injection moulding to assist with the design of the full scale mould;
- building a full size die and welding machine for manufacturing the floating modules.

In December 2006, Rio Tinto commenced a twelve month demonstration trial of the floating modules at the Northparkes mine, in New South Wales. The demonstration trial consists of two water storage dams built side by side. One dam is a control and the other is covered with floating modules manufactured by Nylex Corporation Pty Ltd. The trial aims to:

- measure module performance (water evaporation, wind stability, material stability, water quality and the module restraining system);
- provide experience in handling the modules, and
- demonstrate the design to Rio Tinto business units and community, farming and government groups.

This trial also tested some modified versions of the floating modules in order to simplify the design and reduce manufacturing costs.

The demonstration trial to date has generated very positive results that indicate that evaporation in a floating module covered dam can be reduced by up to 90 per cent. This is equivalent to 50,000 L/day/hectare for the Northparkes mine site during summer. The modules have proved to be stable on the dam even during windy days. Their presence does not impede the collection of rainwater nor do they affect the quality of the water in any way.

In 2007, the NSW Minerals Council awarded Northparkes Mines its Environmental Excellence Award for the floating module cover system.

Negotiations have been completed with an Australian plastics manufacturer to license the commercial production and marketing of the floating modules. There is now a working die that can be used to manufacture floating modules. This will allow other Rio Tinto mines, as well as other industries and the wider community, to use the technology. The floating modules are being marketed internally via posters and brochures, collaborative forums and internal conferences. Marketing to the wider community is being done through conferences, reports in the local Parkes media and in mining journals.

Reports

Towards excellence in water management (EWM)

This project sought to develop diagnostic tools and a methodology that would identify and prioritise water management issues at Rio Tinto operations. Studies began in 2003 and concluded in 2006.

The result is a comprehensive approach that helps operations consider all aspects of water management systematically. The current approach to EWM is a result of three years of practical trials on a variety of Rio Tinto operations in Australia and overseas. It is currently helping 28 Rio Tinto operating sites to improve their water management by meeting water standards, water targets and align with the Rio Tinto Water Strategy. The EWM approach is also being applied at pre-feasibility, feasibility, planning and construction stages of new projects.

Applying EWM tools and thinking allows sites to manage water in a more sustainable, rational and cost effective way. Pilbara Iron operations, the Northparkes copper mine, Energy America's Jacobs Creek coal mine, Diamonds' Murowa project and Diavik mine and Kennecott Utah Copper operations have all held diagnostic and opportunity workshops and are implementing EWM in a range of projects. Some sites have developed water management plans or dynamic water balance models with predictive capabilities. Other sites have implemented action plans to improve water efficiency. As use of the EWM's toolkit spreads, the feedback from sites is analysed and used to improve its effectiveness.

Water reinjection at Yandicoogina

Many Pilbara iron ore deposits in the arid Pilbara region of Western Australia are below the water table and need to be de-watered. Discharging ground water into existing creeks is thought to affect the long term sustainability of the ground water supply.

A Yandicoogina iron ore operations project has investigated the re-injection of a portion of the dewatering discharge into an adjacent aquifer for potential re-use. The trial, which commenced in 2005, set out to assess the viability, constraints, economics and potential size of a re-injection programme from the Yandi JSE iron ore deposit under operational conditions.

The analysis, modelling and reporting for the trial were completed in December 2005. A dewatering strategy has been subsequently developed and was implemented in 2006. This is expected to help the development of dewatering strategies in similar hydrological environments.

Snapshots

Tailings management

Most water loss from a minerals processing operation occurs in the tailings and process water circuit through evaporation, seepage and entrainment. This project aims to develop tools to maximise the tailings circuit water recovery by optimising the thickener, pumping and tailings storage capacity.

The project is being carried out through a series of internal and external development projects. External collaborators include the CSIRO, the A J Parker CRC for Hydrometallurgy, the University of Melbourne and the Ian Wark Research Institute.

Rio Tinto operations in Australia and overseas providing practical assistance to the various research bodies include Bengalla (NSW), Greens Creek and Kennecott Utah Copper (USA).

Lake Lonsdale barrier trials

The aim of this project was to test the efficacy of controlling groundwater by the use of an injectable sealant system.

The project ran from March to November 2003. The technical challenges of reducing the permeability in the barrier, and improving the artesian conditions downstream of the Lake Lonsdale embankment, near Stawell, Victoria have been met. Wimmera Mallee Water was successful in achieving a complete reduction in artesian pressures at the lake by increasing the completion of the barrier from 87 per cent to more than 97 per cent.

Discussions were subsequently held with a number of Rio Tinto business units and other companies where the project's findings were thought relevant.

Funds applied to water Management and Control Project - to 30 June 2007

Project	Allocation	Expenditure
Subterranean barriers	$595,741	$595,741
Excellence in Water Management	$1,200,000	$1,271,830
Reducing evaporation losses	$200,000	$197,052
Tailings Management	$950,000	$1,684,495
Ion exchange	$65,000	$65,000
Floating Module	$1,123,588	$727,997
Reinjection of excess water at Yandicoogina	$502,250	$343,889
Total	**$4,636,579**	**$4,886,004**

Case study

Future Reef

The Great Barrier Reef is one of the world's most important natural assets. It is the world's largest coral reef ecosystem, stretching more than 2,300km along the northeast coast of Australia.

On an international scale, the Great Barrier Reef is much more than a natural showpiece. It poses many unanswered questions about our planet, making it a prime focus for scientific research. While little is known about the precise impact of climate change on the Great Barrier Reef, scientists do agree that coral reefs are being affected.

In November 2005, Rio Tinto Alcan (RTA) entered into a partnership with the Great Barrier Reef Foundation (GBRF) to support research-based initiatives to protect Australia's Great Barrier Reef.

Future Reef is a world first collaboration between industry and science in climate change reef research and is an active, $1 million, four-year partnership. The University of Queensland is the research provider and runs the Heron Island Research Station where the partnership's two programmes are based.

The first programme is a four year Ocean Acidification research project - the world's first significant investigation into the impact of increased concentrations of carbon dioxide (CO_2) in oceans and on the Great Barrier Reef.

The second is a four year employee programme. This initiative involves Rio Tinto Alcan employees from its Australian operations working alongside reef experts on Heron Island to collect data for the research project.

The Great Barrier Reef Foundation was founded in 1999 by business leaders seeking to mobilise private sector resources to contribute to the preservation of the Great Barrier Reef. It is the only fundraising body focused solely on the Great Barrier Reef and is committed to raising national awareness about both the value of the Reef and its fragility.

