

Vision 2040



Mining, Minerals and Innovation

A vision for Australia's mineral future



About the Mineral Futures Collaboration Cluster

This publication has been produced as part of the research funded by the Mineral Futures Collaboration Cluster. Researchers from the CSIRO Minerals Down Under Flagship and five Australian universities have formed the Mineral Futures Collaboration Cluster (2009-2012) to address future sustainability issues facing the minerals industry in this country. One of the Cluster's strategic goals is focused on delivering national benefit and ongoing licence to operate for the minerals industry in Australia through research into 'Commodity Futures', 'Technology Futures' and 'Regions in Transition'.

More information about the Mineral Futures Collaboration Cluster can be found at:
<http://www.csiro.au/partnerships/mineral-futures-collaboration-cluster.html>

About the authors



Leading the work on 'Commodity Futures' is the Institute for Sustainable Futures (ISF) at the University of Technology, Sydney. ISF was established in 1996, to develop sustainable futures through research and consultancy work with industry, government and the community. Our mission is to create change toward sustainable futures that protect and enhance the environment, human wellbeing, and social equity. We seek to adopt an inter-disciplinary approach to our work, and engage collaborators in processes that emphasise strategic decision-making for long-term benefit.

Contact details can be found on page 28. Additional information is available at:
<http://www.isf.uts.edu.au> and <http://resourcefutures.net.au>

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+ The path to Vision 2040

Vision 2040 is the product of continuing research, and a series of stakeholder engagement processes outlined below.

National Peak Minerals Forum (29 April 2010 - Sydney)

- Identified four key areas for positioning the minerals industry within a more sustainable Australian economy: (1) technological advances, (2) new structures for long-term decision making, (3) new approaches to business (not a 'quarry' but a 'mineral services hub'), and (4) better distribution of impacts and benefits.
- **Proposed actions:** incentives for industry sustainability including research into mine site remediation and new technology; new business models around resource custodianship.

WEF Mining & Metals Scenarios (28 Sept 2010 - Melbourne)

- Participants explored Australian implications of megatrends under three scenarios prepared by the World Economic Forum (WEF): Green Trade Alliance; Rebased Globalism; Resource Security.
- **Proposed actions:** development of a National Minerals Strategy and a sustainability rating system for mining operations.

Vision 2040 Workshop (28 November 2010 - Brisbane)

- At the 'Vision 2040: Innovation in Mining and Minerals' workshop, stakeholders analysed plausible future scenarios from which inputs to a preferred vision for Australia's mining and minerals future were generated.
- **Key themes:** Net positive benefits; indigenous leadership; commodity chain value; Brand Australia = clean energy solutions; governance and reporting for long term benefit.

Draft Vision 2040 & Consultation (May - June 2011)

- A consultation paper containing the draft Vision was used as the basis for stakeholder engagement. A national online feedback process, open to industry, government and the community, was supplemented with key informant interviews. Feedback from this process has been included throughout this document, and a summary of key feedback on the draft vision has been included on page 25.

Vision 2040 Launch (30 June 2011 - Perth)

- Building on two years of research and input from over 150 organisations and individuals, Vision 2040 aims to raise the profile of a national conversation about long term benefit, mining, minerals and sustainability. The intention of this document is to stimulate innovative thinking and analysis directed towards a national minerals strategy. Further research, including policy and technology options that will assist in making the vision a reality, will be completed in 2011 and 2012.



+ Introduction

Australia's mineral future in 2040

It is 2040 and Australia's economic prosperity is the result of decades old strategic decisions about the future. These decisions challenged the short-termism of government policy and industry focus on capitalising on high commodity prices. These decisions made it possible to harness Australian ingenuity for transformational change. These decisions were made by individuals and companies, communities and elected representatives in parliaments. These decisions about the future shaped our present.

In 2011, the issues surrounding Australia's mineral future are complex, requiring broad and ongoing discussion among all stakeholders to reframe problems, find solutions and identify the opportunities that change will bring.

Vision 2040: Mining, Minerals and Innovation aims to provide direction for a national strategy that transforms existing assumptions about how Australia can contribute to local and global development.

The consultation process for this vision aimed to answer the following questions:

- What should Australians be doing with our mineral endowment in the next 30 years to underpin long-term national benefit?
- What strategies can deliver on a vision of a minerals industry embedded within a sustainable Australian community in a range of future scenarios?
- What technologies and innovations should be given priority for research and development?

Stakeholder views: Key stakeholders were asked about their views of the benefits, costs and impacts of existing mineral industries and Australia's role as a major supplier of minerals

into the future. Concerns, issues, and ideas raised during this process have been highlighted to broaden the discussion and enrich a national conversation about Australia's mineral future.

Summary of key themes:

Building long-term benefit for Australia

Problem: Economic, social and environmental impacts are affecting the productivity of mining in Australia, and future benefits.

Solutions: Sovereign wealth fund to support diversification, infrastructure and innovation.

Looking ahead to get ahead

Problem: Declining mineral deposits are creating greater impacts during operations and upon closure.

Solutions: Embedding best practice mine closure, and post-mining transitions, in planning and daily operations. Exporting this knowledge globally.

Brand Australia: responsible minerals

Problem: Social licence to operate is extending to sustainable and ethical supply chains for consumer products and infrastructure.

Solutions: Developing and applying accredited standards for mining operations; Link mining to clean energy.

A National Mining Strategy

Problem: Limited information and coordination reduces strategic competitiveness and opportunities for innovation.

Solutions: Measuring and managing above- and below-ground stocks to guide technology and policy development.

More detail on these problems and solutions is provided in this document. Further information about ongoing research can be found on page 25 and project contacts are provided on page 28.



+ Mining and Minerals in 2040: Trends and drivers

Maturing demand

Australian minerals production is projected to rise, based on demand from countries including China and India continuing to follow growth trends. However, per capita steel consumption in China is now maturing to steadier levels, similar to those in developed economies like the USA (worldsteel 2010).

Challenges for energy and water

Energy consumption for mining in Australia has increased by a factor of 10 over the last decade (ABARE 2009). In the future, Australia's competitiveness will depend on being able to access even more energy with dramatically reduced carbon dioxide emissions. Recent floods and droughts have also demonstrated that managing water is becoming a high priority for both mining operations and surrounding communities.

Excellence in remediation

With over 30,000 legacy sites in need of remediation (Worrall 2009), the minerals industry in Australia must be at the forefront of best practice in mine closure and remediation. This will ensure that mining and mineral production is a 'welcome guest' rather than a 'bad tenant' in communities.

Planning for transitions

Similarly, increasing emphasis on 'Fly-In-Fly-Out' (FIFO) and 'Drive-In-Drive-Out' (DIDO) operations has reduced the benefits to local communities during operations, and failed to address collapses in economic development post-closure. In 2040 Australia must lead the way in transition planning for communities.

Indigenous leadership

It is expected that by 2040, indigenous Australians will have increased their levels of economic and political power with respect to mining and mineral production (Pearce, 2010). How will greater indigenous leadership in 2040 affect mining and benefit sharing?

Social Licence to Operate

Local social and environmental impacts are already a problem for securing and maintaining social licence. As expectations for 'ethical' products rise, manufacturers are looking much further up the supply chain, to ensure that all raw materials included in their products comply. Could addressing local impacts give "Brand Australia" the edge in this market?

New approaches for new needs

Rates of discovery for new, accessible, high-grade ores are declining. Consequently, research for new discoveries, technologies and approaches are needed to continue Australia's position as a global commodity supplier and to develop innovation beyond mining. International joint ventures, and strategic collaborations between mining and other industry, universities, and government are required create long-term prosperity for Australia.

Making our own luck

Australia – the lucky country – must deepen its commitment to innovative thinking and collaborative action to build long-term value from our resourcefulness – not just our resources.

Operationalising sustainability: new contexts, new understandings

Understandings of the world are changing

The idea of sustainable development came to the world's attention through the Brundtland report "Our common future" (1987). The definition of sustainability used in the Brundtland report states that the development of the present should not deny future generations similar opportunities for development.

Although it was once common to think of the human world of 'society' and 'economics' as separate from the physical world, it is increasingly clear that the physical world sets limits on what human societies can achieve. With this change in our understanding of the world, our understanding of 'sustainability' must also be revised.

Figures 1 and 2 (below) illustrate the evolution of both our understandings of the world, and of sustainable development. The key difference in these concepts is the relationship of the three aspects of environment, society and economy.

