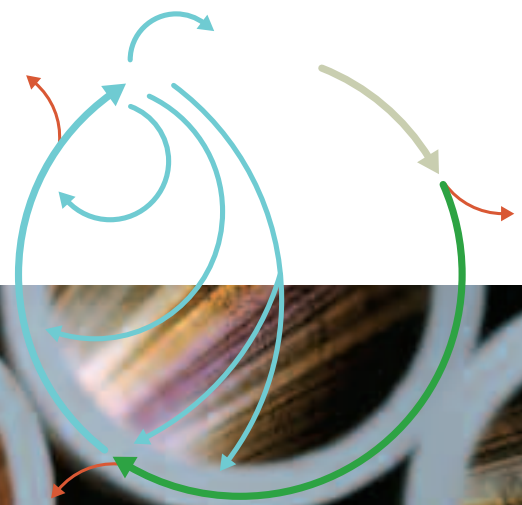


Maximizing Value

Guidance on implementing materials
stewardship in the minerals and
metals value chain

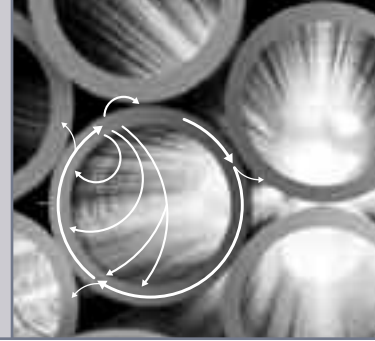
September 2006



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This guidance document assists International Council on Mining & Metals (ICMM) members in the implementation of effective stewardship strategies for the minerals and metals they produce. It is entitled *Maximizing Value* because the value of minerals and metals to society is maximized when the various stakeholders along the value chain undertake activities that enhance the durability and recyclability of minerals and metals, increase the efficiency of their production and use, and minimize associated risks.

Maximizing Value supports members in fulfilling their commitment to a number of the Principles within the ICMM Sustainable Development Framework, in particular: Principle 8, to “facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products”; Principle 4, to “implement risk management strategies based on valid data and sound science”; Principle 6, to “continually seek ways to improve our environmental performance”; and, Principle 5 to “seek continual improvement of our health and safety performance”.

Materials stewardship is an evolving concept that will ultimately be defined and implemented through the actions of various players in the life cycle or value chain of specific minerals and metals. This document presents current best practice through the use of industry case studies of what these actions should include.

The themes and activities presented in *Maximizing Value* were informed by a multi-stakeholder workshop hosted by the Minerals Council of Australia in Canberra in April 2004 and by subsequent consultations with key stakeholders. While the themes and activities are designed to point ICMM members in the right direction, these will be expanded and improved upon as materials stewardship practices become more fully developed.

ICMM recognizes that while many good initiatives are underway, fully implementing materials stewardship will require the input and co-operation of stakeholders along the value chain. Suppliers to mining operations, the users of minerals, product designers and engineers, regulators, the recycling industry and non-governmental organizations all have roles to play. To this end, ICMM welcomes input from interested stakeholders within and related to the metals and mining industry.

Paul Mitchell
Secretary General ICMM

‘Materials stewardship is built on the premise that the mining and metals industry has a shared responsibility for the performance of the whole materials cycle we are a part of, well beyond our direct operations.’

ICMM Workshop Report
March 2004, Canberra

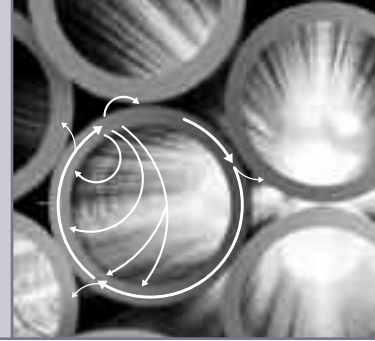
ICMM recognizes that making progress on sustainable development will require greater attention to the management of the materials produced from mine exploration, through use to reuse, recovery, recycling and eventual disposal (see Figure 1). Materials Stewardship is the concept ICMM defined to embody the range of activities required for optimal and appropriate use of minerals and metals in society. This guidance document provides practical direction, ideas and examples on the implementation of materials stewardship. It is entitled *Maximizing Value* because the value of minerals and metals to society are maximized when the various actors along the value chain undertake activities that minimize risks, improve efficiency and optimize the life cycle application of minerals and metals.

The audience for the guidance in *Maximizing Value* is ICMM members and other stakeholders in the minerals and metals life cycle (including end users, suppliers, communities, workers, the recycling industry and policy makers). *Maximizing Value* builds on previous ICMM efforts which defined materials stewardship as “the responsible provision of materials and supervision of material flows to create maximum societal value and minimum impact on humans and the environment”.¹

Materials stewardship encompasses both process and product stewardship. Process stewardship refers to activities undertaken by a company to ensure that its processes to explore, extract and refine minerals and metals are done in a way that minimize environmental impacts and health and safety risks. Product stewardship addresses the minerals and metals utilized in product systems by others, and refers to activities that influence or guide their application in order to minimize environmental, health and safety risks and enable recovery, reuse or recycling, as appropriate. The implementation of materials stewardship requires:

- **Understanding** the social, environmental and economic impacts of materials as they move through the life cycle from mining to use and through to the end of their life.
- **Developing Relationships** with different stakeholders to assist and influence beneficial use of materials as well as the minimization or elimination of risks to human health and the environment.

¹ ICMM, materials stewardship: An ICMM Workshop Report, March 2004, Canberra.



- **ICMM members to take action** on appropriate stewardship activities for the part of the life cycle they directly control. For areas outside their direct control, they should work with other actors in the life cycle to support their efforts.

Drivers for pursuing material stewardship include: meeting commitments contained in the ICMM Sustainable Development Framework; maintaining the 'social licence to operate' from communities and regulators; ensuring continued access to markets; keeping ahead of regulatory developments; costs savings opportunities that can arise from efficiency improvements and better risk management practices and the growing demand for more sustainable materials. The business benefits of pursuing materials stewardship include improvements in the efficiency of industrial processes, access to secondary resources, eliminating exposure to hazardous materials and optimizing product design to enhance durability, recycling and wider access to markets.

The guidance is organized into four themes, each with a comprehensive set of activities and illustrative examples designed to support materials stewardship programs. These themes are:

Taking a System Perspective encompassing activities to better understand material flows and life cycle impacts and benefits;

Building New and Strengthening Existing Relationships which includes a range of activities to enhance interaction with other actors in the value chain;

Optimizing the Production and Application of Minerals and Metals which is about undertaking activities to improve eco-efficiency at the process and the product level; and

Contributing to a Robust, Accessible Base of Information to Support Decision-making which is about transparent sharing and reporting of data and information to identify and improve materials stewardship.

Recognizing that Materials Stewardship is an evolving concept that involves a variety of actors, *Maximizing Value* does not prescribe specific activities for companies but rather a 'menu' of possible actions to select from.

The guidance has been developed to support an industry facing the need to demonstrate its commitment to responsible performance of the whole materials cycle. However it is equally important to understand and communicate that putting materials stewardship into practice will depend on the co-operation of stakeholders right across the value chain – the end users, product designers and engineers, regulators, commodity associations, the recycling industry and non-governmental organizations. It is hoped that *Maximizing Value* will help stimulate such co-operation.

1. Overview of Materials Stewardship and this Guidance Document

What is Materials Stewardship?

Materials stewardship means responsibly providing materials and supervising material flows to create maximum societal value and minimum impact on humans and the environment². In practice, materials stewardship is about:

- **Understanding** the social, environmental and economic impacts of your material as it moves through its life cycle from mining to use and through to the end of its life.
- **Developing relationships** with other actors along the life cycle who can promote beneficial and appropriate use of your material or who can minimize risks to human health and the environment.
- **Taking action** on appropriate stewardship activities for the part of the life cycle you directly control. For the areas outside your direct control, but where you have influence, work with and encourage other actors in the life cycle to play their part.