As one of the many businesses operating within the Great Barrier Reef area, RTA recognised the potential contribution of GBRF and joined as a founding member in 2000. The Future Reef partnership is the result of this long standing relationship.

Future Reef formally commenced in January 2006 when a team of highly experienced and respected marine scientists from The University of Queensland's Centre for Marine Studies began preparing their Heron Island Research Station headquarters for the research programme.

Scientists spent most of 2006 building new reef mini-environments, or mesocosms, in 2000 litre aquariums. Here they are varying carbon dioxide levels in the aquarium water, to simulate changing ocean acidification. They are also monitoring what happens to coral and other marine life as acidity changes.

In addition to the research programme, the employee programme commenced in March 2006 when the first group of 'Reef Searchers' visited Heron Island and participated in the research programme. The expedition gave employees an opportunity to learn more about climate change and thus encouraged them to drive energy efficiency across RTA's integrated aluminium business.

Two more expeditions followed in July and November of 2006 so that a total of 30 RTA employees have now participated in the programme.

In October 2006, the Future Reef partnership reached a significant milestone when it assisted the University of Queensland to secure a linkage grant worth $475,000 from the Australian Research Council. The grant has enabled the University's scientists to significantly expand the scope of the research project into the impact of ocean acidification on the Great Barrier Reef.

As the world's largest aluminium producers, Rio Tinto Alcan's footprint in Queensland is almost exactly aligned with the Great Barrier Reef. The company ships its products and raw materials through the Reef and its main concentration of assets is located around Gladstone - the gateway to the Great Barrier Reef. Maintaining this access route is a fundamental business need for RTA.

By formalising a partnership with the GBRF, RTA has been able to establish and build relationships with key stakeholders to which the GBRF has access. The GBRF has a close working relationship with those organisations responsible for the reef as well as a network of organisations involved in the national response to climate change including government, science and industry groups.

In addition, the 'Reef Searcher' employee programme is providing RTA with opportunities to engage its employees in its long term emissions reduction initiatives. Programme participants are learning about climate change and its effects in a practical environment, encouraging them to implement improvement initiatives both at work and at home.

Other partnership outcomes include:

- making a real contribution to the sustainable development of the Great Barrier Reef
- benefiting the Australian community in a long-term, meaningful and lasting fashion
- delivering research that is relevant globally to the protection and preservation of reefs in a warming world
- providing an example of good practice between science and industry that will encourage others to form partnerships in the interests of sustainable development

The Future Reef partnership underwent an annual independent health check at the end of 2006. Results showed that the partnership and its two programmes are progressing well and meeting their objectives. Of particular note however, was the recommendation that the partners engage a part-time partnership manager to ensure Future Reef provides maximum benefits and opportunities to its partners. RTA and GBRF accepted the recommendation and the process of recruiting a suitable manager has begun.

Reports

Argyle Diamonds regional Development and participation Agreement

Argyle's regional development and participation agreement is intended to restructure the company's relationship with the people of the East Kimberley region. In particular, it aims to ensure that Aboriginal communities derive sustainable benefits from the mine. To this end the agreement deals with: increasing direct community participation in the operation; business development; localisation and partnerships to improve health and other social and economic indicators.

Argyle Diamonds wants Indigenous Australians to comprise 40 per cent of its mine workforce by 2008; a percentage roughly in line with the demographic composition of the region. In order to attain this goal, the company has invested heavily in educating and training Indigenous employees, who currently comprise 25 per cent of its workforce.

In 2003, Argyle Diamonds concluded an important partnership with the Commonwealth Department of Employment and Work Relations (DEWR) that committed the company to employing 150 trainees and apprentices over five years. The Government undertook to assist Argyle with a third of the salary and training costs. The benefits of this partnership extend to other businesses in the Kimberley in the form of a larger pool of skilled labour. It also helps Argyle to attain its localisation target of deriving 80 per cent of its site workforce from the East Kimberley. Localisation, in turn, will help the company to reduce its dependence on a 'fly-in fly-out' workforce.

Argyle employs a business development officer in Kununurra. Between 2002 and 2005 the company increased its expenditure on goods and services from nearly $10 million to more than $30 million. The multiplier effect of this expenditure encourages local business growth and attracts vital services.

The process of formally renewing the relationship between Argyle Diamonds and Traditional Owners started in 2001 and underpins Argyle's Regional Development objectives. Argyle and the Traditional Owners have worked towards a formal Participation Agreement that reflects respect and recognition between both parties and trust and commitment to an ongoing relationship.

This agreement is essential to sustaining the relationship between Argyle Diamonds and the Indigenous people of the East Kimberley. In 2005, the National Native Title Tribunal formally registered the Indigenous Land Use Agreement (ILUA) between the Traditional Owners and Argyle.

With the registration of the ILUA, the Relationship Committee of Traditional Owners became responsible for the implementation of the management plans and management of the Participation Agreement.

The various elements of the Regional Development Project – localisation, direct participation and business development – and the Participation Agreement and subsequent ILUA share a common philosophy. Each, in its own way, is helping Argyle Diamonds contribute to the sustainable development of the East Kimberley.

Argyle Diamonds extended stakeholder study

This project was an extension of the Argyle Underground Study. It looked at the global repercussions, economic and non-economic, that would result from mining underground at Argyle, as opposed to the impact of not going underground and thus shortening the life of the operation.

Moving to an underground operation required the approval of a variety of stakeholders: traditional owners; State Government agencies; the WA Cabinet; local communities and others. It was imperative that the company was able to demonstrate the impacts of such a move and the measures it intended to take to deal with them. The Sustainable Minerals Institute at the University of Queensland helped to develop a process to identify, evaluate and respond to potential impacts that involved key stakeholders. The University of Aberdeen similarly assisted in devising techniques to assess the financial impacts on stakeholders.

The study focussed on the consequences of closing the mine on the East Kimberley region; on India, and on Rio Tinto Diamonds and other Rio Tinto businesses. It concluded that closure would have significant economic and social effects throughout the Kimberley region. It also quantified the surprising proportion of the Indian diamond industry involved in cutting and polishing Argyle diamonds and the considerable economic and regional development impacts that would result from changes to Argyle.

It noted that closure would not only unfavourably affect Rio Tinto's position in the global diamond industry, but would also be likely to affect several other Rio Tinto businesses with interests in India.

The findings were included in the Argyle underground study. The 'extended stakeholder study' concluded when the Rio Tinto Board decided to go ahead with the Argyle underground project. Knowledge and methodologies from the extended stakeholder study have become a resource for the universities involved, as well as for Rio Tinto, stakeholders and the industry in general.