Figure 1 shows a common notion of sustainability, which underlies the "triple bottom line" approach to decision making (Elkington 1998). This view of interaction between three separate spheres, implies that each is independent of the others, and that 'sustainability' lies in the area that overlaps. Figure 2 (adapted from Lowe 2010), shows our society and economy as being built upon, or embedded within, our environment – the true 'bottom line' of sustainability. This notion supersedes the concept of sustainability in figure 1, and recognises that both our economy, and our society, degrades as our natural environment is degraded.

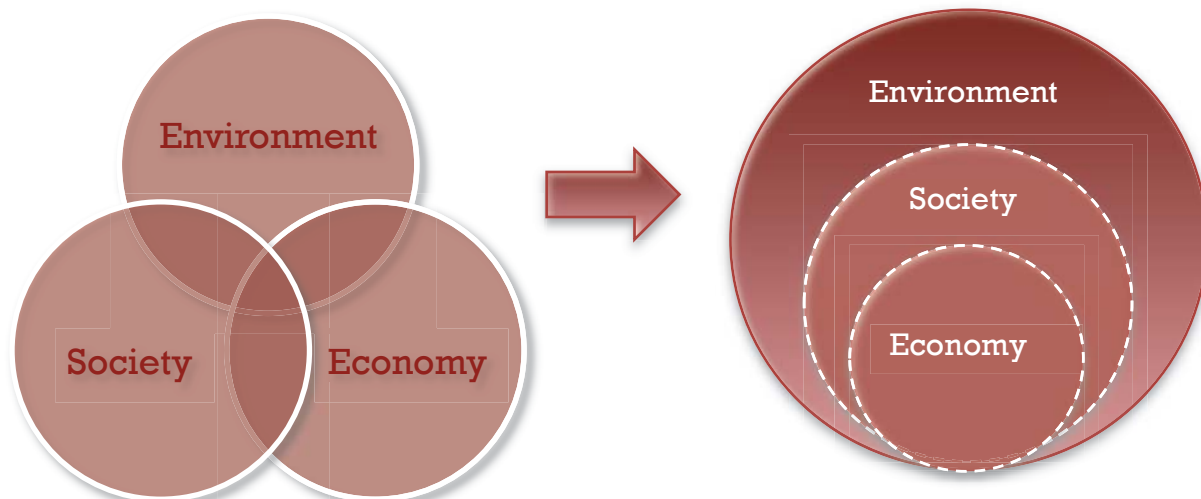


Figure 1:
Interlinking spheres notion of sustainability
Practical decision-making applications of this view, have attempted to 'balance' or make 'trade-offs' with what appear to be competing interests.

Figure 2:
Nested or embedded notion of sustainability
Practical decision-making applications of this view recognize that a functional ecosystem provides food and materials for shelter, allowing societies to develop the stability and trust that supports an economy.

Making commitments to future generations: stakeholder views

Setting objectives for social benefit

“...current approach is ad-hoc and benefits are not comprehensively understood or appreciated.”

Monitoring and evaluating the benefits of mining and mineral production are the foundation for implementing systems of accountability for minerals. Stakeholders noted the importance of developing, or adapting, and implementing new measures of wealth and development that go beyond GDP – measures that reflect greater understandings of value from minerals.

A world worth inheriting

“... no legacy issues should remain...”

Environmental degradation was the most cited concern for stakeholders with respect to the costs and impacts of mining and minerals. Many believed that these could, and should, be reduced through the use of technology and processes that are designed to significantly reduce environmental degradation. Others believed that improvement in this area required commitments to ‘positive impact’.

Investing today’s profits for tomorrow

“Growing demand ensures we can put aside a portion for future generations while helping the current one...”

Stakeholders indicated that not enough thought was being directed to the prosperity of future generations, and that not enough was being put aside to ensure that finite mineral resources were replaced by something as valuable. Innovation in economic management of mineral revenues, including profit-based taxes and sovereign wealth funds could be used to achieve this goal.

Innovation and sustainability: The case for system innovation beyond mineral production

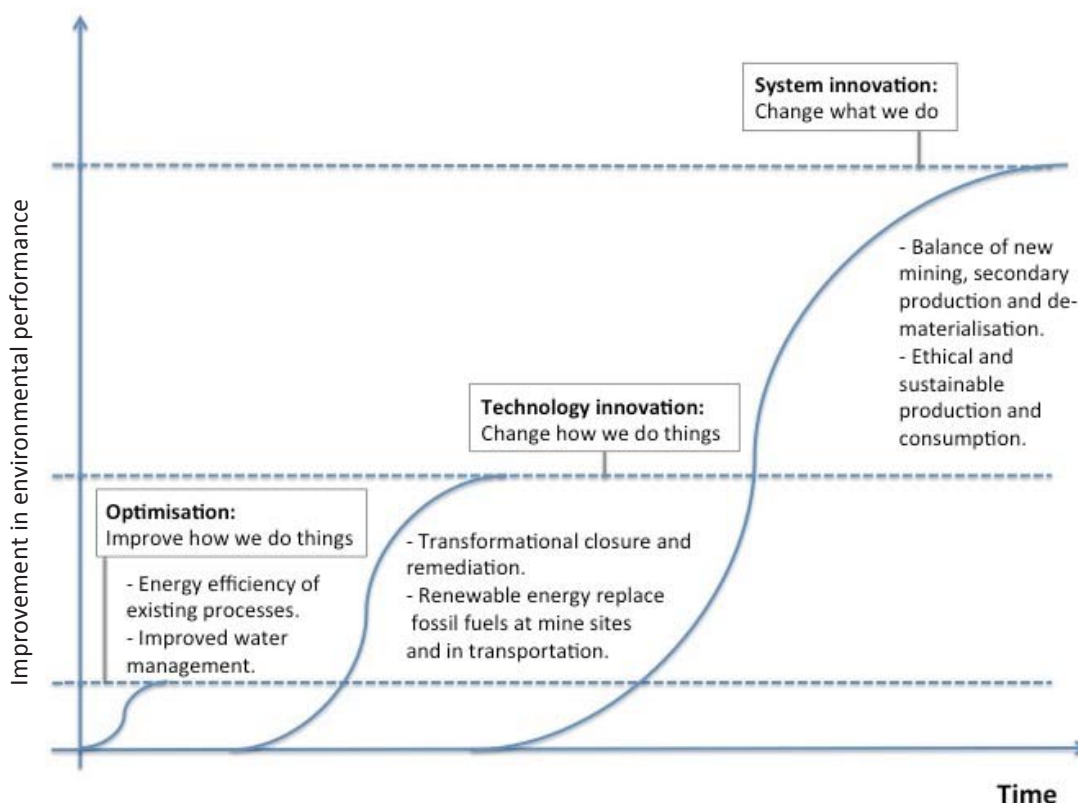


Figure 3: Levels of innovation Potential for different levels of innovation in the mining industry, and the impacts this may have on environmental performance.



Long-term national benefit

What should we as Australians be doing with our mineral endowment in the next 30 years to underpin long-term national benefit?



Prosperity: something more than wealth

Natural materials and objects hold different meaning for different members of our society, and this influences how we attribute value. Whether economic, cultural or physical, the attribution of value designates what we consider to be resources.

The value we place on resources is determined by the function or functions those materials or objects perform in our society. We are familiar with the idea that we all benefit from the money that selling our resources brings in, but is it enough?

In 2001, the World Bank assessed Australia as being one of the lowest performers amongst developed countries when natural resource depletion and land degradation were considered (Brown et al 2005).

While Australia is in a position to demonstrate that having a large resource base is not a 'curse', existing policy is not likely to achieve this outcome. What changes will be required to ensure that Australia can deliver on the promise that exploiting mineral resources can be the base of sustainable development?

Australia is in a unique position

At the height of a 'boom', Australia is well placed to shape its mining and minerals processing operations to eliminate negative impacts, strengthen positive impacts, and begin a new story by embedding itself within systems of sustainable resource use and reuse. Understanding prosperity from Australia's finite resources needs to have a stronger focus on how this 'wealth' is measured, managed and distributed between the Australian community and foreign investors.

The International Monetary Fund (2011) and OECD (2010) have suggested that Australia creates a sovereign wealth fund. Given Australia's current reliance on export income from mining, measures to increase and save some of this income could shield the economy and budget from revenue volatility, as well as acting as a savings pool to fund the development of long term infrastructure projects, and assist Australia's move to a low-carbon future (see more on page 18).