The ICMM Materials Stewardship Workshop Report from the Canberra meeting noted that materials stewardship is built on the premise that the mining and metals industry has “a shared responsibility for the performance of the whole materials cycle we are a part of, well beyond our direct operations”. The scope and main themes of materials stewardship are presented in Figure 1. These themes will be explored in more depth in Section 3.

How is This Guidance Document Structured?

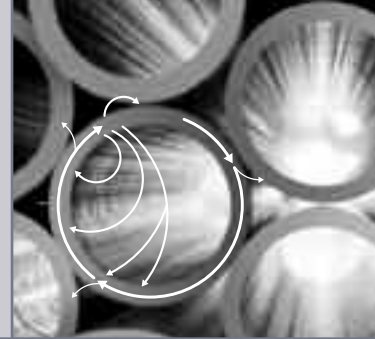
This document provides an overview of the context and drivers for materials stewardship, focusing on specific themes and activities that will support ICMM and its members in implementation. This section provides a basic overview of the concept, and of the audience for this guidance document. Section 2 provides context for materials stewardship in the minerals and metals industry, along with drivers and potential business value. In Section 3 the full scope of materials stewardship, represented by four guiding themes and associated activities, is presented. Each theme includes illustrative examples. Section 4 provides guidance on how to integrate materials stewardship into business decision-making. Section 5 contains some conclusions on the importance of immediate action. Finally, a list of resources and reference material is provided in Section 6.

Who is this Guidance Document For?

Maximizing Value provides ICMM and its members with practical direction, ideas and examples on the implementation of materials stewardship. The primary audience for the guidance is minerals and metals companies, however many of the recommended activities require interaction and collaboration with other actors in the value chain or material life cycle.

The guidance will also be useful for commodity associations and regional mining associations interested in promoting materials stewardship with their members, the users of the commodity(s) and other stakeholders. Commodity associations are often a key interface between the users of minerals and metals and the mining companies and therefore play an important role in helping the latter develop a better understanding of markets and end-users of the material. They are increasingly playing a key role in articulating the material life cycle (e.g., through the development of life cycle studies and risk assessments) and *Maximizing Value* may support them in these efforts. Regional mining associations are helping to improve the sustainability of mining operations through initiatives such as the Mining Association of Canada's *Toward Sustainable Mining Initiative* and the Minerals Council of Australia's *Enduring Value* guidance document. *Maximizing Value* compliments these and other efforts by providing guidance on how to extend the scope of company activity to include upstream (e.g., suppliers) and downstream (e.g., customers and the recycling industry) actors in the material life cycle.

² ICMM, Materials Stewardship: An ICMM Workshop Report, March 2004, Canberra.



Why Materials Stewardship?

Governments and leading industrial companies are moving toward more sustainable forms of production and consumption

...and this shift is resulting in ever greater scrutiny of the technical performance, environmental, social and health and safety attributes of materials that go into product systems.

Materials that are not managed properly are being restricted from certain uses

...and this means material producers must minimize negative impacts of their materials or risk losing access to certain markets.

There is business value in undertaking stewardship activities

... and companies that undertake effective stewardship actions will gain competitive advantage by realizing benefits such as cost savings, increased market access and reduced risks.

The continued use and application of minerals and metals is supported by developing relationships with various actors in the value chain

...and materials stewardship activities can help identify and initiate these relationships.

Is Maximizing Value a Prescriptive Guidance Document?

Maximizing Value supports continual improvement by providing guidance on materials stewardship practices. ICMM member companies represent a diverse audience, each managing a particular group of materials with its own unique characteristics, markets and end uses. *Maximizing Value* does not prescribe specific activities a company must undertake, rather the activities under each theme can be seen as a 'menu' of possible actions from which to select. The themes represent key areas where activities should be undertaken, and it would be difficult to envision a materials stewardship initiative that would not require action in all of these areas. At a minimum, integrating life cycle thinking into your decision-making and deepening relationships along the value chain are key principles underpinning materials stewardship.

Readers are directed to select and structure materials stewardship activities according to core business, largest markets, customer base, position in the value chain and the characteristics of the materials or products you provide. Some of the activities require shared responsibilities between various companies along the value chain, while others can be taken on internally.

Maximizing Value will also provide policy makers and stakeholders with insight on the contribution materials stewardship can make to evaluating and improving the overall sustainability of mining operations, as well as the performance of minerals and metals and the products they are a part of. Maximizing Value may also be of direct interest to other actors in the material life cycle who may want to initiate or enhance their own stewardship efforts.

2. Context, Drivers and Business Value

‘Sustainable Development – development that meets the needs of the present without compromising the ability of future generations to meet their own needs’

Our Common Future 1987³

Materials Stewardship and Sustainable Development

Sustainable Development (SD) is an increasingly important priority for government, industry and non-governmental and multi-lateral organizations around the world. Evidence is mounting that unsustainable patterns of development are undermining the environmental, social and economic foundations of modern society and it is increasingly critical that all actors in society do their part to support the shift to more sustainable consumption and production practices⁴. The ICMM and its members have responded to this challenge through an overarching SD Framework, comprising a set of Principles, a public reporting and verification system (in conjunction with the Global Reporting Initiative) and ongoing efforts to share good practices.

Even with these efforts the challenge ahead is significant and ICMM’s SD Framework represents an ambitious challenge. Of critical importance will be the ability of ICMM members to work with other actors in the value chain to promote optimal use, minimize environmental, health and safety risks and wherever possible, capture and re-circulate the value of materials through the economy. Materials stewardship is the concept the ICMM has chosen to embody the range of activities required to ensure the industry works with other actors to encourage optimal and appropriate use of metals in society.

Materials Stewardship and the Minerals and Metals Life Cycle

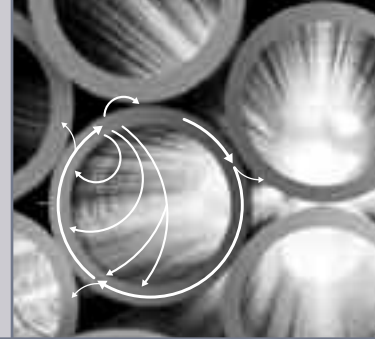
Figure 1 illustrates the scope and key themes around which materials stewardship activities can be organized. The diagram illustrates a mineral and metal life cycle highlighting key operations and activities from production through end-of-life and recycling⁵.

The early stages of this life cycle (exploration, mining, processing, smelting and refining) are areas where the primary stewardship activities are focused on efficiency, productivity of resources and minimizing environmental, health and safety risks. This aspect of materials stewardship represented by the silver arrow is where many ICMM members

³ Bruntland, G. (Ed.), (1987) *Our common future: The World Commission on Environment and Development*. Oxford University Press, UK.

⁴ Numerous reports and studies have documented the need for sustainable development, in particular see the Millennium Ecosystem Assessment at www.millenniumassessment.org/en/index.aspx, the report of the 2002 World Summit on Sustainable Development at www.uneptie.org/outreach/wssd/home.htm and the Inter-governmental Panel on Climate Change’s assessment reports and technical papers at www.ipcc.ch/activity/act.htm

⁵ Adapted from *Breaking New Ground – the Mining Minerals and Sustainable Development Final Report*. Earthscan Publications, 2002.



have the most direct control and it is referred to as process stewardship.