Spent aluminium smelter cell lining

Spent Cell Lining (SCL), a by-product of producing aluminium, is the inside lining of the electrolytic cells in which alumina is transformed into aluminium metal. It consists principally of carbon and refractory materials. After several years, the original cell lining deteriorates and the cells need to be taken out of service for lining replacement. The spent lining material is traditionally discarded as a waste material.

Spent cell lining has hazardous properties, which limit placement and re-use in other industries. Traditionally, SCL has been stored at aluminium smelters or treated to produce an environmentally benign landfill material.

Over the past three years, Rio Tinto Alcan and Cement Australia have worked together to demonstrate that cement can be made using calciner ash, a form of processed SCL. The results have shown that SCL is a commercially reliable feedstock for making cement that does not impact on product quality or increase emissions. The carbon in the spent cell lining is utilised as a fuel for the cement manufacturing process and the refractory components are fully incorporated into the cement. The hazardous properties of the SCL are rendered harmless during processing.

The project was undertaken in Gladstone, Queensland by Boyne Smelters Limited and Cement Australia Fishermans Landing plant using existing plant and equipment as far as practical. The processing of SCL into cement has operated continuously since the inaugural commercial delivery on 1st July 2004. Equipment upgrades are occurring at both sites to enable consumption of the annual generation of SCL from Boyne Smelters.

In Tasmania, Rio Tinto Alcan Bell Bay and Cement Australia Railton have also benefitted from the project. Both operations are collaborating to determine the best way to prepare, transport and process SCL into cement. This will differ in detail from the Gladstone application due to differences in SCL properties and in infrastructure. However, a trial in November 2006 has shown that SCL from Bell Bay can be successfully incorporated into cement at the Railton kiln, at rates that will exceed the annual generation of SCL at Bell Bay.

Although the Foundation project finished in 2005, Rio Tinto Alcan and Cement Australia will continue to work together to increase the amount of Spent Cell Lining processed into cement. The knowledge gained is also being used to support placement of SCL from other Rio Tinto Alcan smelters into cement. At Anglesey Aluminium in Wales, SCL has been commercially processed into cement since the start of 2006 and, in New Zealand, NZAS are working with Holcim at Westport and carried out a small trial in April 2007.

Sustainable mining towns

This project aims to make Rio Tinto towns more sustainable and to develop a strategic framework for company interaction with mine dependent towns.

For more than half a century, Rio Tinto has either built mine towns, or had a significant presence in certain existing towns. Within the mining industry there has been a trend to move away from so-called 'company towns' and to 'normalise' their administration. For historical and other reasons, Rio Tinto townships are at various stages in this progression and one of the aims of the project is to bring greater rigour to analysing how the company can best make this transition. At the same time, the project seeks to understand what factors affect the sustainability of such communities.

In order to help Rio Tinto make informed decisions, the project has looked at how 'normalisation' would progress in different circumstances; if the mining operations were to expand, continue as they do at present, or if they were to close. Research has therefore been commissioned into the history and circumstances of each community and the nature of the company's engagement.

Sustainability assessment studies have been undertaken that allow for current and prospective development. A comprehensive township normalisation assessment framework is being developed. It covers legal, economic, social, political and environmental issues and incorporates a range of scenarios, from rapid operational expansion through to mine closure. Finally, a summary of best practice in township engagement and sustainability is being compiled with accompanying recommendations. Ultimately, these findings will be incorporated into Rio Tinto business unit plans for town management.

Important Bird Areas in Australia

This project assists Birds Australia to identify areas of global importance for bird conservation in Australia. These Important Bird Areas, or IBAs, can be used in mine-cycle planning to minimise and offset threats to biodiversity.

When assessing the environmental impact of mines, there are few standardised measures that map biodiversity importance. IBAs are more comprehensive and flexible than the two statutory designations of protected areas and listed threatened species. BirdLife International has identified IBAs around the world as a standard of bird conservation importance and Rio Tinto has assisted BirdLife International in its work. The distribution of bird species is used as an indicator of biodiversity because these distributions have been mapped relatively accurately. IBAs have proved to be a rigorous tool for setting biodiversity priorities and they are used by a range of government, industry and non-government land-use planners.

In the first year of the Birds Australia project, the scientific criteria were revised to ensure best use of the Birds Australia Atlas of Australian Birds, scientific literature and expert knowledge. This is analysed to identify a suite of sites which conserve nearly all bird species. Many IBAs are irreplaceable remnants of threatened habitats; others are the best representatives of commoner habitats. Many IBAs are on protected land and the IBA designation supports specific management activities. Other IBAs are on private, leasehold or traditionally owned land. Their designation provides land-holders with opportunities to balance conservation with other land-uses. IBA designation is independent of government and has no statutory implications.

The project has now mapped IBAs in several regions of Australia and is receiving requests for these maps and the underlying data in order to help government biodiversity monitoring, academic research and the promotion of Indigenous business opportunities. When the maps are complete, they will become part of Rio Tinto's biodiversity planning tools for mine development, operations, rehabilitation and offset programmes. IBAs also provide a framework for engaging local communities in bird monitoring, revegetation and other conservation activities. Local communities in remote northern Australia could benefit economically from bird-based tourism, and opportunities to utilise IBAs to promote local businesses will be investigated. The IBA process combines science and grassroots knowledge, connects policy to action, and promotes flexible and practical options for conservation and sustainable activities in Australia's most important and precious places.

Northparkes Mines sustainable farming

The Northparkes Mines Sustainable Farming project aims to demonstrate the benefits and promote the sustainable farming techniques that Northparkes Mines conducts on its buffer zone land.

No till farming commenced at Northparkes in 1998. The RTFSMI project started in 2004 in collaboration with the NSW Department of Primary Industries (Agriculture) and Central West Farming Systems. The intention was to communicate the results of Northparkes farming systems to the NSW central west region through large scale crop management trials and cropping demonstrations.

Northparkes has combined several advanced farming techniques to develop a better farming system. Examples are: GPS guided no till farming, crop rotation, and full stubble retention with no stubble burning. Large scale native vegetation corridors are also being established. This project promotes a sustainable land buffer by applying best practice farming. Its success has inspired other farmers in the central west of NSW.

2006 was the driest on record at Northparkes, with only 166mm (average 530mm) of rain. Northparkes was one of the few farms in the region to harvest and sell grain and the Northparkes' wheat crop won the regional crop competition for 2006.

Northparkes held a field day on the farm in October to showcase the crops under severe drought conditions. The field day was well attended by farmers from across the region, the ongoing drought having increased interest in the system.