Concerns: Stakeholder views

“We need to be doing more to retain some of the wealth being generated by the current boom”

24% of respondents were concerned about the need to manage ‘boom’ and ‘bust’ cycles, and a ‘two speed economy’ (dutch disease).

“Mining in particular areas impacts different sectors and the taxes collected from the enterprise should in part be apportioned to providing specific benefit.”

21% of respondents believed that minerals and mining contributed to losses in other sectors.

“... more benefits if there was better planned and more strategic development of our reserves.”

14% of respondents were about the need for improved productivity in the mining sector.

“Future generations will have to deal with the legacy of current mining activity.”

14% of respondents were concerned about the need to preserve agricultural land and to avoid conflicting land uses.

Developing a national minerals strategy based on shared values

This vision supports the development of a national minerals strategy. This should incorporate community views of how long-term benefit can be derived from Australia’s mineral endowment (see figure 4).

Concerns about the poor quality of public debate on minerals may be usefully addressed by making the Australian public central to decision-making on this issue.

Using deliberative and representative participatory processes, such as a citizen’s ‘assembly’ or policy jury, it is possible to facilitate debate and discussion about what is in the public interest, rather than what is in the interest of particular stakeholders. It is a process involving discussion, thoughtful argument, critical listening and evidence-based decision-making.

Citizens’ assemblies and policy juries offer a promising format for having the voices of Australians heard. These processes involve randomly selecting citizens without vested interests. Selected citizens are then presented with detailed information on an issue and given the opportunity to think about it and discuss it in a non-adversarial way. Citizens’ assemblies combine the specialist knowledge of experts with the experiences of participants as citizens and members of a national community of communities. More details on a national mineral strategy are provided on page 14.

Proposal for national minerals strategy development: broadening the conversation through participatory processes



Figure 4: Elements of a participatory process for decision-making (Carson & Hart 2005)

Benefits, costs & impacts: valuing minerals

What strategies can deliver on a vision of a minerals industry embedded within a sustainable Australian community in a range of future scenarios?

Price and value

Almost every aspect of our daily lives is affected by the availability of many mineral resources used in goods and infrastructure. The current mineral production and consumption patterns reflect the values we attribute to these resources.

As Australia purchases more goods and services from overseas than the value of goods and services we export (ABARE 2009), the way that we manage our export income now is a fundamentally important question for Australia's future.

Other countries are thinking very hard about how they manage their mineral wealth for long-term national benefit. A number of mineral producing countries are using sovereign wealth funds to make investments in areas that will keep their communities healthy, wealthy and wise long after their original mineral endowments are gone.

What is a sovereign wealth fund?

The term sovereign wealth fund (SWF) refers to any government-controlled fund that manages and invests government savings. Commodity-based sovereign wealth funds have been created for the purposes of reducing negative economic impacts from mining (high currency value) and ensuring that future generations can continue to share in this wealth. See pages 18-19 for more on this form of wealth management.



Benefit: stakeholder views

The majority of survey respondents felt that the benefits of minerals and mining were primarily economic or financial. These responses included a variety of different approaches to understanding benefit.

“Economic benefits”

64% believed that minerals and mining made a contribution to GDP, Australia's terms of trade, “money”, or other economic benefit.

“Essential to life and services”

50% believed that minerals and mining were beneficial in terms of their contribution to standards of living.

“Jobs”

35% believed that minerals and mining contributed significantly to employment.

Costs and impacts: stakeholder views

The majority of survey respondents felt that the costs and impacts of minerals and mining were felt across environmental, economic and social systems.

“Environmental degradation”

73% of respondents believed that minerals and mining were creating costs or impacts through environmental degradation.

“Economic impacts”

44% of respondents believed that minerals and mining were creating costs or impacts for other industries, and for the wider economy through cycles of boom/bust and high currency values.

“Social disruption”

34% of respondents believed that minerals and mining were creating costs or impacts through social disruption.

Is Australia prepared for changes in mineral production?

As Australia’s largest export industry, mining brings financial benefits to the nation.

However, extraction and production are becoming more challenging, and while *physical* depletion may not present an issue in the short-term, continued production combined with falling resource quality brings greater technological, environmental and social expense.

These factors make it more likely that some resource will face economic depletion long before they ‘run out’.

Global scenarios for mining and metals developed by the World Economic Forum, propose three plausible futures in which Australia must grapple with changes to the system of global trade (WEF 2010).

Furthermore, technologies to recover high quality minerals from products at the end of their useful life are gaining ground.

For example, it takes 2 grams of gold to make a wedding ring, which can be produced from 10,000 kg of gold ore or 10 kg of mobile phones.

Worth thinking about...

The United States Geological Service has estimated that the proportion of world gold supply that is circulating aboveground is greater than the amount still in the ground - 122 tonnes compared to 100 tonnes (USGS 2005).

Who will be controlling the ‘above ground’ stocks of gold and other high value metals in 2040?



Regions and benefit

In the face of increasing environmental and social impacts, or significant change in the global trading context, how can metropolitan and regional communities (indigenous and non-indigenous) reconcile their relationships to mineral production?

Regions: stakeholder views

17% of survey respondents indicated that regional development was a factor in their view of benefit from mining.

42% of survey respondents believed that 'mining communities' should receive more benefit than they do at present.

53% of survey respondents believed that given the choice of various levels of 'government', 'mining communities' or 'indigenous communities' there were others that should benefit more, or had another view of how benefit should be distributed.

"Mining in particular areas impacts different sectors and the taxes collected from the enterprise should in part be apportioned to providing specific benefit."

- Vision 2040 stakeholder

"I think that this can be very project specific. Some groups might desire more benefits than others depending on the project."

- Vision 2040 stakeholder



The Peel Region (WA)

WA's Peel region is a geographically diverse area that lies immediately south of the Perth metropolitan area. Although the region had a diverse agricultural and forestry based economy, it is now the state's third largest mineral extraction region - after the Pilbara and Goldfields - and provides the feedstock for the state's entire alumina output. Uneven development has produced a number of tensions. Rapidly expanding urban areas in the west and north of the region are now home to a large fly-in fly-out/drive-in drive-out mining workforce. Mineral rich mine sites in the sparsely settled eastern areas coincide with natural features attractive to those involved with the development of eco- and adventure-tourism. High average age and high unemployment rates for young people and women add to a complex mix of interests and needs.

Mining companies can achieve 'welcome guest' status by:

- Reassessing strategies to achieve a local workforce
- Ameliorating the negative social and environmental impacts of large volume Drive-In-Drive-Out (DIDO).
- Working collaboratively with small scale local business interests to develop long term strategies for more integrated and flexible multiple user access to mineral rich areas during and beyond the life of the mine.
- Incorporating into all decisions and actions an awareness of the values attached to existing and emerging qualities of place.

This research forms part of the work being undertaken by the P3: 'Regions in Transition' group of the Mineral Futures Collaboration Cluster. See more about this initiative at:

<http://www.csiro.au/partnerships/mineral-futures-collaboration-cluster.html>

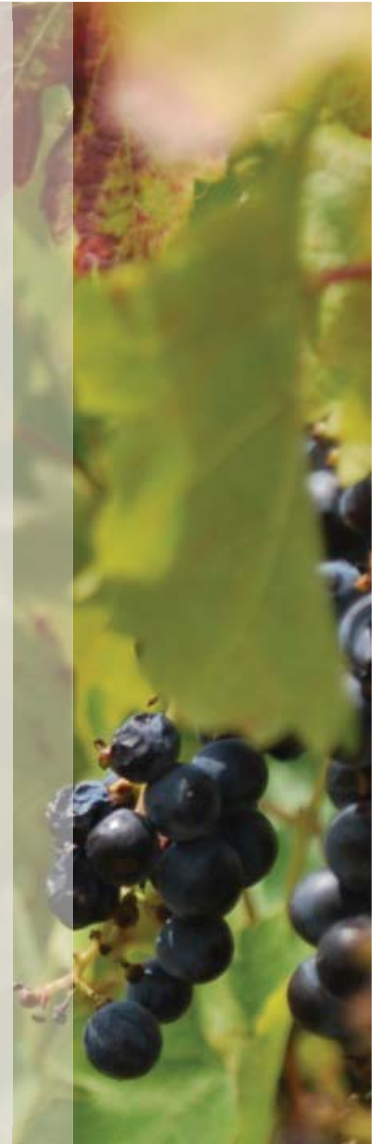
The Hunter Valley (NSW)

In contrast to the example provided by the Peel region, the Hunter Valley region of NSW has a long history of mineral production, and continues to have wide diversity of established industry. While this has resulted in tensions similar to those experienced in the Peel region, there is also additional complexity arising from competition between agriculture, mineral development and energy generation industries for local support and resources, such as water and land. As a coal producing area, the Hunter Valley faces further additional tensions arising from the recognition of 'cumulative impacts' from prolonged development of coal resources, and the long-term decline of local employment in mineral-related industries (Franks 2009, Evans 2007). More recent tensions have focused on the close relationship that the area has to a major source of concern about continuing fossil fuel use (Evans 2007).