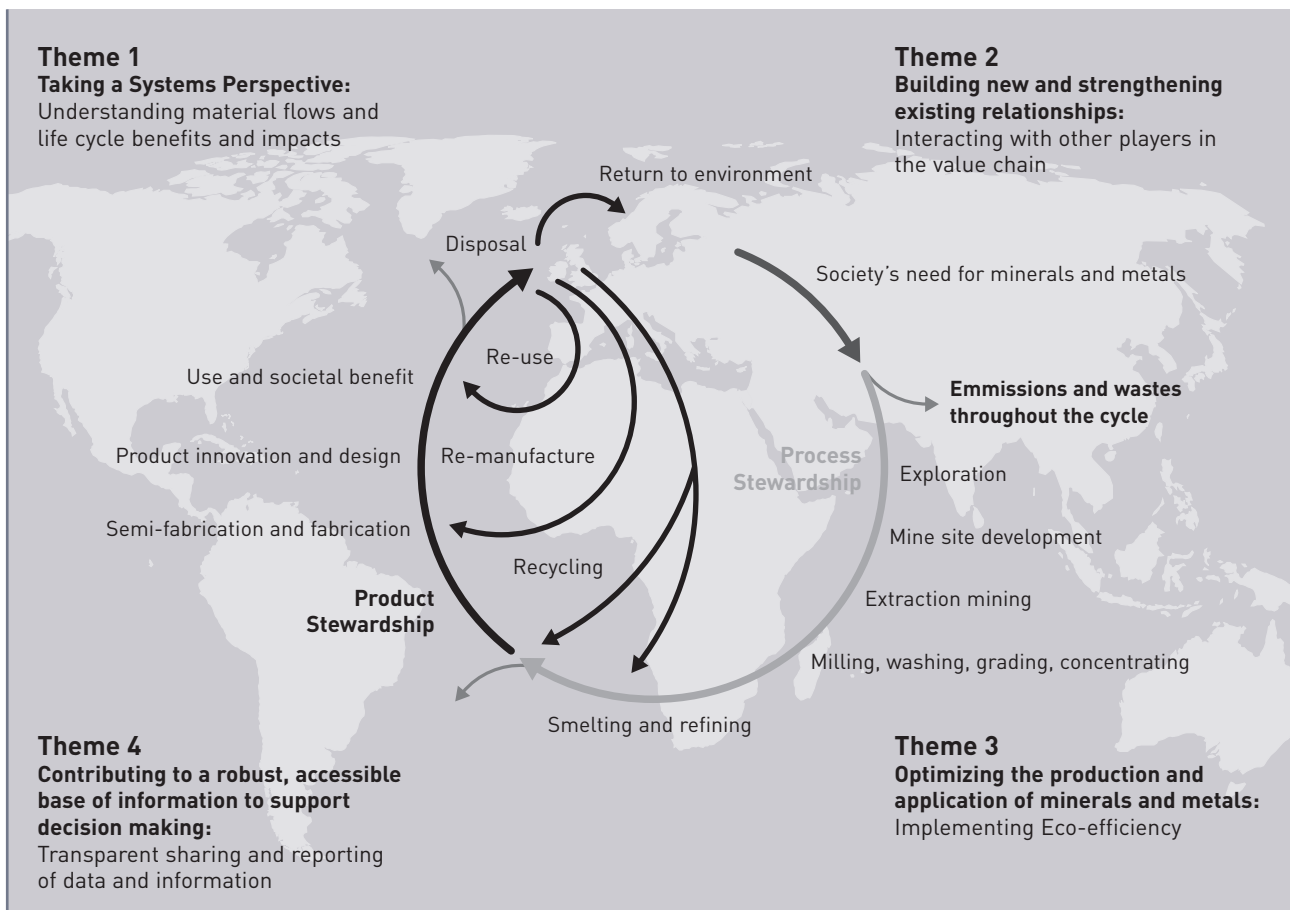
As mineral and metals make their way from smelting and refining operations into widespread use, stewardship responsibilities expand. These responsibilities include supporting appropriate applications and facilitating efforts towards recovery and re-use as appropriate. This aspect of materials stewardship represented by the black arrow is referred to as product stewardship and involves many more actors in the value chain. For example, choices made by product designers and engineers (e.g., material and process technology selection) can have significant influence on a product's overall environmental impact, and these actors can therefore be important players in implementing materials stewardship strategies.

When selecting from the materials stewardship activities outlined in this guidance document it is important to consider your position in the life cycle

of a particular material. In practice, individual companies have varying degrees of control or influence at different points and this will affect their materials stewardship activities. For example a vertically integrated company involved in fabrication and product development as well as exploration, extraction and refining, will have greater opportunity to influence the design of products (e.g., to enhance materials recovery and recycling) than a company that sells its materials as commodities.

Similarly the characteristics of specific minerals and metals can help determine where materials stewardship activities need to be undertaken. A mineral or metal with hazardous properties may require more co-ordinated and structured materials stewardship activities than a more benign substance. Producers of minerals that in various applications are effectively consumed in use, may also prioritize different materials stewardship activities.

Figure 1: Themes and activities in materials stewardship



Adapted from: 'the minerals cycle' in *Breaking New Ground – the Mining Minerals and Sustainable Development Final Report*, Earthscan Publications, 2002

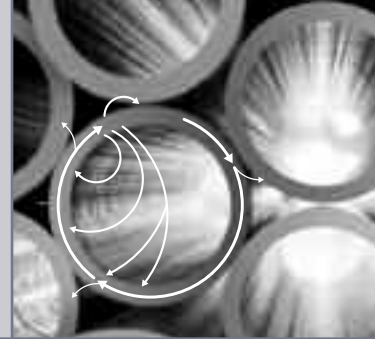
Business Drivers for Materials Stewardship

The business benefits of pursuing materials stewardship are clear for many actors along the minerals and metals value chain. Improving the efficiency of industrial processes, minimizing exposure to hazardous materials and optimizing product design to enhance durability and recycling are only a few reasons why materials stewardship makes sense. For the minerals and metals industry, the drivers for materials stewardship can include:

- **Public Commitments** – ICMM and its members have committed to a comprehensive Sustainable Development Framework. These include maximizing the value of materials from mining through use, end-of-life and recycling. This public commitment must be acted upon to ensure the industry maintains credibility with external and internal stakeholders. Meeting these commitments will also help secure continued access to capital, land and mineral resources (see social licence to operate).
- **Competition and Market Access** – Industrial sectors such as electronics, automotive, heavy manufacturing and building and construction are evaluating the environmental and sustainability attributes of materials as part of selection processes. A small but growing number of leading companies in each of these sectors want assurance that the materials they select do not cause undue costs and risks. In some cases, companies are proactively searching for materials that will contribute to the environmental or sustainability performance of their products or projects through the entire life cycle. In the future, the evaluation of sustainability performance of materials will increasingly take into consideration the specific source of the materials (e.g., practices at the mine or factory where the material originated).
- **Earning and maintaining the social licence to operate** – Reputation as a good corporate citizen is an increasingly important determinant in establishing a company's social licence to operate and grow. For example, failing to obtain regulator and community support for a new mine or an expansion project can increase costs by holding up approvals in lengthy public hearings. The Mineral and Metals Sustainable Development initiative clearly illustrated that stakeholders have high expectations of mining companies when it comes to managing impacts associated

with the extraction and processing of metals (e.g., land disturbance, tailings and effluents and emissions to air from smelting and refining operations). Effective stewardship of mining and material processing is a key aspect of mitigating and managing these impacts to meet stakeholder expectations.

- **Regulation** – There are global regulatory initiatives to decrease the impacts of mining operations, reduce the amount of material going to landfill and direct proper management and recycling of materials. Extended producer responsibility, integrated product policy and other product-focused policies are assigning responsibility to actors along the product life cycle to manage environmental impacts and optimize resource recovery and recycling. Chemical prioritization schemes seeking to limit the impacts of toxic materials on human health and the environment are also taking a broader view of the materials being evaluated (i.e. the REACH chemical policy strategy for the European Union will incorporate more information on downstream users into risk assessment and chemical prioritization, and its rules will have a global impact on the industry).
- **Cost Savings** – Numerous case examples illustrate how materials stewardship can improve resource productivity, increase mine efficiency, inform risk management, improve processes and eco-efficiency and contribute to other cost saving measures. (See section on business value, page 10).
- **Market Development** – Future markets will favour materials with superior sustainability performance. Population growth, economic development in markets such as India and China, and the rise in worldwide industrial output all point to a continued and growing market for minerals and metals and other materials. However the environmental and socio-economic consequences of these trends also point to an increasing need for materials that are harvested, extracted, produced, used, recovered and reused with minimal negative impacts on the environment and society.