The project has created goodwill with both farmers and local government departments. Field days and private visits/tours are the main avenues of communicating the farming techniques to the community.

This project will continue as the farming system and soil health are continually evolving and there remains strong community interest in Northparkes Mines farming.

Ongoing term trials and larger demonstration areas are planned for 2007 and beyond.

Snapshots

HIsmelt® slag utilisation

Direct smelting of iron using HIsmelt® involves the addition of limestone flux to iron ore and low volatile coal. The process produces a high calcium content slag that also contains silica and alumina. This project aims to investigate the use of HIsmelt® by-product slag in industry and agriculture. The use of ironmaking slags can reduce the energy intensity of cement production.

Technology & Innovation has completed a review of the slag and its market potential. Results have been encouraging and many potential uses for HIsmelt® slag have been identified including; the cement industry, as a road base and agricultural applications such as soil remediation.

Slag characterisation testwork on synthesised HIsmelt® slags was carried out in conjunction with Tribovent Laboratories in Austria. This analysis of HIsmelt® slags demonstrated their potential as an additive in cement. The impact of adjusting chemical properties on cement strength was also examined.

During 2006, it was established that HIsmelt® slag could be used as a road base and positive results were returned from tests of leaching behaviour. The slag was also successfully dry granulated and it was shown that phosphorus in the slag was beneficial to cement strength under certain circumstances. HIsmelt® is currently in the process of patenting its slag for use as an hydraulic binder.

Reducing aluminium smelter dust and fumes emissions

The smelter emissions project was intended to reduce fluoride emissions at Rio Tinto Alcan, smelters through using reduction line monitoring and dry scrubber technology. The project's goals were to avoid non-compliance with legal limits and to meet internal targets.

Reducing line roof fugitive emissions and emissions from the reduction line dry scrubbing system requires improved process control and continuous monitoring. RTA smelters planned to install long path length laser monitors in all reduction lines and cross duct laser monitors on dry scrubber inlets and outlets, where appropriate. Improved measurement tools, plus the Lean Six Sigma process improvement methodology, gave management the means to tackle emissions and determine which projects gave the greatest return.

When the project concluded, long path hydrogen fluoride (HF) monitors had been installed on a number of reduction lines and, similarly, cross duct monitors had been installed on the inlets and outlets of dry scrubbers at the Boyne Island and Bell Bay Smelters. The work of installing and refining the monitors and bringing about other changes continues. Early in the project it became apparent that there were problems with the calibration of the commercially supplied monitoring instruments. RTA and the suppliers have worked together to eliminate these problems.

The measurement systems and the changes that result from the information they provided have allowed all RTA smelters to keep fluoride emissions within licence limits. While emission levels still fall short of internal targets, implementation of the changes identified as effective will see further reductions in fluoride emissions.

SODAR inversion monitoring

Blast vibration impacts are an inevitable consequence of large scale open cut coal mining. Although advances have been made in blasting control technologies, there are times when unusual weather conditions amplify air vibration (or blast overpressure), resulting in unacceptable impacts. These weather conditions are extremely difficult to predict without specialised monitoring equipment.

The project aims to establish an atmospheric monitoring and prediction facility to identify conditions that are likely to cause 'overpressure amplification' and the possibility of exceeding licence limits when blasting. The project will assist Rio Tinto Coal Australia staff to protect communities from unacceptable impacts during unfavourable weather. Without a specialised atmospheric monitoring system, it is difficult to ensure that blast overpressure is kept within acceptable limits.

The technology and resulting services will be available to all coal mining companies in the Hunter Valley. Additionally, the technology will be freely available to all Australian Coal Association Research Programme (ACARP) members throughout Australia.

Construction began in March 2006: The SODAR (sonic detection and ranging) and RASS (radio acoustic and sounding system) instruments have been installed and the former is now operational. There has been a delay in obtaining the radio licence required for the RASS instruments, which will delay final commissioning of the facility.

Real time noise and dust monitoring

This project aims to upgrade the effectiveness of existing dust and noise controls by developing a reliable 'real time' monitoring and feedback system to alert operational staff when intervention is required.

An effective alarm system is essential in order to limit false alarms. This project includes developing automated tools linked to key decision making factors to determine when to take action. For example, an alarm would not be created if a dust monitor on the windward side of the mine indicated a high dust level. Similarly, a noise with the predominantly high frequencies that are not attributable to mining would not trigger an alarm.

All of the monitoring and communications systems have been installed and their data is being logged to a database with reporting available online.

Fly ash utilisation

This project set out to document an analytical technique for classifying fly ash produced when coal is burned in power utilities. It also sought to improve understanding of how fly ash could be used in copper acid rock drainage (ARD) remediation.

The technical objectives of the project were met and Rio Tinto now has an improved characterisation tool for classifying fly ash, as well as an understanding of fly ash utilisation technologies. The company also has an increased understanding of the environmental and business consequences of using fly ash in the remediation of copper ARD.

These insights have been shared with a range of potential end users (ACARP, CSIRO, Ash Development Association of Australia and the CRC for Coal in Sustainable Development). It is expected that one or more of these organisations will undertake further development of the project's findings.

Jabiru region sustainability project

This project set out to create a shared vision of a sustainable future for the inhabitants of the Jabiru region, the site of Energy Resources of Australia Ltd's (ERA) Ranger uranium mine and the Jabiluka uranium deposit. Among other matters, the various stakeholders considered the options available when mining eventually ceases. The project was jointly funded by the Commonwealth Government, the Northern Territory Government, the Northern Land Council, ERA Ltd and the Mirrar people.

The project involved the collection of data, the identification of options and the compilation of a report. An implementation body, known as the Kakadu Community Development Service was created. The project terminated in mid 2004. It was judged to have created an effective collaborative forum, able to weigh options for the future of the town and region of Jabiru.

Funds Applied to Regional sustainability project - to 30 June 2007

Project	Allocation	Expenditure
Argyle regional development	$6,540,000	$5,690,415
Argyle extended stakeholder study	$150,000	$201,553
Community economic development	$1,000,000	$1,146,648
Sustainable farming	$33,600	$39,500
Jabiru sustainability	$200,000	$136,038
Kwinana waste management	$20,000	$4,300
Spent cell lining	$624,000	$895,983
Fly ash utilisation	$31,422	$31,422
Smelter dust and fume	$4,380,000	$2,974,812
Three Springs water study	$50,000	$24,658
Sustainable mining towns	$345,000	$345,000
Real time noise and dust monitoring	$1,170,330	$1,058,801
Sodar inversion monitoring	$193,400	$110,504
Important bird area	$153,590	$377,319
Total	**$14,891,342**	**$13,036,953**

Case study

Excellence in closure management (ECM)

The main purpose of this project was the development and piloting of a diagnostic framework and methodology (the "ECM diagnostic") to assist operations to develop and implement closure plans. The scope included developing "second tier" products to help operations to address gaps and opportunities in their closure planning.