Australia accounts for almost 30% of world coal trade, with coal from the Hunter Valley accounting for about half of this material (NSW DPI, 2006). For these reasons, the 'benefits, costs and impacts' of mining are considered in different terms than those that might apply in the Peel region.

Becoming a 'welcome guest' in the Hunter requires:

- Engaging with local residents, key labour unions, and environmentalists, around economic restructuring and transitions post-mining.
- Significant investment to reduce or eliminate the cumulative impacts of existing operations.
- Demonstrating a commitment to the development and use of successful mine closure, and remediation techniques, to restore valuable land to the community.



Questions around long-term benefit for states and regions

Mining in Australia has a very long and varied history. Cities such as Melbourne and Broken Hill are living monuments to the wealth that mining have brought to Australian cities. In Western Australia, the government has adopted a new approach in an attempt to deliver greater economic benefits from current mining developments to the regions. 'Royalties for Regions' aims to return "the equivalent of 25 per cent of the... mining and onshore petroleum royalties to the State's regional areas each year..." (WA RDL 2011). Of the ten regions of WA, nine receive royalties under this scheme. Perth, WA's capital city is the only region that does not receive proceeds from the Royalties for Regions program.

One factor limiting regional benefit is the comparative absence of employment and population growth in settlements around mining development. The use of Fly-In-Fly-Out (FIFO) and Drive-In-Drive-Out (DIDO) workforces has meant that Perth has experienced greater levels of population and employment growth than regions where mining is actually taking place (BITRE 2010). Even within Perth, mining jobs have been "highly centralized" with Perth Inner SLA from 2001 to 2006 "adding 3800 jobs and no other SLA adding more than 600 mining jobs" (BITRE 2010).

Further research will be required to assess the contribution that 'Royalties for Regions' has made to the long-term development of mining regions, and the impacts upon the rest of the state.



Perth (WA)

Looking ahead: Creating a sustainable Australian economy

A National Minerals Strategy

What role will Australian minerals play in the global supply and reuse of metals in 2040?

It has been suggested that a minerals industry embedded in a more sustainable economy must shift its activity to include active stewardship and seek opportunities to use less metal for service provision, and maximise ecological, social and economic value from mineral resources.

In this vision, Australia develops a national strategy for the development of its mineral resources that will guide future development and ensure long-term benefit to the national community.

Global demand for Australian minerals and metals continues to rise, making a comprehensive assessment of the industry's current and future role in the Australian economy an important goal. As a mineral dependent economy, Australia faces challenges from declines in key minerals, and must also find ways of adapting to carbon constraints and a new tax structure. The development of a national minerals strategy is an opportunity to integrate mining sustainability into economic planning. Such a strategy should include policy measures and programs that:

- Improve the coordination of mineral development across states and territories through an organisation, similar to The National Water Commission, which would drive progress in sustainable management of Australia's mineral resources.
- Identify challenges, such as declining productivity and high currency values, and develop innovative responses.
- Improve knowledge of Australia's mineral resources including much stronger reporting requirements for exploration undertaken by private companies.
- Improve social and environmental outcomes by encouraging all mining and mineral processors operating in Australia to report under the Global Reporting Initiative.
- Improve capacity for innovation through collaborations amongst universities, mineral producers and other researchers.
- Facilitate the commercialisation of technologies that make a 'step change' in the environmental and social performance of mining and mineral production.
- Monitor and evaluate key social, environmental and economic indicators for mining and mineral production.
- Implement sustainability reporting on the Australian economy as a whole, to ensure that improvements by the mineral industry can be monitored and compared with other sectors (as is the case with the National Pollutant Inventory and NGER data).



Integrating mining sustainability & economic planning

In this vision Australia's reliance on minerals is reduced, while improved management of resources transforms negative economic, environmental and social impacts into net positive benefits in each of these domains. Australian initiatives such as the Sustainable Operations (SUSOP) framework use a five-capital 'balance sheet' to assess the impact of a particular mining project plan, or a particular decision regarding changes to existing operations. Improvements in financial 'capital' are put into context against possible declines in 'manufactured', 'human', 'social' and 'natural' capitals.

Taking stock, measuring impact, and making ourselves more accountable

If Australia is to achieve the goal of a sustainable economy, it would be highly worthwhile to develop a national account of economic, social and environmental sustainability that is practical to apply to different industries.

Becoming more accountable to all members of our community, and to future generations, will require an evaluation of the *quality* of the jobs generated by industry, not just the number of jobs. It will also require us to look at negative economic impacts, such as increasing currency values and interest rates, as well as the more conventional 'positive' indicators (GDP, GNP). Furthermore, bio-diversity losses, and social disruption such as community conflict over land-uses would need to be considered as a loss to national prosperity.

Performance indicator sets, such as the Global Reporting Initiative (GRI) and the United Nations

Global Compact (UNGC) provide a starting point for developing a National Sustainability Report that helps existing and future Australian communities to understand the state of Australia's progress towards long-term sustainable development. The goal of this report would be to monitor and evaluate the extent to which we are:

- Reducing environmental impacts across all operations in Australia
- Reducing the environmental and social impacts of Australian mining operations overseas
- Reducing negative social impacts across all operations in Australia.
- Making progress with improving the distribution of benefits to all members of the Australian community.
- Investing in a way that facilitates an increasingly sustainable Australia.

Genuine Savings and the Global Reporting Initiative

Internationally recognised, sustainable development indicator sets, such as the World Bank's Adjusted Net Savings or Genuine Savings Rate (GSR) and the Global Reporting Initiative (GRI), have been developed to monitor the progress of sustainable development (Singh et al, 2009). GSR calculates the extent to which losses of natural resources and environmental damage have been offset by gains in human capital (measured in terms of expenditure on education). The GRI is a reporting system that encourages companies to demonstrate their performance across social, environmental and economic areas. The United Nations has also developed a system of indicators that focus on corporate performance in the area of human rights. More on these can be found at: <http://www.globalreporting.org/> and <http://go.worldbank.org/8CWDARYMB0>

Getting ahead: Australian ingenuity supporting transformation

Brand Australia:

This vision is of a mineral industry in Australia that is a globally recognised supplier of responsible minerals.

Corporate reputations increasingly depend on being linked within ethical and responsible supply chains. The importance of this issue involves global companies seeking certification for avoiding issues such as conflict minerals, but also improving social and environmental outcomes. How can Australia position itself for advantage in this future market?



Ethical minerals

Increasing focus on the ethical trade of minerals is illustrated by *The Dodd Frank Act* in the USA, which requires the disclosure of conflict minerals from the Congo. Other initiatives include the extension of the concept of “fairtrade” to gold (“fairmined”), and the Extractive Industries Transparency Initiative (EITI). EITI reduces potential corruption by providing a standard for disclosure by companies and governments.

Chain of custody and stewardship

The Responsible Jewellery Council is an international not-for-profit organisation lead from Melbourne, which brings together 300 member companies committed to promoting responsible, ethical, human rights, social and environmental practices in a transparent and accountable manner from mine to retail. These companies are now leading the development of Chain of Custody Certification Standards.

The Steel Stewardship Forum in Australia is the first of its kind – bringing together organisations along the steel supply chain with a focus on stewardship and sustainability.

Thinking differently about value-adding

The need to add value to mineral commodities produced in Australia has been a perennial discussion. Economic arguments, which cast doubts on the viability of semi-finished or finished metal product at a competitive price, have largely prevailed. However, if we think differently about ‘value’ and how it might be added, there are several opportunities available.

These opportunities arise when we recognise that Australia has many resources beyond ores in the ground. These include inventiveness, a strong service sector, our relationships with a range of growing Asian economies, and last but not least, our fresh air and sunshine.