Environmental, Market and Government Policy Signals

Environment

Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted.

Statement from the Board
United Nations Millennium Ecosystem Assessment Report
2005

Market

A higher level of recycling is an important method of reducing the consumption of finite resources. All Volvo cars are designed to take account of their recyclability at the end of their useful life. This is a matter of specifying the correct materials and developing solutions which will facilitate dismantling. To simplify recycling, we mark plastic components, avoid mixed materials and reduce the number of fasteners. This allows 85% of a new Volvo to be recycled and the aim is to increase this to 95%.

Volvo Car Corporation

Government

OECD governments should... "take steps to improve information on material flows, including its quality and relevance for environmental management, in particular: develop methodologies to enhance knowledge of material flows within and among countries; consolidate and improve data collection concerning material flows within and among countries; and develop tools to measure resource productivity and economy-wide material flows, including appropriate estimation methods, accounts and indicators".

Excerpt from Statement on Material Flows and Resource Productivity, OECD Council 21 April 2004

Regulatory controls on end-of-life automobiles & electronics as a driver for materials stewardship

Regulations to reduce the environmental burden of two major consumer products groups, automobiles and electronics, at the end of their use have been initiated in various jurisdictions worldwide. This is putting pressure on manufacturers and material suppliers to consider how material selection will facilitate easier recycling processes downstream. Several such directives are described below and those based in the European Union are becoming the standard by which others are being developed globally. However, these directives have also had a broad impact on global product design as manufacturers recognize the trends being established in Europe are spreading throughout the world.

End of life of Vehicle (ELV) Directives

(European Union and North America) – The European Commission officially adopted ELV in September 2000 in order to promote recycling of vehicles and make vehicle dismantling and recycling more environmentally responsible. It sets quantified targets for reuse, recycling and recovery of vehicles and their components and calls on producers to design more easily recyclable new vehicles. The European Union's development of ELV targets for recyclability and phase-out dates have also influenced efforts in the U.S. automotive industry, including manufacturer's activities on substances of concern and the timing for reduction or phase-out of various materials. In connection to the ELV Directive, the International Materials Data System (IMDS) has been developed for collecting information on all materials used in vehicles. Most of the largest manufacturers in Europe and North America use the IMDS and ask their suppliers to report material data into the system.

WEEE and RoHS Directives

(European Union) – The Directive on Waste Electrical and Electronic Equipment (WEEE), which came into force in February 2003, addresses collection and recycling of electronics in European Union member countries. The objective is to prevent waste from electronics and electrical equipment by encouraging reuse, recycling and other forms of recovery. The Directive also intends to improve the environmental performance of all operators in the product life cycle, including producers, distributors, consumers, and those involved in waste treatment. Under the Directive,

producers must finance collection, treatment, recovery, and environmentally sound disposal of EEE waste from households and other entities.

The European Community has simultaneously adopted the proposed Directive on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment. The Directive calls for manufacturers to remove certain hazardous substances from several types of equipment, including IT and telecommunications equipment, large and small household appliances, lighting equipment, and electrical and electronic tools and toys.

Automobile Recycling Law

(Japan) – Under the law, which went into effect in January 2005, it is compulsory for car owners to prepay automobile recycling charges, and for manufacturers and importers to collect and appropriately dispose of various hazardous parts from end-of-life vehicles. During January of 2005 alone, 1.49 million cars were disposed of, and a total of 1.46 billion yen was collected. Although the ferrous and non-ferrous metals are currently recycled, the remaining shredder residue is being disposed of as waste in landfills. To reduce the amount of material being sent to landfills, automobile manufacturers have looked beyond the implementation of this law and have started to develop cars that are easier to dismantle or recycle. The government is aiming to increase the recycling rate from the current 80%, to 95% or higher by 2015.⁶

The Business Value of Materials Stewardship

Three examples below demonstrate how the implementation of materials stewardship practices create tangible business value. Additional case studies illustrating the business value of materials stewardship activities are provided throughout the remainder of the document.

Improving resource productivity, conserving energy and water, and preventing environmental health and safety risks improves the financial performance of mining operations and helps secure their continued licence to operate

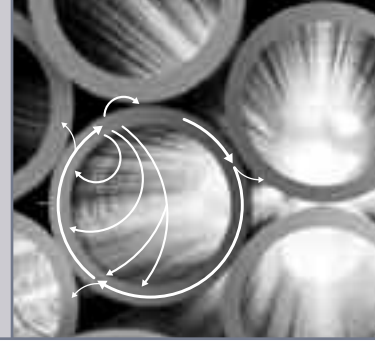
The BHP Billiton subsidiary QNI operates a nickel refinery at Yabulu, 25 kilometres north of Townsville in Queensland, Australia. The refinery developed the Yabulu Optimization Initiative to increase cobalt and nickel recovery, increase throughput and decrease unit costs.

The optimization project commenced with employee workshops aimed at identifying viable projects. Three initial projects resulted in significant water and energy usage efficiency improvements as well as reductions in greenhouse gas emissions per tonne of product. The initiatives also resulted in breakthroughs in engineering design and implementation. Overall efficiencies in the use of water and coal, and increased product sales yield savings for QNI of over AUD\$3.8 million per year.

Working with recyclers and product manufacturers who take responsibility for their products at the end of their useful life will help increase the recovery and recycling of metals

Umicore has evolved from its roots of refining and smelting base metals to become very active in recycling and downstream materials businesses (batteries, fuel cells, engineered materials and many others). Two specific business activities – the creation of their Precious Metals Services recycling business and the development of advanced technologies and production facilities close to key markets – have broadened the company's scope and contributed significantly to Umicore's revenues (which have grown by a factor of three since 1995). Recovered materials can be an increasingly important source of metals.

⁶ Adapted from: www.jijigaho.or.jp/app/0505/eng/gov02.html and www.toyota.co.jp/en/environment/recycle/nitty_gritty/index.html



Working with downstream users of minerals and metals can help ensure applications of metals are appropriate from an environmental perspective, durability is enhanced, and new applications are identified to help preserve and grow the market for metals

Alcoa is aggressively pursuing the ‘environmental value’ of recycled aluminium by developing a number of strategic initiatives and partnerships with key customers and other stakeholders. These initiatives include setting aggressive corporate targets for the use of recycled aluminium, partnerships to develop recycling technologies (e.g., working with Tetra Pak to effectively separate and recycle aluminium and paper in beverage cartons), promoting awareness and participation in recycling programs with civic leaders, and increasing overall recycling capabilities and efficiencies. The recycling strategy is part of the company’s overall efforts to position aluminium as a sustainable material of choice for packaging and transportation applications.

Materials stewardship also contributes to the overall reputation of the sector, and a positive reputation supports continued access to capital, land and human resources necessary to maintain a viable and sustainable industry

While some sources of business value are clearly visible and easily measured (e.g., cost savings through energy and water efficiencies), other sources of value are less tangible (e.g., an enhanced ‘reputation’ of a material with customers and regulators may lead to more applications and market growth). It has already been demonstrated that when materials stewardship is not embraced throughout the value-chain, regulators may intervene and place the burden of responsibility on manufacturers. Such regulation is often disproportionate, focusing more on minimizing impacts of materials than on maximizing their value, and can be relatively inflexible in implementation. Accordingly, industry sectors that adopt a proactive approach to materials stewardship benefit by pre-empting the imposition of unnecessary regulation and preserving market access⁷. Employee productivity, morale and retention are other sources of intangible value. Studies have shown employees respond positively to the proactive management of

environmental, health and safety issues by their employer and materials stewardship can support this relationship. Aligning corporate values and behaviours with employee values typically results in a win-win situation.