The approach considered closure holistically; encompassing financial, operational, technical, environmental and social aspects of closure. Its implementation sought to deliver sustainable, positive post-closure legacies.

Early work on the ECM diagnostic (Phase One; 2004) focussed on developing a diagnostic methodology for evaluating closure plans and work programmes. The initial diagnostic framework benefited from broad cross-functional input.

The diagnostic was piloted at Weipa in December 2004 and feedback from participants indicated that:

- the diagnostic method was a useful framework for identifying gaps and risks;
- the workshop increased understanding of the Weipa closure plan and the key issues, and
- the results provided a basis for an improvement plan.

Phase Two, in 2005, aimed to develop and extend the ECM diagnostic method for broader application across the Rio Tinto Group. Improvements were made to the diagnostic methodology and supporting IT tool during early 2005, based on experience at Weipa.

More pilot studies were conducted at the Iron Ore Company of Canada (IOCC) and Energy Resources of Australia (ERA) during 2005 and the diagnostic method was further improved. The diagnostic was subsequently utilised at Bell Bay (Q3 2005) and Rio Tinto Coal Australia (RTCA) operations in the Hunter Valley (Q4 2005). These engagements marked the rollout of the ECM diagnostic as a robust, standardised, value-adding approach to closure planning.

Further opportunities to "fine tune" the framework and supporting software tools were identified in December 2005, with those changes made in January 2006. Throughout 2006, further diagnostic engagements were conducted at RTCA's Tarong mine and at Rio Tinto Alcan's Boyne Smelters. By year end, nine operating sites across Canada and Australia had used the diagnostic.

The development of "second tier" products to help operations to improve their closure planning occurred in 2005 and 2006. ERA developed such a second tier closure product in the form of a "road map" tool involving a generic risk-based decision tree method for prioritising and tracking closure studies and associated decision-making. In addition, guidance documentation was prepared to describe the process for developing a closure plan and cost estimate to meet the requirements of the Rio Tinto closure standard.

In Q4 2006, efforts turned to providing a common understanding of the closure study processes and level of scope definition expected in a closure plan at different stages of development (concept, pre-feasibility, feasibility), in order to underpin the ±20 per cent cost estimate requirement specified in the closure standard.

There are closure plan improvement programmes in place at most of the operations that have used the ECM diagnostic approach. At Weipa, IOCC and ERA, for example, the diagnostic outcomes contributed to the preparation of detailed action plans (and/or roadmaps) for updating existing closure plans. These three operations all subsequently committed to comprehensive work programmes under the auspices of newly created closure working groups.

Reports

Remediation technology development

It is estimated that there are tens of thousands of contaminated sites in Australia of which around 20 per cent are associated with historical mining areas.

Groundwater contamination, in particular, still presents serious technical challenges. In other areas, current science is inadequate so that risk assessments may be overly conservative or site characterisation and monitoring unreliable. Consequently, there are major public and industry funded R&D programmes in the US, Europe and Australia to develop and demonstrate new technologies for the assessment and remediation of environmental contamination. For more than a decade, Rio Tinto has recognised that R&D is essential to improve remediation methods and outcomes, and achieve sustainable risk-based land management. The Foundation has supported this work since 2003.

An important element of the programme is widespread collaboration with leading research groups in Australia, the UK and North America.

Monitored Natural Attenuation (MNA) can be a cost effective risk management approach for groundwater contamination. It has been employed successfully at several Rio Tinto sites since the mid 1990s but, because of the need to monitor and manage contamination over long periods, it is not suitable at all sites.

MNA was used to complete the clean up of an 800kL diesel spill from a buried pipeline at New Zealand Aluminium Smelters (NZAS) in 1991. Initial spill response and product recovery operations removed around 500kL from an aquifer by 1993. It was not possible to remove the remainder as much of the contamination was under buildings. While very small amounts of persistent phase separated hydrocarbons (PSH) are still present close to the original release point, natural attenuation has substantially reduced the volume of diesel remaining to less than 500L. Remediation is expected to be complete within a few years.

Current soil quality guidelines for phytotoxicity do not consider bioavailability and the range of Australian soil types. Rio Tinto supports a project at the University of South Australia (CARE CRC) to develop phytotoxicity guidelines applicable to Australian conditions.

Various grasses and leguminous plants have potential for phytoremediation of hydrocarbons in soil. Research at Flinders University, in support of field trials at Weipa and the Hunter Valley coal operations, has identified several candidate Australian native grass species. This project continues, with further studies of hydrocarbon degradation and the responsible microbial populations using these native species.

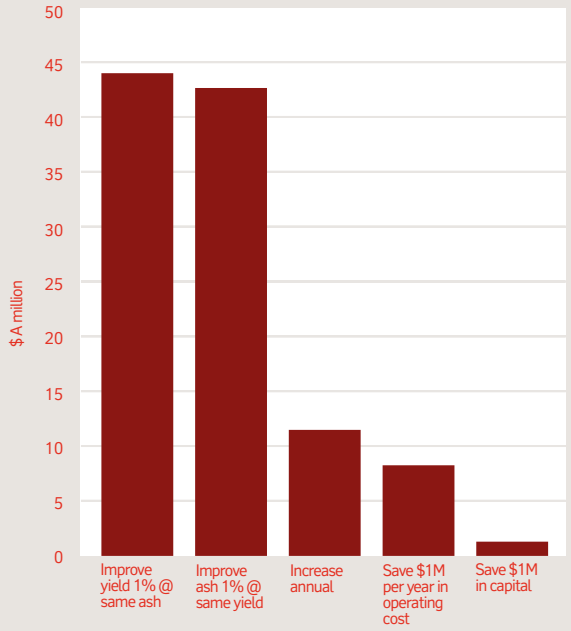
Several Rio Tinto legacy sites in Australia and North America have dense organic fluids in groundwater systems, a scenario recognised worldwide as challenging. The latest assessment techniques have been deployed to measure groundwater contaminant flux in Western Australia and innovative resistivity tomography was used to monitor in situ reductive dechlorination in Arizona. Recently, QMP, a Rio Tinto Group company in Canada, began marketing its iron powder for groundwater remediation in reactive barrier and other applications.

