AMIRA International Limited
ACN 004 448 266 ABN 60 176 687 975
www.amira.com.au

Inquiry into Business Commitment to R&D in Australia
Submission by AMIRA International Limited
August 2002

This paper argues that the mineral industry is the major contributor to wealth in Australia, is a major generator and user of hi-technology, is Australia's only major global industry and that incremental R&D is a major contributor to commercialization. Extraction of economic value from R&D varies significantly from industry to industry and is poorly reflected in the ABS statistics. Consequently input measures such as BERD are an unsatisfactory measure of the contribution of minerals R&D to the Australian economy.

Overview

Australia is only a true global leader in one industry – Mining and Minerals. At $41.6 billion the Australian minerals industry accounts for 34% of total merchandisable exports. With oil and gas adding another 11%, the grand total for 2000/01 is $55.1 billion. Over the past twenty years, Australian mineral resources (mining, oil and gas) have grown by 512% - that is 25.6% per annum.

These figures compare favourably with other high profile Australian exports. For example, tourism exports accounted for $16.1 billion in 2000/01 and wine exports for $1.6 billion.

Whilst the ABS categorises Mining at 5% of GDP, this greatly understates the total contribution to the economy as the ABS mining break point, at the ore production stage, excludes ore processing and metal production. Consequently a mineral commodities break point including downstream processing would double the contribution to GDP.[i]
As a result of this narrow definition of mining, (in the ANZIC data collected by the ABS), the Business Expenditure on R & D (BERD) data as it relates to mining and minerals is flawed. This undermines the value of the inquiry as far as minerals research is concerned.

The ABS statistics do not capture the contribution of minerals related R&D to commercialisation in existing industries like mining and minerals particularly the contribution to exports, the value of using and generating R&D for commodity products, the linkages to small service providers and universities and the understanding that in a knowledge based industry like mining hi-tech also resides in the highly skilled workforce.

One area omitted from the mining data is services. Austmine estimate the domestic market for mining technology services to be $11.9 billion. In addition, mining equipment, technology and services account for $1.5 billion of exports from the Austmine group of companies alone. As this self-selected group accounts for about one third of the total companies servicing the industry, total exports again can be conservatively estimated at twice that figure. An example of these exports is that sixty per cent of all mining software used around the world is Australian.

Furthermore, the political emphasis on *product* and *product differentiation* as Elaborately Transformed Manufactures, and by implication the marginalization of commodity products such as minerals, masks the true contribution to the knowledge economy and knowledge networks from the mineral and resource industries which are great *exploiters and users of hi- technology.* By creating a demand for, and as a source and provider of new technology, the minerals industry is central to the 'new knowledge economy'. Far from '*exploiting* natural resources' the mineral industry *creates* wealth. It is not a gift from nature.

This is a major contribution to the wealth of all Australians and it continues to grow. Australian mineral, oil and gas assets now represent some 2.5 times the value in 1990[ii]. In addition, the industry is directly or indirectly responsible for some 240,000 jobs.

The success of the mining and mineral industries is underpinned by the continual development of new technology. According to the ABS in 2000-2001 'The mining industry recorded a 57% increase in R & D expenditure, reversing the trend of the previous three years'. In 1999-2000 it was $550 million, 14% of the total business expenditure on R & D. This 57% increase in 2000-01 contributed significantly to the highest level of BERD recorded (in dollar terms) and reversed the decline of the past four years. These figures are flawed as they represent annual fluctuations in an unrepresentative database. As far as can be established in the only definitive study of innovation in the minerals industry, the 1993-2002 trend in BERD for a wider definition of the minerals industry is down (unpublished data from Vandermark 2002). [iii] However, the overall contribution by the industry is underestimated.

What the decline in BERD does represent is an overall emphasis on extracting maximum outcome value from R & D expenditure rather than increasing expenditure as a percentage of sales. The mining and mineral industries have had a very strong lower-cost/efficiency focus over the last ten years, contributing to the outstanding productivity performance but necessarily including reductions in R & D. Nevertheless, in comparison with major competitors in Europe, South Africa and the USA, Australia has maintained a stronger R&D base and is the acknowledged world leader in minerals R & D.

AMIRA was created by the leaders of the mining industry in 1959 as the 'Australian Mineral Industries Research Association'. AMIRA quickly established itself as a broker, manager and facilitator of multi-sponsor collaborative research projects. AMIRA acts as the agent for industry sponsors whilst research is with Universities, CSIRO or other institutions. With globalization, AMIRA has become 'AMIRA International' a global association.

Whilst 47% of AMIRA International's funding in the year ending June 2002 was sourced from companies outside Australia, over 95% of the research was still in Australian Institutions. This reflects that the research is world class and hi-tech. Spillover effects are in disciplines which extend widely into other sectors of the economy.