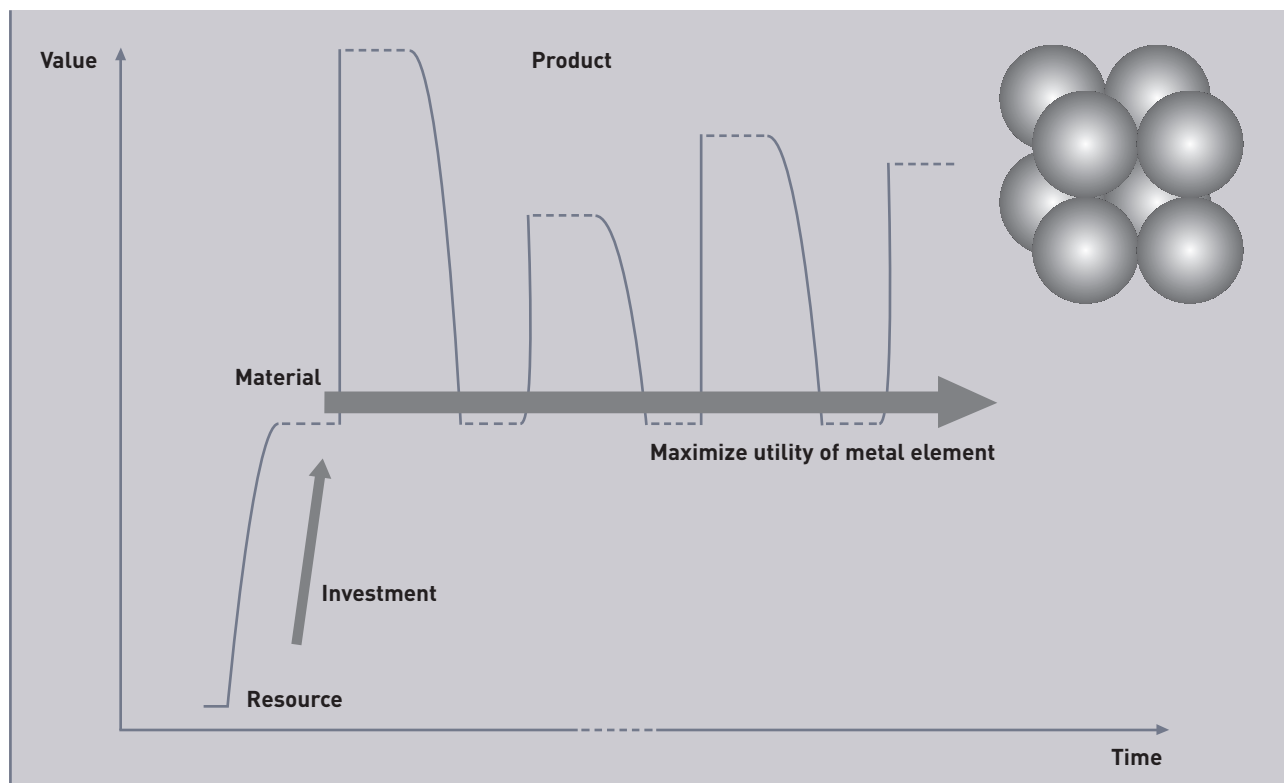
⁷ICMM – see www.icmm.com

Value added profile for recoverable metals

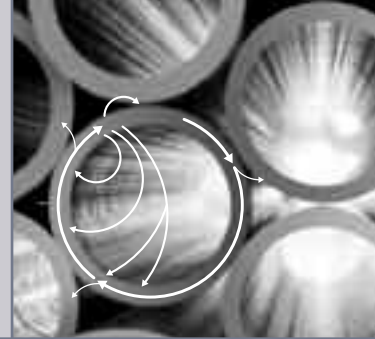
For metals, an initial investment is required (exploration, mining, refining, smelting) to turn mineral resources into useable materials (e.g., copper, zinc, nickel, gold etc.). This investment can be significant in terms of energy and financial costs, but it is rewarded by the valuable benefits the material provides (e.g., by improving thermal conductivity and energy efficiency, or by extending the durability of products, or enabling reuse or ongoing recycling of the products it is integrated into). Thus, once resources are transformed into a 'materials', they should be managed to maximize their utility and minimize the 'loss' or degradation of their inherent value (Figure 2). Continued investment in the appropriate use and recovery of the material will offset the initial investment and impacts, and support the use of the material in (multiple) product cycles. The recycling of the material stock is potentially unlimited. Thus, many of the materials stewardship activities put forth in this guidance document focus on continuing or extending the use of materials in order to maximize their value and meet the needs of future generations⁸.

For minerals, the value profile is different. In particular applications, minerals and some metals are dispersed and recycling is not a straightforward option. For instance, boron, zinc, copper, manganese, iron and other essential micronutrients may intentionally be dispersed to agricultural soils or in pharmaceutical products for social and health reasons. Here, a company's materials stewardship activities may include risk assessment and life cycle studies to understand uses, fates and effects of their material on humans or the environment. Activities may also include co-operating with manufacturers, consumers and associations to find points in the life cycle to enhance the material's valuable benefits or manage its negative impacts during production, processing, use and disposal. It is essential to recognize there are multiple issues and impacts across the life cycle of a product, not only at end-of-life. In managing these, an assessment of both benefits and potential negative impacts will be fundamental.

Figure 2: Materials eco-efficiency profile for metals (primary stewardship strategy indicated)



⁸ Five Winds International. 2001. Eco-Efficiency and materials, International Council on Metals and the Environment, Ottawa.



The Scope of Materials Stewardship

As noted above, materials stewardship activities directly support a number of ICMM's Principles, in particular Principle 8, to "facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products"⁹. In developing its approach to materials stewardship, ICMM efforts have been informed by:

- Ongoing engagement and dialogue with key stakeholders (via forums such as: the World Summit on Sustainable Development, the Global Mining Initiative, the Mining Minerals and Sustainable Development Project, development of the Minerals and Metals Sector Supplement for the Global Reporting Initiative's Sustainability Reporting Guidelines and the UN Global Compact), and
- Specific projects to quantify life cycle flows of minerals and metals and their benefits and impacts, undertaken by research groups, commodity associations, individual companies and regional associations.

Processes & Products

From these consultations, projects and research efforts, the scope of materials stewardship is now understood to encompass both process and product stewardship. For ICMM, *process stewardship* refers to activities undertaken to ensure processes undertaken directly by a party to explore, extract and refine minerals and metals are done in a way that minimize environmental impacts and health and safety risks. *Product stewardship* addresses minerals and metals utilized in product systems by others and refers to activities that influence or guide their application in order to minimize environmental, health and safety risks and enable recovery, reuse or recycling, as appropriate. (See Figure 1). This is the scope of materials stewardship as it was defined at the ICMM Workshop on materials stewardship held in Canberra, Australia in 2004.

Shared Responsibility

Guidance for implementing process stewardship (e.g., managing the social, health, safety and environmental issues of mining operations) is well underway through efforts such as the Mineral Council of Australia's *Enduring Value* document. In comparison, understanding and implementing product stewardship – from production through manufacturing, use and end-of-life – is still evolving. This is understandable given the

Materials Stewardship

Materials Stewardship involves actively managing materials use along the value chain to maximize net benefit, minimize losses, conserve resources, actively contribute to sustainable development, enhance societal value, and maintain our licence to produce and market.

It requires the acceptance of complementary responsibility, the recognition of stewardship roles among all stakeholders and provides a common interface for collective pursuit of sustainable development in material life cycles.

Materials stewardship is one facet of good governance, has a strong market driven component and will require going beyond regulatory compliance. It requires adoption of a life cycle management approach utilizing risk assessment and risk management at all points in the life cycle.

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necessary involvement of other actors in the value chain and the considerable variation in the complexity of the product systems in which the materials are used (e.g., a gold bar to a telephone to an automobile). Although it may be complicated, understanding the entire value chain and the roles and responsibilities of other actors can be very helpful from a stewardship perspective. Knowledge of the value chain can help identify key partnerships and actions that will improve the overall stewardship 'performance' of your material(s). This shared responsibility among the various actors in the material life cycle is critical. As the participants in the Canberra Workshop noted "*The overall concept of materials stewardship is built on the premise that we have a shared responsibility for the performance of the whole materials cycle we are part of, well beyond our direct operations*".