Exporting Fresh Air and Sunshine

Using Australia’s vast resource of sunshine to mine, and process, minerals would put Australia at the forefront of coupling clean energy and heavy industry. By leading the way, we can both “export fresh air and sunshine” in a wide array of mineral and other products, and then sell our knowledge, expertise, and services in this area to the rest of the world.

Designed and developed in Australia: Transformational mine remediation and closure

This vision is of an Australia that recognizes a global need to develop cutting edge mine remediation knowledge, processes and technologies that it can promote and distribute to the world. In this vision Australia combines the skills and resources of government, researchers, communities, and mining operators to transform current liabilities into long-term assets.



With over 30,000 mine-related legacy sites in Australia, there is a both a challenge and an opportunity to benefit by leading the way

Collaborations between government, researchers, companies and communities to develop transformational techniques and processes could ensure that Australia continues to benefit from its wealth of knowledge and expertise in mineral production. The benefits from such collaborations would be present for many generations beyond the present.

What does 'transformational' remediation look like?

World leading mine closure management will involve stepping beyond remediation to regeneration. A joint venture between the Australian community and the mineral industry could lead the world in developing and implementing, transformational mine closure and remediation. The aim of this project would be to leave mining sites in better condition than when mining began – *increased* ecological services, *increased* biodiversity, *improved* water quality, *better* land management systems, *more* fertile soils.

Return on investment

The outcomes described above have clear benefits for local, national and global communities. However, there are also clear *economic benefits* for companies that flow on from these 'net positive' social and environmental benefits.

Benefits for the local community

include reduced impact from existing operations, and the prospect of improved ecological services over the long-term.

Benefits for national and global communities

include an increasingly sustainable resource base with no long-term reductions in the productivity of land for other essential roles.

Benefits for mining companies are likely to include:

- **Increased Social Licence to Operate**
 - Decreased costs for managing community impacts and concerns.
 - Increased reputation (local and global) and increased business opportunities.
 - Better prospects for positive legacy post mining.
- **Decreased risk**
 - Increased business opportunities.
- **Increased well being of employees**
 - Reduced turnover.
 - Greater retention of knowledge and skills.
 - Increased productivity.

Staying ahead: Creating long-term value from minerals

Australian Mineral Sovereign Wealth

In this vision, Australia has implemented a profit-based royalties scheme, and created sovereign wealth funds to put aside savings from the mining boom.

Funding the future

Prices for many key Australian minerals have been very high in recent years, however there is no guarantee that these prices will continue. Indeed, as more countries try to take advantage of this unprecedented situation, Australia becomes just one of many countries that international companies such as BHP Billiton and Rio Tinto choose to invest in.

Given the unusual range of high-quality minerals resources available in Australia, it was important to consider whether existing approaches to developing these resources are going to bring the most benefit.

The case for getting more

Iron ore, which has just overtaken coal as Australia's largest export earner, presents a very clear case for making the most of high prices. In 1993-94, the average price for iron ore and pellets was approximately \$24 per tonne, while a decade later it had reached \$27 per tonne. However, in 2008-09 the price for this mineral had increased to \$88.50 per tonne. Even at the more moderate prices available in 2004-05, the export value of iron ore and pellets was reported as \$8.12 billion (ABARE 2009, Table 39), while WA government figures for revenues from iron ore indicate that the WA government received just \$380 million (around \$200 per WA resident) during this period. This comes out to around 4.6% of the value of the iron ore minerals taken from WA. It's not surprising that questions remain about how these funds can deliver benefit for the state, and the nation, over a number of generations.



Aligning national and corporate benefit - a taxing question

Benefits from mining are very different for countries that mine these resources for themselves. For example, while China mines at home, it also mines in other countries, in a similar way to a multinational company like Rio Tinto or BHP Billiton. The ability to shift emphasis from mining leases in one part of the world to another, when price or other constraints arise, is what keeps these government- and privately-owned operations profitable and competitive.

In contrast, Australia relies on such companies to develop mineral resources and provide government with revenues to run services and programs. For this reason, Australian governments have preferred to have a smaller but regular stream of funds from mining, rather than using a 'profit-based' or 'rent-based' royalties that would take better advantage of high prices (Harmon & Guj 2006). Although mining companies have resisted the idea of changes to the royalties system, mineral economists consider profit-based and rent-based systems to be 'the most economically efficient and equitable' approaches (Harmon & Guj 2006). More importantly, such a system would assist in aligning the interests of governments and mining companies, so that mining only occurred when the prices are right, and the costs are low (Productivity Commission 2008).

Sovereign Wealth: the case for saving more

The term sovereign wealth fund (SWF) refers to any government-controlled fund that manages and invests government savings (Devlin & Brummit 2007).

SWFs can have a variety of economic and financial benefits and objectives. They are typically set up to be stabilisation or savings funds as they can help avoid economic boom-bust cycles in their home countries, and/or, facilitate the saving and transfer across generations of proceeds from fiscal surpluses related to commodity exports and privatisations (IMF 2011). They can also allow for a greater portfolio diversification, and focus more on returns, than is commonly the case for central-bank-managed reserve assets (IMF 2011).

Sovereign wealth fund successes

Norway (Larsen, 2006), Chile (Chile Finance Ministry, 2009), Oman, Kuwait, Venezuela and Papua New Guinea (Davis et al., 2001) have all established successful sovereign wealth funds. Funds such as Norway's Government Pension Fund and Chile's Stabilization fund have earned a reputation for following strict standards of transparency.

Different minerals, different strategies

High prices for mineral resources have provided unprecedented profits for mining companies, and create an incentive for more countries to develop the resources that they have available to them. For this reason, the demand and the profitability of minerals, such as iron ore, gold, and copper, will be difficult to predict in the medium- to long- term. A good strategy will recognise the relationship between changes to the sale price and production costs of different minerals, and the revenues they generate. One way to improve the connection between economic benefit from minerals and long-term benefit for the Australian community would be to tax the mineral industry on the basis of profits, and use part of this money to invest in innovation across a number of different industry sectors.

A note of caution

Sovereign wealth funds need to be established on a sound base of clear objectives and strong governance. An example of an unsuccessful sovereign wealth fund is provided by the island nation of Nauru. Twenty years ago, the island state of Nauru had \$US 800 million in a sovereign wealth fund that was set up to create long-term benefit from its vast phosphorus rock resources. At that time, this equated to around \$US 200,000 for each citizen, however mismanagement of the fund means that this nest egg has disappeared. Today, Nauru's phosphorus resource has been largely exhausted, and replacing this source of income is proving difficult.

What is being said...

“In mid-2008, Chilean authorities resisted pressure to spend the soaring receipts from high copper prices. When copper prices dived as the global downturn hit, the Chilean authorities were able to increase spending sharply, financing a large fiscal stimulus with assets acquired from copper receipts....As was the case here, the stimulus moderated the downturn.”

Ken Henry

(Treasury Secretary from 2001-11)
18 May 2010

“The main thing we don't know is how long the boom will last. This matters a great deal...If the rise in income is only temporary, then we should not respond to it with a big rise in national consumption. It would be better, in such a case, to allow the income gain to flow to savings that would then be available to fund future consumption...”

Glen Stevens

(Reserve Bank Governor)
February 2011

“Such a fund could include specific accounts for investment in higher education institutions and hospitals ... pre-paying some of the costs associated with the ageing of the population... funding productivity-enhancing infrastructure investment... tackling entrenched areas of indigenous disadvantage... and for other purposes requiring expenditures over long periods.”

Saul Eslake

(Program Director, Grattan
Institute)
March 2011

“The rules, governance, ultimate economic objective, investment mandate and transparency of any wealth fund would indeed be critical issues to resolve. But the Future Fund has shown such issues are far from insurmountable”.

Malcolm Turnbull

(Member for Wentworth)
April 2011



Innovation in technology

What technologies should be given priority for research and development?

In this vision, Australia uses its voice in mining to make a difference globally.

If minerals and metals are going to continue to underpin the prosperity of our society, the way in which resources are currently used, and might be used in future, requires a serious discussion. Key stakeholders have suggested that Australia’s current position, as a ‘big voice in mining’ is an opportunity to set the standards and the pace for developing transformational technology.

Figure 5 (below) shows best practice for sustainable mine planning in the arrow going down the page in blue. It extends from exploration through construction and mining to closure and restoration. Yet, to date, the primary focus in Australia has been on mining and the stages preceding mining. Our vision is that future obligations become opportunities by developing expertise and best practice in transformational remediation.