Metallurgical margin improvements (MMI)

In 2003, the Technical Services group set up a programme for establishing performance levels at Rio Tinto's mineral processing plants, with the objective of identifying ways in which the efficiency of the operation could be improved. The emphasis was on improving process plant performance at a technical level rather than simply cutting costs. An illustration of the leverage that process improvements affords is shown below for a coal preparation plant.

NPVs comparison of improvements

(10 years, excel interest, tax, depreciation, amortisation)
Key drivers: yeild, ash, ROM rate, operating cost, moisture, each case assumes other drivers constant.



The programme was referred to as Metallurgical Margin Improvement (MMI). Its core was a computer based assessment run in workshop sessions at four Australian mine sites – copper, coal (2) and iron ore. At each operation an action plan was developed for implementing major improvement opportunities identified and ranked by the MMI programme.

The economics of treating a block of ore are defined by the revenue generated as well as by the operating costs. MMI has the potential to redefine the boundaries between ore and waste as process improvements become embedded in operating and cut-off grade statistics. Perhaps the most enduring outcome of MMI was recognition of the need to revitalise technical performance at many mine sites. This contributed to the corporate initiative Improving Performance Together (IPT), which aims to embed operating excellence at all levels of the operation.

Gravity gradiometer

The purpose of this project is to develop, construct and field test an airborne gravity gradiometer capable of measuring components of the gravity gradient to a greater sensitivity than currently possible (by a factor of ten). This technique would improve exploration around existing ore bodies (eg Argyle) by overcoming the problems of restricted access, impact on the terrain and the limited sensitivity of the current equipment. It may also be made available to other exploration companies, government agencies and other parties on a contract basis.

The technology can be used in different aircraft types. The use of an airborne technology minimises environmental impact and allows large areas to be covered quickly. This leads to more efficient exploration and a reduced footprint. The gravity gradiometer output will be used in conjunction with other airborne geophysical techniques, such as magnetic or electro-magnetic mapping, to better understand the geology of a region. This results in a more robust determination of exploration targets.

The technology was conceived by researchers at The University of Western Australia and a collaborative project is underway to build an operating airborne geophysical instrument. Work is progressing on the first instrument and flight trials are scheduled during 2008.

Mining Marra Mamba ore below the water table

A large proportion of Rio Tinto Iron ore's (RTIO) resource base is made up of Marra Mamba deposits, with a significant proportion of these deposits below the water table (BWT). The below water table Marra Mamba material is estimated to account for around 1.2 billion tonnes of Pilbara Iron's resources. Rio Tinto Iron Ore has no experience of mining BWT Marra Mamba ore.

This project conducted pilot scale plant test work on a bulk BWT Marra Mamba ore resource (60,000t). The objective was to find sustainable ways to mine, handle and process the ore and manage the associated water balance. The test programme covered mining, crushing, wet screening, product dewatering, treatment of waste fines and re-injection of excess water into the bedrock groundwater systems. It compared different equipment and circuits so that the results can be extrapolated for the expected range of BWT Marra Mamba feed characteristics.

The work focussed on handling the ore and developing an innovative processing flowsheet. The aim was to extend resources, lessen the need to bring on new mines and maximise production from existing mine infrastructure.

The experimental testwork for the dewatering drew on the results of a previous dewatering trial at Marandoo in 2004 and the Foundation funded water re-injection project into pisolite ore at Yandi. However, these had only limited application for Marra Mamba deposits because of differences in the ore and the aquifers.

The project aimed at clarifying these aspects and minimising the potential to sterilise some of the State's resources. It was intended to demonstrate to stakeholders that RTIO is capable of taking a sustainable approach to Marra Mamba BWT mining.

The results of this study will be applied to future Rio Tinto operations. They will eventually become available to other mining companies. This project applies innovative techniques to dewater, mine and process BWT Marra Mamba iron ore. It enhances the sustainability of the iron ore operations and promotes best practice in water management, biodiversity and waste management.

Diesel fuel additives

This project demonstrated the effectiveness of a range of diesel fuel additives in increasing fuel efficiency and reducing greenhouse gas emissions from mobile plant across the Rio Tinto Group.

- The immediate objective was to test a range of additives on heavy vehicles under controlled conditions in order to determine how they affected fuel consumption, whilst assessing other effects on fleet operations.
- The testing programme aimed to establish the effectiveness of additives under a range of operating scenarios and to recommend their application across the Rio Tinto Group.
- The project incorporated data from previous trials and reviewed data and benchmarks so that results were comparable across the Group and against industry best practice.

The demonstration of significant fuel savings from additives led to the development of best practice tools and the transfer of experience and knowledge to Rio Tinto business units.

Technology and Innovation visited more than twenty Rio Tinto sites to discuss fleet and fuel management and the development of a methodology for fuel additives trials.

- Discussions with Kennecott Land Corporation, Rio Tinto Energy America (RTEA), additive suppliers and the Southern Research Institute led to the development of a suitable methodology, which formed the basis for a trial at the Jacobs Ranch coal mine in Wyoming.
- Jacobs Ranch completed a comprehensive trial that shows cost effective savings in diesel fuel from the application of the phosphamid based “DFC” additive.
- The trial demonstrated an overall reduction in fuel use of around 8.5 per cent with a number of additional benefits, including reduced exhaust emissions and a significant reduction in noise levels.

RTEA has introduced the use of the DFC additive to five of its operations and a trial of the same additive will take place on the diesel locomotives used by the Iron Ore Company of Canada.

The fuel additives project made a clear business case for their use. Although the project has concluded, more trials, of both fuel additives and biodiesel, have been approved.

Snapshots

Hunter Valley green offsets

Mount Thorley Warkworth has a Green Offset strategy, which was approved as part of the development consent conditions for the extension to the Warkworth mine in May 2003.

The extension application requested approval for open cut mining of approximately 566ha of land, comprising approximately 126ha of woodland, 186ha of open woodland/regrowth and 254ha of cleared grazing country. A total of eleven threatened fauna species listed under both State and Federal legislation were found to inhabit the woodland and open woodland areas. In addition, the extension area also hosts the Warkworth Sands Woodland vegetation community. In December 2002, this community was listed as an endangered ecological community under the NSW Threatened Species Conservation Act, 1995.

The Green Offset strategy was developed to compensate for the loss of habitat. It includes the protection and management of 758ha of land in non-disturbance areas and the management of 889ha of land in habitat management areas until the latter is required for mining.

The offset strategy also includes a contribution to research, a programme to promote regeneration and rehabilitation of woodland and ongoing monitoring, as well as the establishment of an advisory group to monitor and review implementation.