This observation applies to all actors in the value chain but recognizes that some may be in a better position to influence outcomes than others. Materials stewardship compliments many existing concepts and tools that support industrial activities toward sustainable development (e.g., eco-efficiency, life cycle management, environmental management systems). A selection of these complementary concepts and tool are listed at the end of this document.

⁹ www.icmm.com/icmm_principles.php

3. Themes and Guidance on Activities

Theme 1

Taking a Systems Perspective

Materials stewardship is supported and facilitated when actors in the material life cycle take a systems perspective and look at the business, social, environmental and health and safety issues and opportunities beyond their own immediate position in the value chain.

This perspective is turned into action when life cycle considerations are integrated into an organization's management systems and business decision-making processes. Purchasing, research, marketing, as well as long-range planning and capital allocation procedures will require information on the business, social, environmental and health and safety issues and opportunities which lie beyond your own gate. A systems perspective can help advance materials stewardship. As it requires new ways of thinking and new inputs into decision-making, leadership, skills, incentives and resources are also needed.

Stewardship activities

Have I mapped out my relationships and material flows?

1.1 Map your key materials flows, applications and responsibilities. Begin with a 'big picture' summary of main inputs to your material (from exploration to your key end-use markets), priority end-uses, customers and actors along the life cycle – particularly those who affect the ultimate use and end of life of the material. The main objective in undertaking this mapping exercise is to better understand who is involved in your material(s) value chain. This activity can help identify where you may have direct control over stewardship activities, where you may have a shared responsibility and where other actors in the value chain need to take the lead. As a first step, you may try to gather this type of information from business unit managers and marketing personnel.

Have I identified the areas in the material life cycle where I have the most direct control and influence?

1.2 Look downstream to understand the social, environmental, health and safety (EH&S) issues and benefits for the key applications for your material. The objective is to know where your material is being used including potentially inappropriate applications and potential opportunities for growth. To begin, you may gather this type of information from government affairs, marketing and from your industry association. For major applications of a material, you may want to investigate:

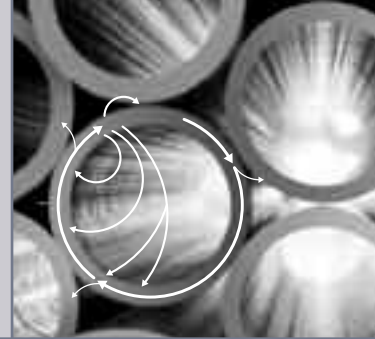
- environmental, health and safety issues or concerns;
- technical and cost benefits of your material for a given application;
- performance attributes that enhance the environmental performance of the application/product;
- competing materials profiles;
- any perceptions or concerns of downstream players regarding the use and end of life of the material; and
- concerns associated with by-products generated throughout the life cycle.

Do any of the applications of my material pose a risk or opportunity to my business?

1.3 Look upstream to learn about the firms supplying your operations with material, water, electricity, equipment, transportation and other inputs. Understand the social, environmental, health and safety issues associated with suppliers to exploration, mining, smelting or refining operations. Document perceptions and concerns, and gain an understanding of how your operations influence these (e.g., can you adjust your process or contract terms in a way that improves environmental performance or reduces risk). Initially, purchasing, contracting and government affairs may be able to provide some of this information.

What do I need to investigate further?

1.4 Select an end product or material application to learn more about (for instance, a workshop to track one product from beginning to end). Setting priorities is necessary as mining, refining, and smelting operations can have many different impacts, and materials leaving the refinery or the smelter can go into thousands of different



applications. Prioritize according to volume, economic value, risk exposure, commodity association activity, emerging environmental regulation, interest from a customer or particular market region, or other factors. Be careful not to assume applications with highest demand volumes have the greatest adverse impact as this is not always the case [see *work with industry associations, non-governmental organizations and regulators*]. Once you have selected a product or application to investigate further, consult existing information sources to learn more (e.g., product environmental regulations, product certification schemes, public concerns relating to products or materials).

Is there a risk if I do nothing, or a value if I do something?

1.5 If an application has a demonstrable sustainability benefit or a potential social, environmental or health and safety impact, attempt to quantify it. Measure the life cycle environmental and health and safety attributes of your material in key applications where there may be a significant impact or viable opportunity with a customer. Life cycle studies are one way to quantify environmental impacts associated with energy use, water and land use, durability, reuse or disposal.

For Kennecott Utah Copper, quantifying the environmental performance of its sulphuric acid became a priority when a customer requested the information before selecting Kennecott as its supplier.

Can my reputation and credibility be strengthened by reporting on impacts identified across the life cycle of my materials?

1.6 Report on impacts and risks within your own operations and in various applications along the life cycle. Your stakeholders look for assurance that you know where inputs to your operations come from, where your materials and products are used, and what your role is in managing key impacts throughout. Transparency and credibility are enhanced when governmental and non-governmental organizations are involved in the identification of life cycle impacts, the creation of plans to address impacts and in reviewing or verifying any public reporting of those impacts.

Looking downstream (Activity 1.2)

Understanding a wider scope of issues, conventionally seen as purely a risk to business, can reduce risks and uncover those which offer opportunity, not only those risks which pose threats¹⁰. Decisions in design and purchasing, based in part on the analysis of a product's environmental impacts through its life cycle, continue to increase in a range of sectors, from the equipment industry (ABB, TetraPak) to construction (Outokumpu copper roofing) to personal mobile telephones (Nokia) and computers. Such analyses require multi-player co-operation over the product life cycle.

Tetra Pak conducted a life cycle study and created an ISO certified Environmental Product Declaration for one of its machines, which forms and fills packages. The study incorporates life cycle data on stainless steel, aluminium, glass, silicone, brass, copper, bronze, titanium, PVC and other materials as well as electrical cables and electronic boards. The declaration is given to customers as well as other interested stakeholders.

 **Tetra Pak**
protects what's good™

Nokia manages its environmental activities based on life cycle thinking for mobile phones and network equipment, which have different life cycle profiles. For mobile phones, raw material extraction and component manufacture account for the largest share of overall environmental impact. For network equipment, energy consumption during use accounts for the largest share of overall environmental impact. Keeping these differences in mind, Nokia can work more effectively to minimize negative environmental impacts.

Priorities for selection and use of materials are made by considering the materials efficiency of products along with substance management issues. A key component of materials efficiency is the consumption of less raw material in product manufacturing. As the size of mobile devices has decreased drastically, the range of services they provide has increased, meaning materials efficiency has greatly improved. Nokia has taken a precautionary approach and compiled a Nokia Substance List (NSL) based on regulatory

¹⁰Sustainable Asset Management, "Research Methodology: focus on value". www.sam-group.com

requirements and reasonable facts. The NSL identifies substances that Nokia has banned, restricted or targeted for reduction with the aim of phasing out their use in Nokia products.

Learning more about life cycle analyses in your key markets, the business drivers behind those and resulting decisions will highlight the type of life cycle information you can contribute. If the industry does not proactively offer solutions, it is possible more substances will be deemed 'of concern' and designers will refer to lists of hazardous properties to make decisions.

NOKIA

CONNECTING PEOPLE

Latvata (formerly Outokumpu) received certification by a German environmental product declaration scheme for several of its copper roofing products. The AUB (Arbeitsgemeinschaft Umweltträgliches Bauprodukt E.V.) certification is based on environmental and health and safety issues in construction products, from sourcing raw materials through to recycling of material at the end of the product's life. In order to obtain AUB certification, Outokumpu was required to provide AUB with a detailed summary of the product's manufacturing processes and information regarding product use and related environmental and human health considerations.¹¹

LATVATA

To address the growing demand for stewardship, DuPont developed a series of supplier criteria to assess the impacts of the materials used in its products. For titanium dioxide (TiO₂) – a material used in various DuPont products – DuPont outlined the following four supplier criteria: Promote the responsible mining and initial processing of titanium ores in the Murray Basin region; encourage the mineral sands industry to pursue environmental, social and economic outcomes that achieve progress towards sustainability in the Murray Basin region; support DuPont's commitments to product stewardship and ethical conduct and its premium brand status for TiO₂ products, which is based on safety, quality and environmental care and provide DuPont with

long-term resource security for obtaining titanium ore feed stocks from the Murray Basin region. These objectives form the basis for the supplier criteria that will become a required condition included in any off-take agreement.