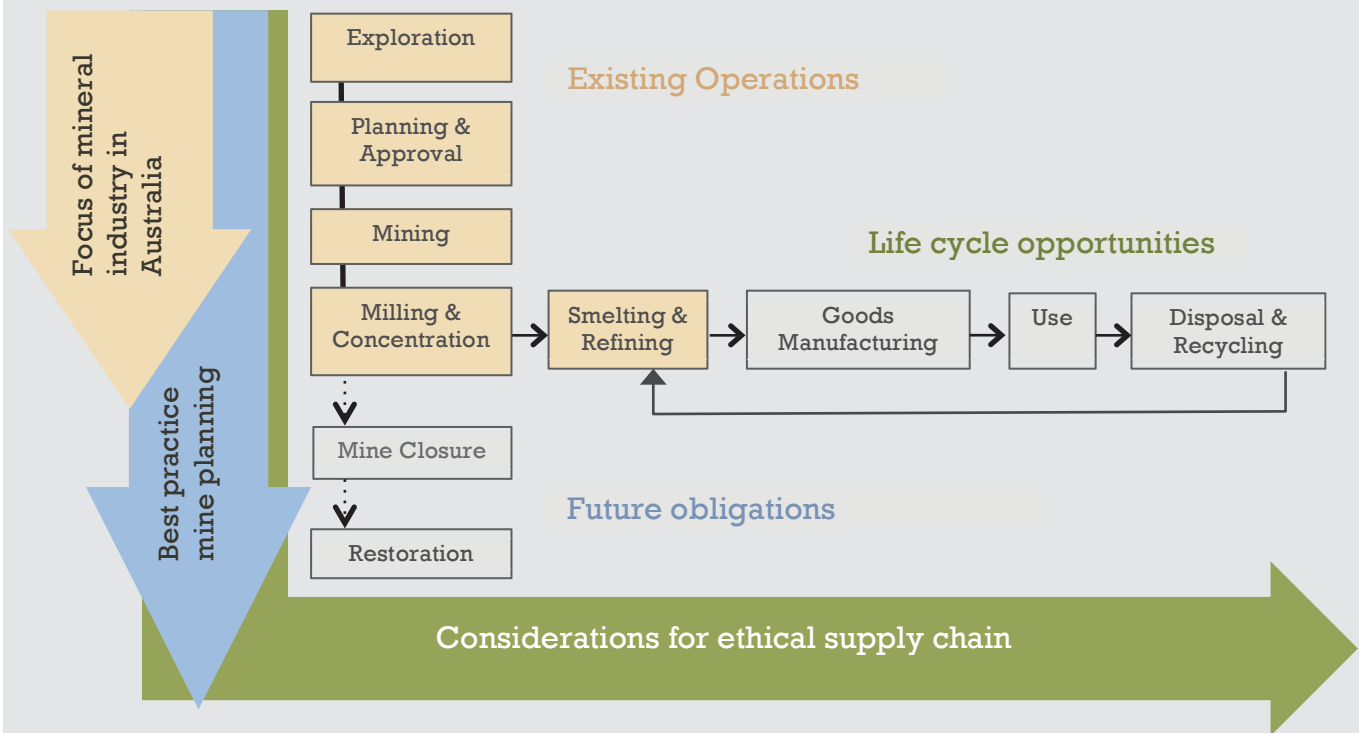


Figure 5: Life cycle opportunities and future obligations

Going across the page, the green arrow illustrates life cycle planning for sustainable production and consumption. Moving to the right adds more value with less impact. It has been argued that Australia must be open to taking up opportunities in these arenas.

"Australia needs more than efficient mining – we need an innovative vision for the nation, we must connect know-how to develop green minerals and product chains using clean energy. Our future depends on innovating systems."

- Prof Markus Reuter, University of Melbourne.

Focusing on our strengths and extending our skills

One key stakeholder indicated that decisions made in Australia have a big impact for mining globally. A notable success for Australian technology development can be seen in the fact that in 2008/2009 Australia made more form mining software sales by Australian companies than it made from the combined sales of uranium and zinc ores (Tedesco & Haseltine, 2010). Figure 6 (below) illustrates the additional value that comes from having an active technology development industry.

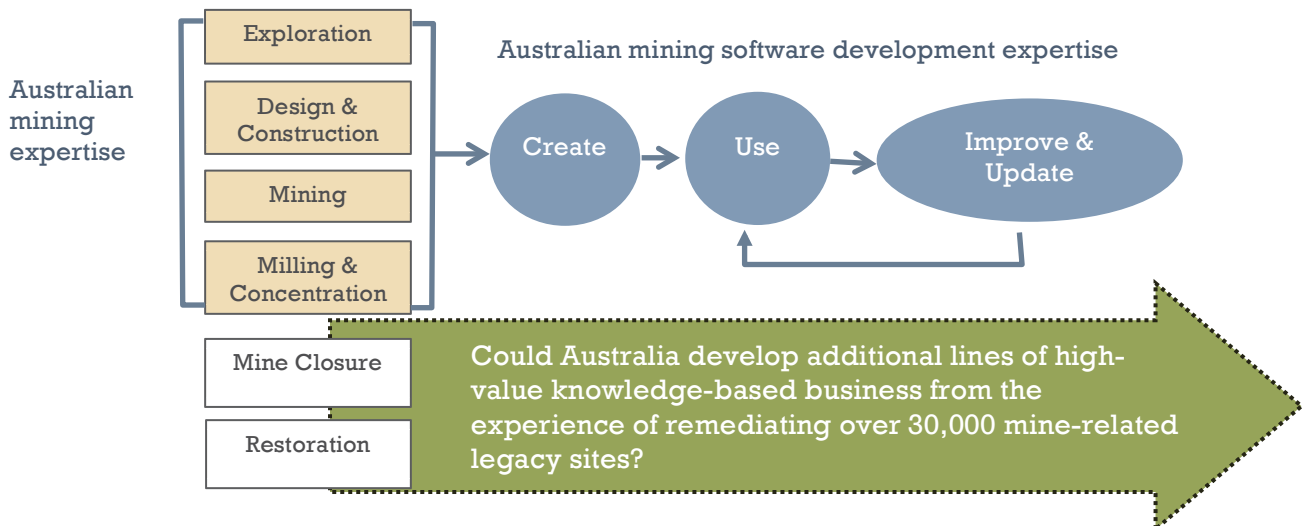


Figure 6: Australian technology captures knowledge and expertise generated by Australian experience.

Technology development that meets industry and community needs

Developing our own transformational technology using knowledge, experience of Australian conditions, and social values, would place Australia in a good position to provide for itself, and provide benefits to the rest of the world for generations to come. This is particularly important when new technologies, such as those that automate processes, are being rapidly developed and deployed. The close relationship between ‘social license to operate’ and technology creates an opportunity to evaluate and address future social challenges within the design stage of technology development.

Figure 7 (below) illustrates the relationship. When assessing a range of possible directions for technological development, it may be increasingly important to engage a wider group of stakeholders to ensure that the path chosen addresses their concerns and meets the standards that each holds.

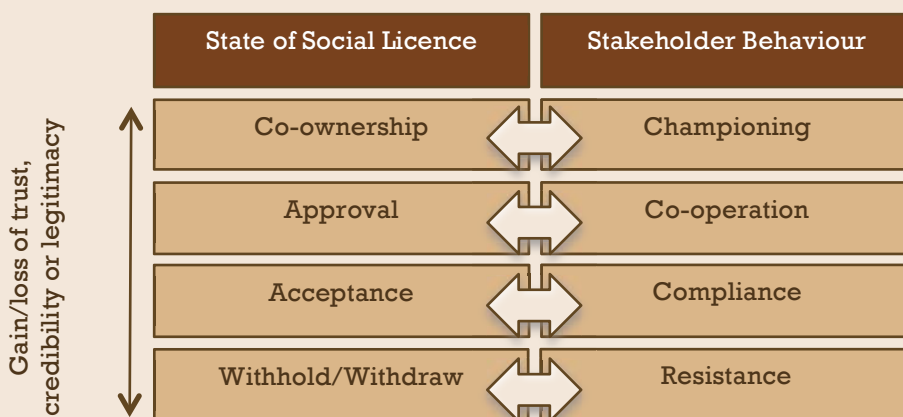


Figure 7: Relationship between the state of a social license and stakeholder behavior (adapted after Thomson and Botillier 2011) in Franks & Cohen (2011)

If a particular direction is considered to be irrelevant to stakeholder concerns, or viewed as untrustworthy, then the applications developed may ultimately prove to be an expensive failure.