Whilst attention in the 1980s was focused on new industry sectors such as Biotech, IT, new materials and aerospace industries, the gold industry exhibited spectacular growth to become a $*5 billion* export industry in a few years on the back of new technologies such as mineral processing chemistry, image processing and regolith geochemistry. This led to the exploitation of the eastern goldfields in WA with spin offs into new sectors such as environmental monitoring by remote sensing, start ups in aeromagnetics, software and instrumentation and digital data processing.

An example is the airborne EM TEMPEST system developed in Australia originally for minerals exploration but is now one of the most cost effective tools for measuring soil salinity mapping. The minerals industry employs more environmental scientists than any other private sector with spillovers into education, consulting and other service sectors.

Another example is in interfacial science and technology, underpinning research into mineral processing flotation and acid mine drainage but also fundamental to drug delivery, nanotechnology, bio-materials, ophthalmic lenses, polymer surface coatings and inkjet printing.

Yet another example is in Computational Fluid Dynamics, fundamental in developing energy efficient mineral processing but also relevant to health care, packaging, food, power generation and water treatment.

There are very many more examples.

Consequently, Australia's world class position in the sciences and disciplines relevant to minerals and resources has established a platform from which to launch into unrelated, new sectors of the economy. This is reinforced by the progressive environmental, community and social programs also developed by the industry in pursuing sustainability objectives.

Terms of Reference
Addressing some of the specific points raised in the Terms of Reference:-

- *Considerations by which major international corporations site R&D investment*
  Mining and mineral corporations site major research investment decisions on two main criteria: research excellence and ability to deliver outcomes and benefits. Cost becomes a factor when these criteria are met. In minerals related research, Australia is world class with an outstanding track record. Only South Africa has a more competitive cost structure but their research base is weaker than it was. Nevertheless, companies do like to support local research institutions to at least ensure expertise and personnel for the local industry. These considerations will be balanced in any funding decision.

  One significant cost advantage provided in South Africa and Canada is the competitive government leverage funding schemes available to researchers who obtain support from industry. These include THRIP (in RSA) and NSERC (in Canada) which can result in one dollar of funding for every dollar provided by industry for research undertaken in these countries.

- *What would be the economic benefit for Australia from a greater private sector investment in R&D?*
  The first consideration is to extract maximum benefit from the work already undertaken. Productivity gains from incremental and new technology in exploration, mining, mineral processing and engineering have all significantly contributed to the 512% growth in mineral resources between 1981 and 2001. However, it is not possible to disaggregate these data from efficiency gains made through improvements in work practices and capital investment.

  A second benefit is the encouragement for undergraduate students to continue post graduate research in appropriate industrial areas which not only offer potentially positive outcomes to the private sector sponsors of research but also provide a training ground for future engineers and scientists for the country. There is an obvious decline in quality students coming into these disciplines, to the extent that overseas students and qualified engineers are being sought.
- *What are the impediments to business investment in R&D?*
  Governments give the impression that their prime consideration is given to commercialization through start-ups rather than through major industries, of which mineral resources is the largest investor in R&D. Lack of useful data on commercialization through incremental research is a barrier to encouraging further expenditure and in establishing research priorities.

  The process of extracting economic value from new knowledge is different for different industries. Expenditure on R&D as a percentage of sales is an input measure that favours some industries, eg the life-sciences, but is not widely applicable. A comparison of the pharmaceutical with the mineral industries illustrates the point. 'Big Pharma' in the USA and Europe spends about 12-15% of sales on R&D however, the Australian pharmaceutical industry spends considerably less. Whilst the minerals industry overall spends a lower percentage, 1-5% of sales, Australian expenditure as a percentage is relatively as high or higher than elsewhere. It is also higher in gross terms. Consequently this measure distorts performance of Australian industry relative to its competitors.

  Business investment needs a range of government incentives and programs to reflect the diversity of new and existing business needs. A study across a range of new and old manufacturing industries (not just mining) conducted by AMIRA for the Business and Higher Education Round Table in 1999 showed that 'The R & D tax concession

was the most favoured Commonwealth Government support programme. Nevertheless a range of other support programmes is needed to address the varying needs of Australian industry. There is a clear preference for schemes that minimize bureaucratic administration and compliance costs'.[iv]

- *What steps need to be taken to better demonstrate to business the benefits of higher private sector investment in R&D.*

  It is always difficult to construct a linear relationship between R&D and profitability. What has been shown by studies in both the USA and Australia is that there is a cluster of good behavioural characteristics which demonstrate that companies with progressive management practices, marketing, work practices, financial management etc also invest in R&D. These companies regularly outperform the market. According to the Chief Scientist, 'The value of research to the 'bottom line' is underscored by an examination of the 'Market to Book Ratios' of leading chemical companies. The market values more highly those companies heavily investing in science and technology' (Batterham 1999).[v]

  Business is driven by useable outcomes, consequently good results from R&D are paramount. But in Australia not enough consideration is given to capturing the 98% of R&D that occurs offshore. The Australian mining industry is big, global and significant in its sector. If they do not do research in Australia, the options are limited elsewhere. This does not apply to other market sectors where technology can still be bought in more cheaply than discovering it through R&D. Enabling technology transfer would be one step towards encouraging greater uptake of R&D.