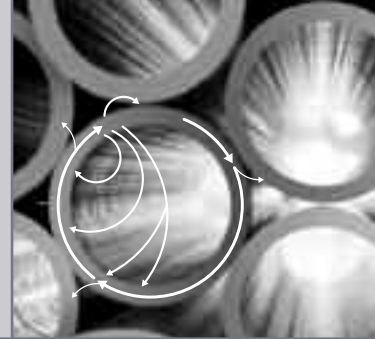
Quantifying impacts for priority products or applications (Activity 1.5)

Kennecott Utah Copper, a mining, smelting, and refining company, conducted a life cycle assessment study on the sulphuric acid it sells as a by-product of its copper smelting process at the request of a key customer. Cargill-Dow LLC made the request as it was seeking a 'green' sulphuric acid for its bio-based polymer. In the U.S., Kennecott is the largest producer of sulphuric acid and its smelter captures 99.9% of the sulphur dioxide emissions produced. The life cycle study included the mine and the process. Cargill-Dow determined from the results of the LCA that the sulphuric acid met its 'green' criteria and established a contract to purchase from Kennecott.

The Business Value?

- Competition and market access – as designers and manufacturers select materials for components and products, they are increasingly evaluating environmental attributes to avoid undue risks or costs and find materials that contribute to overall environmental, economic and social performance of a product. Kennecott used information about the life cycle environmental impacts of its sulphuric acid to establish a contract with a key customer that was actively evaluating the life cycle environmental performance of its own product.
- Market development – future markets will tend to favour materials with attributes that contribute to a product's superior environmental, social and economic performance. Companies demonstrating how a material makes that contribution, during mining, manufacturing, use or disposal, will be better positioned for success in those markets.

¹¹ Adapted from text originally posted on www.outokumpu.com



Theme 2

Building New and Strengthening Existing Relationships

Everyone in the value chain has a responsibility to make sure a material is used properly which means that relationships between actors along the life cycle are a critical part of implementing materials stewardship. Exchanging information with actors you may not be accustomed to working with (such as recyclers, consumers, manufacturers and fabricators and leaders in other sectors) can help you identify risks or opportunities along the life cycle of your material(s). It can better position you to co-ordinate efforts for maximum economic and environmental improvements. The relationships you choose to foster may be determined in part by priorities you identify in Theme 1 (e.g., electronics versus architectural applications). As you extend your understanding of the uses and applications of your materials you will become a reliable source of information and other actors will want to work with you as they strive to meet their own stewardship and sustainability objectives.

Stewardship activities

2.1 Consult with co-workers regarding stewardship opportunities. In your discussions with colleagues in mining operations, sales and marketing, engineering design, and contracting, raise questions and discuss options for increasing the societal value of your material and minimizing its impact on the environment (e.g., through enhanced resource productivity at the mine, increased energy efficiency or durability of the final product, improved recovery and recycling, safer handling upon product disposal, or collaboration with customers on life cycle studies, depending on the material and application). This is part of the capacity building which will help you integrate materials stewardship within your organization (see Figure 5).

2.2 Invite colleagues from outside your organization to speak about their materials stewardship activities. Invite speakers from leading companies – or from companies in the value chain of a priority product or application you identified in Theme 1 – to talk about their materials stewardship initiatives. Ask them to address marketing and sales professionals, business unit managers or others, according to their particular initiative or experience.

Is there an existing relationship I should strengthen to address stewardship issues in a priority product or application?

2.3 Meet with a product design engineer, material specifier or purchasing manager from one of your key product or application markets. Learn about the product environmental attributes they deem important (along with functional and other performance attributes) and ask about market drivers and customer interest in these environmental performance attributes.

- The automotive industry has a list of substances banned from use in automobiles and a second list of substances of ‘concern’ for which all suppliers must report quantities present in any component they supply (mdsystem.com).
- Ericsson requires its suppliers to complete a checklist of environmental performance requirements and provide life cycle data, which is then used in new product development (www.ericsson.com/sustainability/supplier_guide).

Is there a new relationship I should build that may add value to my business and help me avoid risk?

2.4 Meet with a representative from government or another organization promoting certain product-focused environmental attributes. Learn about concerns or issues associated with materials and products from environmental labelling entities and governments proposing product-focused environmental policies.

- For instance, the EPD® system (an informational labelling system) offers open consultations on the development of rules for declaring the environmental performance of various product groups, including fabricated metal products, non-metallic mineral products and machinery, among others (www.environdec.com).

2.5 Sponsor briefings for customers, end-user companies and trade association on your materials stewardship efforts. Address concerns, points for improvement, highlight appropriate uses and sustainability benefits and risks.

What is my current role in the value chain and where do I have influence? Are there other potential roles I could play?

2.6 Work with suppliers or customers to continually improve. In contracts and requests for bids, ask suppliers about their stewardship initiatives and how they can help you to achieve your own goals.

- Newmont established a contract with its supplier of mill liners to return damaged mill liners for re-melting and remanufacturing into new liners, which are then sold back to Newmont (ca 2800 tonnes in 2004).
- Alcoa co-operates with customers to exchange health and safety practices. If you become aware of a supplier or customer not acting as 'responsibly' as you might expect, reiterate your expectations and work together to improve.

2.7 Engage consumer advocacy and environmental groups in dialogue. Proactively engaging these stakeholders can help you gain an early understanding of public concerns with your materials or the products they go into.

- The *Non-Ferrous Metals Consultative Forum on Sustainable Development* addressed the role non-ferrous metals can play in sustainable development and the success of the forum was due in part to participation of non-governmental organizations.

Meet with material specifiers from key markets or applications (Activity 2.3)

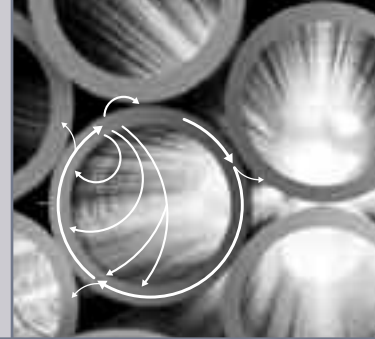
The number of architects and other actors in the construction industry applying sustainable development principles is growing rapidly. Australia, China, Canada, Europe, the U.K. and the U.S. all have established green building councils or systems for certifying the environmental performance of construction materials and entire buildings. Recycled content of materials, locally sourced materials and durability of products are among the types of criteria used to assess materials and certify buildings – and in some cases, these performance criteria are controversial (e.g., a building will receive points for steel from local sources, or of higher recycled content). This trend is further evidenced by the number of environmental product declarations for building products and current work by CEN on sustainable construction. Communicating with customers from this industry is one way to learn more about what is driving material selection. It can also be used to inform your own environmental initiatives.

Dunlop Architects Inc. and Halsall Associates Limited are proving architects, engineers and their clients can collaborate in the early planning stages of major construction projects to design buildings that improve environmental performance, minimize operating costs and deliver a 'cutting edge' aesthetic. Halsall Associates Ltd., an engineering consultancy providing structural and cladding engineering services for new construction and renovations in major public sector projects including hospitals, commercial buildings and cultural facilities, is "committed to changing the way [its] industry creates buildings". Its sustainable design process embraces holistic thinking by all collaborators on the design team, enabling them to integrate such technologies as: super efficient envelopes, life cycle analysis of building materials, re-use of structural steel, reclamation and re-use of demolished concrete, wood products from managed forests, thermal mass systems for storing energy, green roofs and supplementary cementing materials. The process led the team to choose titanium cladding over more traditional metal cladding materials on the west face of a new building to more effectively capture and reflect the changing sunlight. It also led the team to reclaim steel from a recent demolition and use it in a building frame for the new University of Toronto student centre (5% of the frame's total steel content was reclaimed). As the structural engineers for a previous renovation at the demolished building, Halsall knew the properties and strength of steel being demolished.¹²

The Business Value?