This research, undertaken by the P2: Technology Futures group of the Mineral Futures Collaboration Cluster, is developing new approaches to assessing different technologies to meet a wider range of needs.



Innovation in business models

What lessons can we learn about changing what we do and how we do it?

In this vision Australia uses innovative business models to encourage collaboration

Some stakeholders have suggested that the development of game changing technology is difficult for one company to undertake, and that new technologies developed without input from mineral producers can be impossible to implement.

Collaborations between universities, companies, and institutes conducting R&D are seen as one way to ensure that technologies meet a wider range of criteria, including high public benefit and low-cost. However, there are also innovative business models that could encourage more sustainable production and consumption cycles.

Two ideas can be better than one

In response to incoming legislation and targets for recycling, Japanese manufacturers formed two consortiums to develop collection and recycling facilities using funds from a disposal levy under the Specified Home Appliances Recycling Law (SHARL). As shown below in figure 8, Group A and Group B have organized their processes in distinctively different ways. Group A uses existing recycling operators under contract 'as much as possible', while Group B has taken a more extensive entrepreneurial approach to developing their own plants and processes (Dempsey, 2006). The technology and processes developed are now being sold to other countries, such as Taiwan.

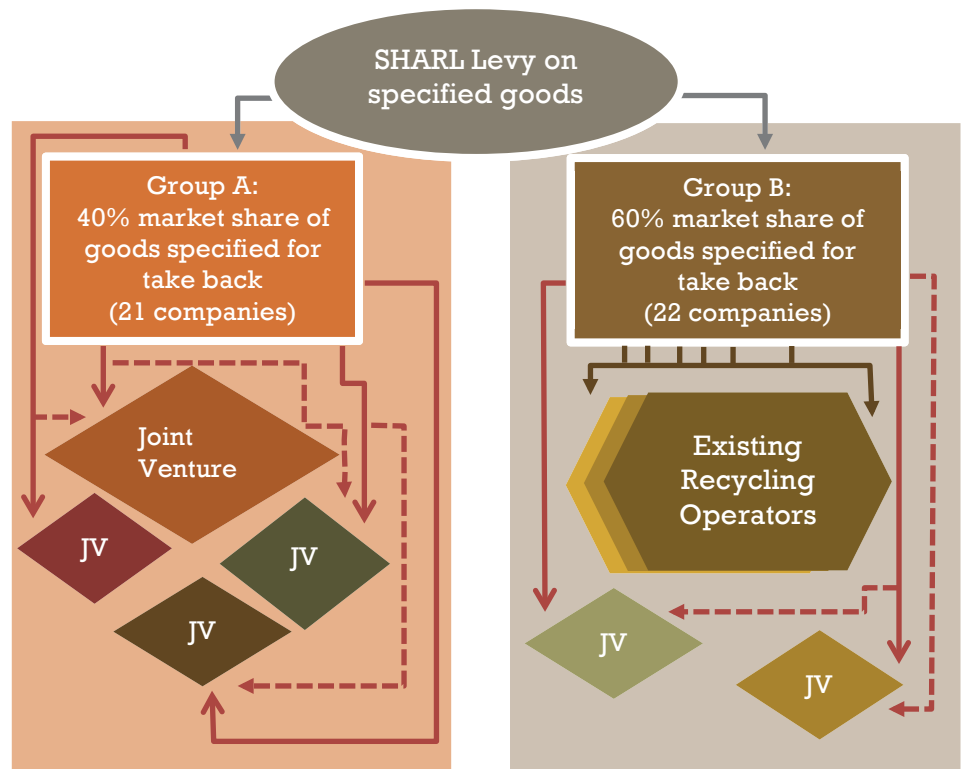


Figure 8: Demonstrates the 'brand-based' individual approach to implementing a waste resource recycling and reuse system in Japan (Dempsey 2006). Red lines represent investments in a joint venture while brown lines represent costs of outsourcing recycling to existing operators.

Australian variations on collaborative technology development

Another example of how the risks and costs of research and development can be distributed across members of a particular industry can be seen in the Australian Coal Association Research Program (ACARP). Research is funded by a voluntary levy of 5 cents per tonne of mined coal. A similar levy on all minerals produced in Australia could provide a significant pool of funds for projects such as developing transformational mine remediation (see page 17).

In this vision, the minerals industry in Australia develops in ways that promote production efficiency, materials stewardship, and connect to investment in recycling technology.

Closing the Loop

Many countries have already recognised the problems of dependence on virgin raw minerals (Chong *et al.*, 2009; DTI, 2005). Japan, South Korea and Taiwan have implemented metals recycling and initiated extended producer responsibility programs that can ensure their manufacturing sectors will not be exposed to supply constraints in the coming decades.

Major producers of consumer goods are benefiting from this push to ‘close the loop’ and avoid environmental problems by recycling and reusing these materials in new products. These producers are effectively stockpiling a range of mineral inputs for future production cycles (DTI, 2005). Some of these minerals include platinum, palladium, tantalum and indium from electronics in end-of-life-vehicles (ELV) (Togawa, 2008).

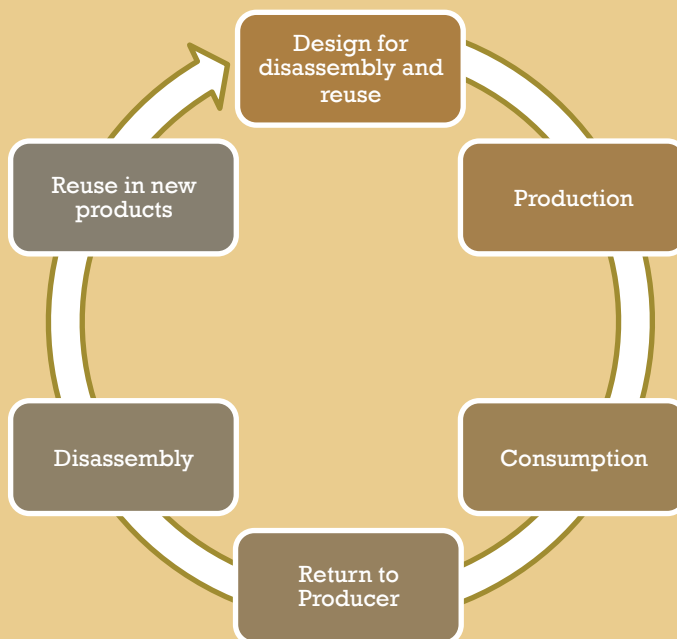


Figure 9: ‘virtuous’ cycle of resource development

Metals that may have originally come from a range of other continents are effectively captured by integrated production, disassembly, recycling and reuse systems (DTI, 2005).

Making Clean Production ‘Business As Usual’

Some stakeholders have suggested that a good way forward would be to support policy that fast tracks research, development and use of clean production technology. Manufacturers are now thinking much harder about how they can create products with high performance on issues like water, energy, social disruption and environmental degradation. In practice, this could mean mining Australian rare earths and supporting local manufacturing of magnets for wind turbines to

provide clean energy. Exporting magnets would provide export dollars and deploying clean energy in Australia would allow us to produce green minerals and strengthen the long term attractiveness of Australia for mining.

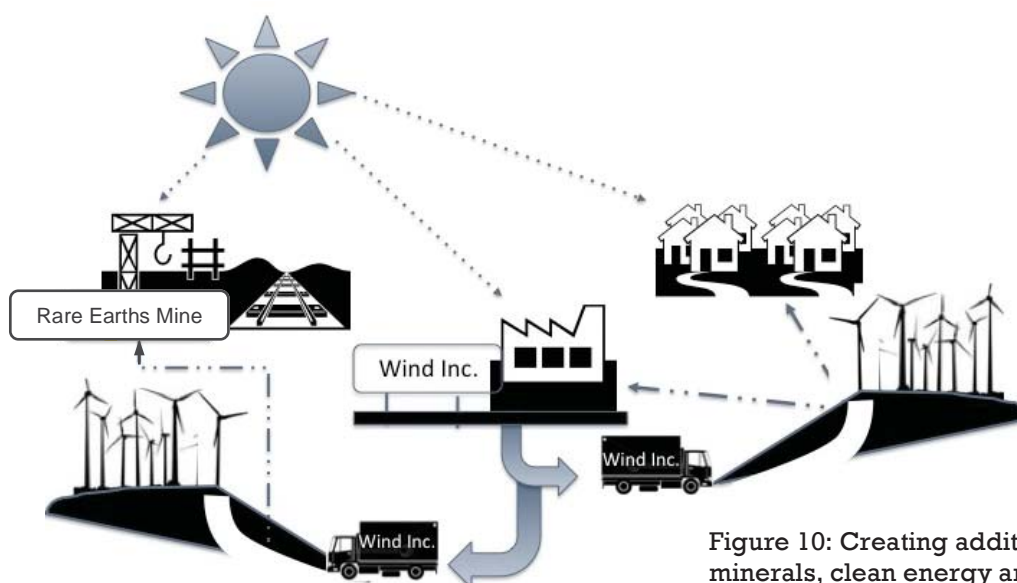


Figure 10: Creating additional value by connecting minerals, clean energy and manufacturing.