Dick Davies
CEO
AMIRA International
Level 9, 128 Exhibition Street
MELBOURNE VIC 3000
Ph: +61 3 9679 9993
Fax: +61 3 9679 9900

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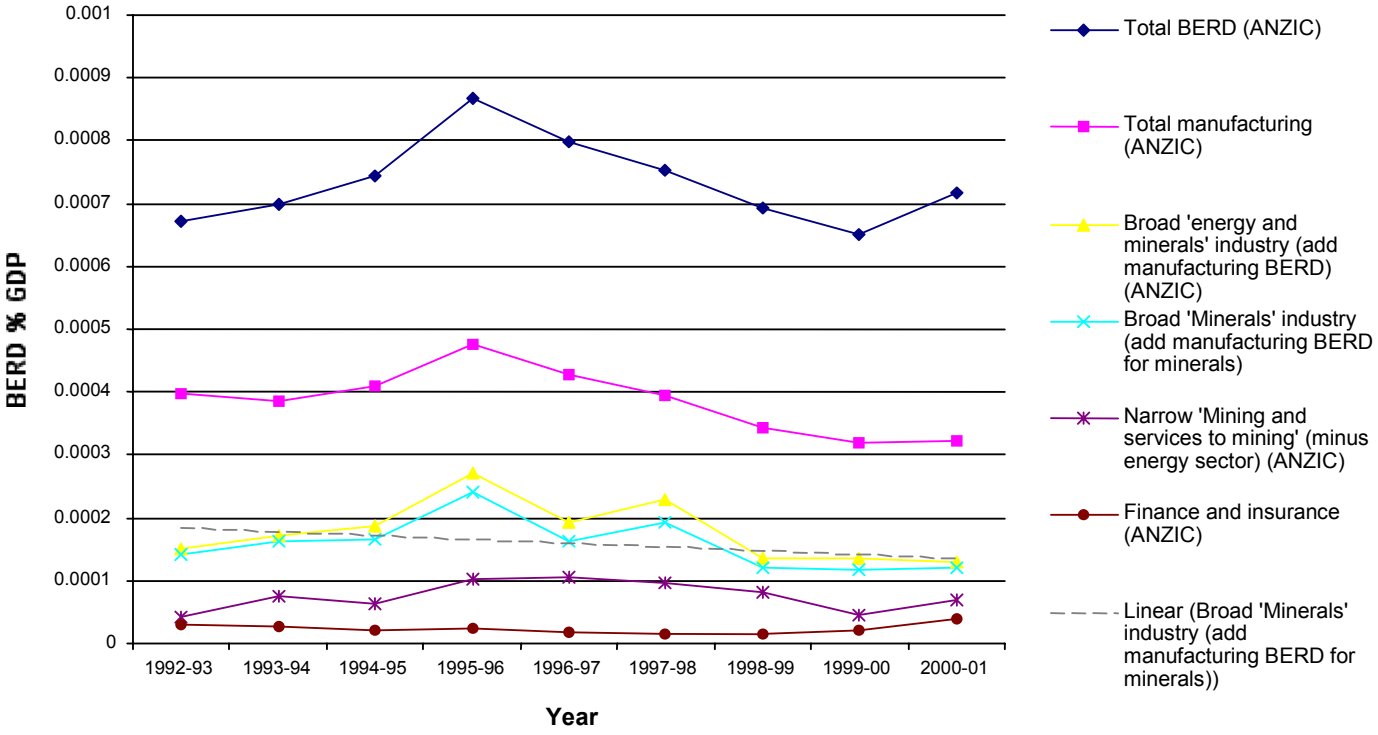
[i] Minerals Council of Australia, 1995, 'The Australian Minerals Industry'.
[ii] Stoeckel, A., 1999 'Our Wealth Down Under' Centre for International Economics 45pp.
[iii] Source: Vandermark SE., (2002) An Exploration of Innovation in the Australian Minerals Industry: An innovation systems approach PhD thesis.
[iv] (BHERT 1999, Survey of Benefits from Commonwealth Government Business Programmes).
[v] AMIRA Forum 'Milestones to the Future' 1999

Trend in BERD for wide and narrow defined Australian minerals industry (1992-93 to 2000-01)



Note: ANZIC data provided by Department of Industry. The data has not been revised by the ABS and there is a degree of unreliability when creating new aggregates.