The Green Offset strategy is managed in accordance with the Warkworth Coal Mine Flora and Fauna Management Plan and Monitoring Programme (FFMPP), which has been approved by both the NSW Department Infrastructure Planning and Natural Resources and the Federal Department of Environment and Heritage. The FFMPP is required to be implemented for the life of the impact, which could be between 25-50 years.

Chalcopyrite heap leach

The aim of the project was to improve the economics of mining and processing chalcopyrite copper orebodies by rendering these orebodies susceptible to heap leaching. This technology could extend the life of mine reserves. Defining suitable leach conditions would enable in-place leaching of broken ore underground, resulting in reduced waste piles at surface and a smaller mining footprint.

The project established conditions for high copper recovery from chalcopyrite ores in columns and developed a way to predict the mineralogical capability for copper ores. The project also developed a costing and financial model to help define the most economic heap/dump leach scenario for this technology. The encouraging leach test results, together with the developments in mineralogical and computational fluid dynamics capability, encouraged further work to scale up the findings. The work will target potential applications, such as:

- heap leaching of chalcopyrite containing ores, enabling the use of more effective processing options and potentially enhancing the value of existing or new ore bodies;
- dump leaching of low-grade ores below the economic concentrator cut-off grade, thus extending mine reserves;
- in-place leaching of fragmented rock underground, which would provide an alternative platform to conventional mining and milling, reduce waste piles and have a smaller mine footprint.

Argyle underground project

This project was a pre-feasibility study of aspects of an underground operation at the Argyle diamond mine in the East Kimberley region of WA, which commenced in 2004. In December 2005, the Rio Tinto Board approved an A$1 billion underground extension that will extend the life of the mine to at least 2018.

The project looked at; the potential for reserve extension, waste reduction, use of renewable energy and a reduction in GHG emissions. It also looked at how the extension could be used to improve the economic health of the region, largely through supporting local employment, training, education and business development.

Argyle's Future Energy Study identified renewable energy supply options to meet the additional needs of an underground operation. Technical, financial and safety risks were similarly identified and mitigation strategies devised. A comprehensive risk register was presented to the construction team and will, in turn, be passed to the mine operations team.

Argyle's long term goal is to create a low impact world class underground diamond mine, with high levels of automation, that will support a sustainable future for the people of the East Kimberley. The underground project interacted with Argyle's other Foundation projects, namely the Regional Development and Participation Community Agreement and the Extended Stakeholder and Sustainability Study.

The Rio Tinto Sustainable Development Leadership Panel has asked Argyle Diamonds to develop the methodology used in this project for wider application.

Comminution efficiency

Comminution is the term used to describe the grinding of material to a fine powder in order to recover valuable components. The process is a major consumer of energy in the recovery of gold and copper ores.

This project, carried out in collaboration with the CSIRO, AMIRA, the Julius Krutschnitt Mineral Research Centre and Nottingham University, looked at ways to reduce that energy demand. Both incremental and large step improvements to the comminution process were investigated. Several successful applications have been demonstrated at Rio Tinto operations.

HIsmelt® improved solid waste management in Kwinana

This project sought ways in which the various industries located in Kwinana, an industrial suburb south of Perth, could collaborate in the minimisation and disposal of solid waste. In particular, it looked for ways in which one industry's waste might have an economic value to another industry. Through the Kwinana Industrial Council, a map of existing and potential process by-product synergies was constructed. Council members have decided that they will collaborate in developing uses for each others by-products.

International caving study

This long-term study of caving mechanics being conducted by the Sustainable Minerals Institute at the University of Queensland began in 1997. Stage three of the project, approved in March 2006, is intended to improve understanding of caving mechanics and rock flow. Ultimately, the project aims to promote block caving in order to reduce the land use impact and the energy demands of conventional mining methods.

Rio Tinto's collaborators include: Codelco; Newcrest Mining Ltd, BHP Billiton, Sandvik Tamrock, De Beers Consolidated Mines, LKAB, Xstrata and Orica.

Funds Applied to Mining, Mine Life and Remediation Project - to 30 June 2007

Project	Allocation	Expenditure
Communition efficency	$500,000	$769,896
Bauxite activation	$485,000	$78,000
Three Springs talc ore sorter	$1,100,000	$822,041
Chalcopyrite heap leach	$1,935,000	$1,950,542
Remediation technologies	$750,000	$864,665
Green offsets	$174,000	$106,891
Argyle underground	$200,000	$245,913
Cohesive material	$200,000	$0
Excellence in closure management	$482,780	$394,378
Metallurgical margin improvement	$769,000	$887,543
Solid waste management	$25,000	$25,000
Block caving	$600,000	$0
Gravity gradiometer	$3,600,000	$5,878,656
Diesel additives fuel trials	$213,000	$133,125
Total	**$11,033,780**	**$12,156,650**

Communication and networking

Funding the Sustainable Resources Processing CRC (SRPCRC)

This project supports the SRPCRC in meeting its objectives. These objectives cover a wide range of sustainability issues that are relevant to Rio Tinto including, over the next three to five years; improved operating efficiencies, decreased demand for energy and water; reduced waste and lower greenhouse gas emissions.

Among the organisations that collaborate with and support SRPCRC are: the CSIRO; the University of Queensland; Sydney University, Curtin University; ANSTO, and around twenty companies.

Funds Applied to Communications and networking project - to 30 June 2007

Project	Allocation	Expenditure
SRP CRC contribution	$2,450,000	$455,181
MCA workshop	$50,000	$50,000
Total	**$2,500,000**	**$505,181**

Partnerships in the Foundation

Partners and contributors in Rio Tinto's Foundation projects include:

Australia

ACMER (Australian Centre for Mining Extension and Research)

Alcan

Alchemix

Alcoa

Anglo Gold

ANSTO

APS

Arcadis

Ash Development Association of Australia

Australian Coal Association Research Program (ACARP)

Australian Cooperative Research Centre for Renewable Energy (ACRE)

Australian Minerals Industry Research Association (AMIRA)

Australian National University (ANU)

Australian Research Council (ARC)

Australian Workers Union

BHP Billiton

Cement Australia

Central West Farming System

Centre for Environmental Risk Assessment and Remediation (CERAR)

Chevron Texaco

Cleanteq

Commonwealth Department of Employment and Workplace Relations (DEWR)

Cooperative Research Centre for Coal in Sustainable Development

Cooperative Research Centre for Greenhouse Gas Technology

Cooperative Research Centre for Sustainable Resource Processing

Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CARE)

CSIRO (Land and Water)

CSIRO (Manufacturing and Infrastructure Technology)

CSIRO (Mathematics and Statistics)

CSIRO (Minerals)

CSIRO (Mining and Exploration)

Curtin University

DeBeers Consolidated Mines

Department of Industry, Tourism and Resources (DITR)

Department of Infrastructure Planning and Natural Resources (DIPNR)

Energetics

Flinders University

Geoscience Australia

Goldfields Revegetation

Great Barrier Reef Research Foundation (GBRRF)

Australia

Gundjehmi Aboriginal Corporation
Holcim
Hunter Coal Industry JV
Ian Wark Research Institute (University of South Australia)
Indigenous Community Volunteers (ICV)
Indigenous Stock Exchange (ISX)
International Network for Acid Prevention (INAP)
Itasca Consulting Group
Jabiru Town Development Authority
Julius Krutschnitt Mineral Research Centre (JKMRC)
Kwinana Industries Council
LKAB
Minerals Council of Australia (MCA)
Monash University
Murdoch University
Murray Darling Basin Commission
Natural Step Australia
Newcrest Mining Ltd
Northern Land Council
NSW Department of Agriculture
NSW Department of Conservation and Conservation.