Recognising knowledge as the ultimate renewable resource

In this vision, Australia uses innovative approaches to managing its natural and human capital for a net gain. South Korea and Finland provide examples of innovative governance that recognise the limits, and impacts, of natural resource development.

Backing Australian know-how through innovative governance:

To broaden what Australia is good at, and to go beyond mining, this vision requires us to change our thinking about our nation's 'resources'.

Australians are extremely inventive, and this creativity has provided the world with many of the things that most people think of as 'modern' life. However, most of these technologies have been brought to the world market by the support of companies in other countries.

Several stakeholders have indicated that existing structures and programs of funding for developing useful technologies are insufficient to make Australia a true 'knowledge' nation.

Where is the ministry for a knowledge economy?

South Korea recognises that knowledge itself is a renewable resource upon which long-term development can be planned. Key initiatives of the South Korean Ministry of Knowledge Economy are outlined in figure 11 (below):

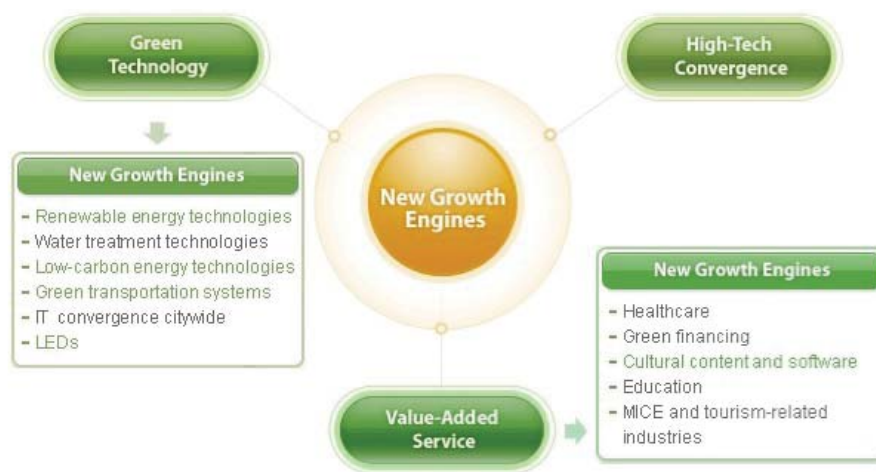


Figure 11: Outline of three majors in the South Korean economy that encompass 17 'growth engines' that will be 'actively fostered and promoted' (MKE, 2011)

Under the 'growth engine' of Green Technology, the South Korean Ministry of Knowledge has goals of "establishing" an innovative R&D system, and expanding "financial support for developing and commercializing technologies" (MKE, 2011).

Could Australia benefit from a proactive approach to economic development through innovation?

Finland's Green Mining program

Finland has set its sights on developing a mineral industry that is "intelligent", "invisible" and highly productive. The stated goal of the Tekes (Finnish Funding Agency for Technology and Innovation) funded *Green Mining* program is to "minimise environmental impact throughout the process chain" and to promote both material and energy efficiency in extraction processes. Finland has committed approximately 30 million euros to the program over 5 years, with the aim of being a 'global pioneer' by 2020. Finland's innovation has recently been acknowledged by the US-based Information Technology and Innovation Foundation (ITIF). Finland ranked second behind Singapore, and two places ahead of the United States in the most recent report on innovation and competitiveness (Atkinson & Andes, 2011). Australia ranked 12th in the ITIF assessment.

+ Vision statement:

“Mineral production makes a net positive contribution to a sustainable Australian economy”

76.7% of surveyed persons thought that the draft vision statement “provides a useful direction for developing sustainable mineral production.”

Survey respondents suggested that this statement could be made stronger or more useful through the use of more specific terms. For instance, some have suggested that the vision statement replace the ‘sustainable economy’ with ‘sustainable society’, while others have said that targets for a range of outcomes or specific environmental and social goals are required.

+ Strategy elements

81.5% of surveyed persons thought that the strategies in the draft vision “provide a clear path for achieving sustainable mineral production.”

Survey respondents indicated that specific strategies for improving the opportunities for innovation in water and energy use were required. It was also suggested that life-cycle costs and the relationship between ‘national’ and ‘industry’ benefit be explored in more detail.

+ Proposed initiatives

Survey respondents indicated high levels of support for most initiatives included in the draft vision. Support was highest for initiatives that:

- Develop appropriate measurements for economic, environmental and social impacts from mineral production (92%)
- Assist industry and communities to develop shared objectives (84%)
- Address resources scarcity (e.g. peak oil, workforce) and rising input costs (88%)
- Invest mineral wealth, so that it pays dividends to the national community - education, health, infrastructure and innovation (88%)
- Examine economies of scale that operate against regional diversification (84%)
- Implement monitoring and evaluation to ensure production reflects true costs (internalising externalities) (80%)
- Create one or more sovereign wealth funds that will act as a ‘trust’ for future generations (72%)
- Empower indigenous communities and support initiatives towards greater autonomy for indigenous people (72%)
- Develop policy for identification and distribution of benefits (72%)

+ Ongoing research

The work undertaken by UTS in developing *Vision 2040: Innovation in Mining and Minerals* will progress on two fronts during 2011-2012. Firstly, through a report on Sustainable Resource Governance that will include strategies and policies to support implementation of the vision. Secondly, future directions in research and technology opportunities arising from the vision will be elaborated – drawing on specific case studies in Iron/Steel, Copper, Gold, Lithium and Coal.



Figure 12: Outline of ongoing research within P1: Commodity Futures stream of Mineral Futures Collaboration Cluster.

Contributors to Mineral Futures Research

Participants from the following organisations are gratefully acknowledged for their input to workshops, surveys, and interviews associated with the Mineral Futures Collaboration Cluster research to date:

AMIRA International	Department of Foreign Affairs and Trade	Rio Tinto
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Australian Government, The Treasury	Energetics	Talison Minerals
Australian National University	ERM Group	The Australia Institute
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Centre for Policy Development	GHD	The Crucible Group
Centre for Sustainable Resource Processing	Institute for Sustainable Futures	The Green House (South Africa)
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Cliffs Natural Resources	Lhere Artepe Aboriginal Corporation	University of Queensland
Colonial First State	McKinsey & Company	University of Technology, Sydney
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CQUniversity	Minerals Council of Australia	World Economic Forum
CSIRO	Minerals Policy Institute	WWF – Australia
Curtin University	Ministry of Economic Development, NZ	
Department of Education, Employment and Workplace Relations	Monash University	
Department of Employment, Economic Development and Innovation (Qld)	Newcrest mining	
	ntscorp	
	Oxfam	
	Outotec	
	Pinoah	
	Productivity Commission	

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Further background information

Mineral Futures Discussion Paper:
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Peak Minerals:
A Review of Changing Impacts and Benefits
<http://www.isf.uts.edu.au/publications/giurcoetal2010peakmineralsreview.pdf>

Vision 2040:
Mining, Minerals and Innovation – Consultation Paper May 2011
http://resourcefutures.net.au/sites/default/files/draft_consultation_pre_survey_030511.pdf

WEF Future Scenarios Workshop Summary
(September 2010, Melbourne)
http://resourcefutures.net.au/sites/default/files/WEF_Australian_Workshop_Session_Summary.pdf

National Peak Minerals Forum Summary
(April 2010, Sydney)
http://resourcefutures.net.au/sites/default/files/UTS-WK-1-3-MinFutures_Peak_Min_Forum_Summary.pdf



Vision 2040: Mining, Minerals and Innovation A vision for Australia's mineral future

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