Office of Indigenous Policy Coordination (OPIC)
Orica
RMIT University
Sandvik Tamrock
Schlumberger
Sustainable Minerals Institute (University of Queensland)
Sydney University
The University of Newcastle
The University of Newcastle Research Associates (TUNRA)
University of Adelaide
University of Melbourne
University of New South Wales
University of Queensland
University of South Australia
University of Western Australia
University of Wollongong
Western Australia Limestone
Western Power
Wimmera Mallee Water
Woodside
Xstrata

International

Alchemix
Arizona State University
Auckland University
Battelle Memorial Institute
Center for Agricultural and Rural Development, Iowa State University
Centre International de Recherche sur l'Environnment et le Developpement
China Energy Research Institute
Chinese Meteorological Administration
Codelco
Codexis
Contaminated Land: Applications In Real Environments (CLAIRE)
Council on Agricultural Science and Technology
Council on Energy and Environment (Korea)
Federal University of Rio de Janeiro
FutureGen Industrial Alliance
Greenwich University
Indian Institute of Management
Instituto Mexicano del Petroleo
Instituto Nacional de Investigaciones Forestales, Agricolas y Pecuarias, Mexico
International Institute for Applied Systems Analysis
International Network for Acid Protection
Japan Science and Technology Corporation

Joint Global Change Research Institute
McGill University
Moscow Energy Research Institute
National Center for Atmospheric Research (NCAR)
National Institute for Environmental Studies
Outokumpu Lurgi
Pacific Northwest National Laboratory
Potsdam-Institut fur Klimafolgenforschung
QED Occtech
SMS-Demag
Stanford China Project
Stanford Institute for International Studies
Tata Energy Research Institute
Texas A&M
The Tyndall Centre for Climate Change Research, University of East Anglia
Tribovent
University of Aberdeen
University of Arizona
University of British Columbia
University of Cape Town
University of Colorado
Universidad Nacional de Cordoba, Argentina

International
University of Illinois
University of Lund
University of Maryland
University of North Carolina
University of Nottingham
University of Oxford
University of Sussex
University of Wales-Bangor
VAI
Voerde

Reconciliation of funds

Reconciliation of Government Loan Funds			
Summary as at 30/06/2007:	**Notes**	**AUD 000s**	**AUD 000s**
Loan funds balance at 30/06/2007	1		35,000
Allocations:			
Approved expenditure		(35,000)	
Approved unexpended allocations		(0)	
Total allocated funds			(35,000)
Remaining funds available for allocation			(0)

Rio Tinto Contribution			
Summary as at 30/06/2007:	**Notes**		**AUD 000s**
Approved expenditure			(36,793)
Approved unexpended allocations	2		(3,646)
Total Rio Tinto Contribution			(40,439)

Notes	
Note 1: Government Loan Funds	**AUD 000s**
Balance brought forward at 1/7/2002	0
Advances to 31/12/2003	23,300
Advances from 01/01/2004 to 31/07/04	11,700
Loan repayments to 30/06/2007	0
	35,000
Note 2: Approved Unexpended allocation – Rio Tinto Funds	
Disbursement at 1/7/2002	0
Total Rio Tinto Funded projects approval	40,439
Approved expenditure	(36, 793)
Approved unexpended allocation	3,646

The Rio Tinto Foundation for a Sustainable Minerals Industry ("the Foundation")

Independent Audit Report to the Advisory Board of the Foundation

Scope

We have audited the attached funds reconciliation of the Rio Tinto Foundation for a Sustainable Minerals Industry, which comprises the statement of position of government loan funds, the statements of disbursements and expenditure from government loan funds and the Rio Tinto contribution, and the related notes, as at 30 June 2007.

The Advisory Board Members are responsible for the preparation of the funds reconciliation, and have determined that the accounting policies used are appropriate to meet the needs of the Foundation and the users of the funds reconciliation. We have conducted an independent audit of the funds reconciliation in order to express an opinion on its preparation and presentation. No opinion is expressed as to whether the accounting policies used are appropriate to the needs of the Foundation.

The funds reconciliation has been prepared for distribution to the Foundation for the purpose of fulfilling Rio Tinto's responsibilities as set out in the Charter and Rules of the Rio Tinto Foundation for a Sustainable Minerals Industry.

We disclaim any assumption of responsibility for any reliance on this report or on the funds reconciliation to which it relates to any person other than the Advisory Board of the Foundation, or for any purpose other than that for which it was prepared.

Our audit has been conducted in accordance with Australian Auditing Standards. Our procedures misstatement, whether caused by fraud or other irregularity or error. In forming our opinion, we also evaluated the overall adequacy of the presentation of information in the Annual Report.

The audit opinion expressed in this report has been formed on the above basis.

Audit Opinion

In our opinion:

- The funds reconciliation statement gives a true and fair view of the state of affairs of the Rio Tinto Foundation for a Sustainable Minerals Industry at 30 June 2007; and
- The funds reconciliation statement has been properly prepared for the Rio Tinto Foundation for a Sustainable Minerals Industry at 30 June 2007.

Steve Baker
Canberra Executive Director

21 January 2008

Declaration of Chairman and Executive director

The funds reconciliation statement and annual report give a true and fair view of the state of affairs of the Rio Tinto Foundation for a Sustainable Minerals Industry as at 30 June 2007.

Charlie Lenegan
Chairman

Dr Bruce Kelley
Executive director

30 May 2008

All images supplied by Rio Tinto.

For convenience only, the expression "Rio Tinto" is used to describe Rio Tinto plc, Rio Tnto Limited and their subsidiary and affiliated companies even though these companies are independently managed, separate, and distinct entities.

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