- Market development – today in building construction there are markets for building materials and components with superior environmental performance. Leading companies are quantifying and communicating this information to interested buyers or specifiers.

¹² Environments, Changing The Way We Build: Architects and Engineers Get Together to Consider the Whole Life of a Building, Sanjoy Mallick and Masood Ahmad, DfS volume 1.0 Exchange Case Studies.



Theme 3

Optimizing the Production and Application of Minerals and Metals

Optimizing the production and application of minerals and metals, requires an understanding of each material's valuable attributes and potential environmental risks throughout its entire life cycle. It is important to learn where in the value chain there are incentives (or disincentives) for, improving process and production efficiencies, extending product life, enhancing recycling, and/or improving design innovation regarding materials use.

Stewardship activities

3.1 Conduct exploration, mining and minerals processing activities in a resource and energy-efficient manner and minimize impact on the environment, health and safety. This will involve a range of activities from designating specific responsibilities, to developing an implementation plan, training personnel and establishing key performance measures which will illustrate progress and contribute to life cycle data on the materials (e.g., energy intensity and water use measures). Canada's Toward Sustainable Mining initiative and the Minerals Council of Australia's Enduring Value document illustrate where materials stewardship activities are being harmonized and standardized (e.g., on environmental performance and risk management).

3.2 Innovate new mining processes, production, fabrication and material applications. Environmental concerns and societal expectations present new drivers and rewards for innovative solutions. Materials stewardship brings the industry closer to its customers, increases its sensitivity to eco-efficiency and therefore better positions it to find new ways of doing business.

Is there more we could do to optimize the application of a material, through extended life (durability), improved recapture and enhanced recyclability?

3.3 Work with design engineers, customers and other research bodies to enhance the design of products and applications for energy efficiency and durability during use, and recyclability at end of life. Using your expertise on the technical properties and environmental attributes of your material, collaborate with researchers to inform

material formulation, design or applications. Ask customers what information they need on life cycle performance to support their own goals for optimizing material use (such as avoiding 'substances of concern', improving durability or reducing embodied energy). Also discuss how to balance trade-offs amongst multiple issues throughout the life cycle.

3.4 Think beyond recycling at end of life.

When considering materials stewardship there is a tendency to focus on recycling and end of life issues, but for a number of applications of minerals and metals it is important to think about durability, energy efficiency and other attributes the material can bring to a product. It is also important to remember recycling is multi-faceted. It can be done within your own processing plants, via downstream users or consumers of the materials or through a broader industrial ecology approach (e.g., where waste from one process becomes an input to another process).

Is there a potential role we could play in the take back and recycling of our material?

3.5 Address materials stewardship in current and future R&D and in new product development activities. Research and development is a cost-effective and strategic entry point for materials stewardship. To prevent risks or capitalize early on emerging opportunities in the market, routinely evaluate materials stewardship performance within R&D and new product development activities (e.g., reference a materials stewardships plan or checklist). Collaborate with commodity associations and other actors in the value chain researching the environmental and health impacts of existing and future products and their applications.

3.6 Educate consumers and customers.

Individual consumers, while often far removed from metals and mining companies, can also play a role in improving use and handling of materials in particular products. Get involved and influence how your material is handled once a product is discarded by providing information to customers and consumers about the value of recovering and recycling your material(s). For instance, architects and building specifiers are increasingly interested in solutions for refurbishing and re-using building materials (as well as insulation properties and durability), as one part of sustainable building programs.

Is our material being used in an unsustainable product or application? Are there sustainable products or technologies where use of our material could be optimized?

3.7 Contribute to the take back and recycling infrastructure. For materials in applications, which are or could be recaptured, provide information to recyclers or municipal recycling programs about the value, and properties of your material or products. Collaborating with others along the value chain may make a used product return program more feasible. Engage government about incentives and disincentives for economical recycling, and contribute to the planning of the infrastructure required to recapture your material or product.

- The RECHARGE battery association was formed to promote the value of rechargeable batteries. It represents the interests not only of battery manufacturers, but reflects interest from members across the battery life cycle to improve collection and recycling.



- Armstrong Ceilings established logistics to collect ceiling tiles from renovated buildings and reprocess them into new tiles, instead of purchasing raw materials.

3.8 For materials with environmental and human health concerns, work with industry associations, non-governmental organizations and regulators on material management systems and standards for safe use and optimal recovery of your material. The Green Lead initiative is, among other things, working to introduce product standards that promote positive impacts and continuous improvement, and to certify the products and organizations that achieve those standards (e.g., for lead batteries).

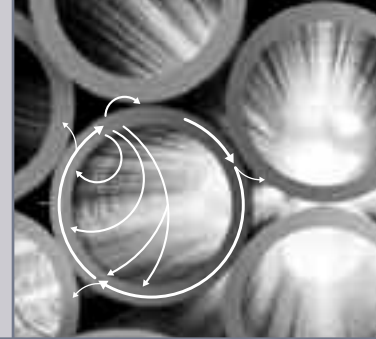
3.9 Contribute to development of sustainable technologies to manage your material and products. There is a role for the industry in promoting wise, sustainable uses of what are non-renewable resources. Collaborate with government, academia and others in the value chain to develop innovative technologies to treat lower value recycled products, reduce overall dispersion, and enhance the ability of the industry to use recycle in added value applications. Offer research grants, undertake joint industry projects or conduct research internally. Umicore developed a process to reclaim metals from used lithium-ion rechargeable batteries.

3.10 Look for opportunities to increase your market in sustainable products and technologies. While difficult to define, sustainable products are generally understood to be products that have superior environmental, economic and in some cases social performance attributes. Identifying existing sustainable products or technologies where your material could be used, or working with industry and academia to develop sustainable applications for your material or product (e.g., solar panels, light rail transit, energy efficient insulation and long-life roofing) can help expand the application of your material into markets that are more likely to undertake stewardship activities.

Controlling minor elements through innovation¹³ (Activity 3.2)

A range of minor elements naturally occur in mineral deposits such as mercury, thorium, thallium, selenium etc, which can be ecologically harmful and a risk to human health if they accumulate in the biosphere. This represents a materials stewardship issue for the minerals industry, since any problems will usually manifest away from the mine site. Satisfactory management of potentially toxic trace elements in the life cycle of minerals and metals is a fundamental requirement for maintaining the industry's social licence to operate. In addition, removal of toxic minor elements from waste streams along the value chains may have positive business benefits. In particular, the removal of dangerous contaminants may free up many of the industry's wastes for use in soils, building and construction products and other end uses, an important aspect of industrial ecology that will contribute to the sustainable development of mined resources by society.

¹³ For more information contact Dr Joe Herbertson at Joe.Herbertson@Newcastle.edu.au



A research project on *Controlling Minor Elements* is currently underway by the Cooperative Research Centre for Sustainable Resource Processing. The purpose of research in this area is to ensure the trace level toxic substances in mined materials can be identified, captured, and rendered inert (preferably early in the process), or as an alternative fed into well-managed closed loop material cycles. The initial focus of work within the CSRP has been the mineral processing chain for copper, which has yielded promising progress on the more efficient removal of Selenium and Tellurium in the Copper making process.

The CSRP is a government and industry funded research initiative established to develop greater levels of sustainability in mineral production and processing. Overall, the Minor Elements research stream within the CSRP aims to: i) manage minor elements to maximize resource utilization, optimize process performance and minimize harm; and ii) unlock the value in waste streams by controlling minor elements.

Working with industry associations, non-governmental organizations and regulators (Activity 3.8)

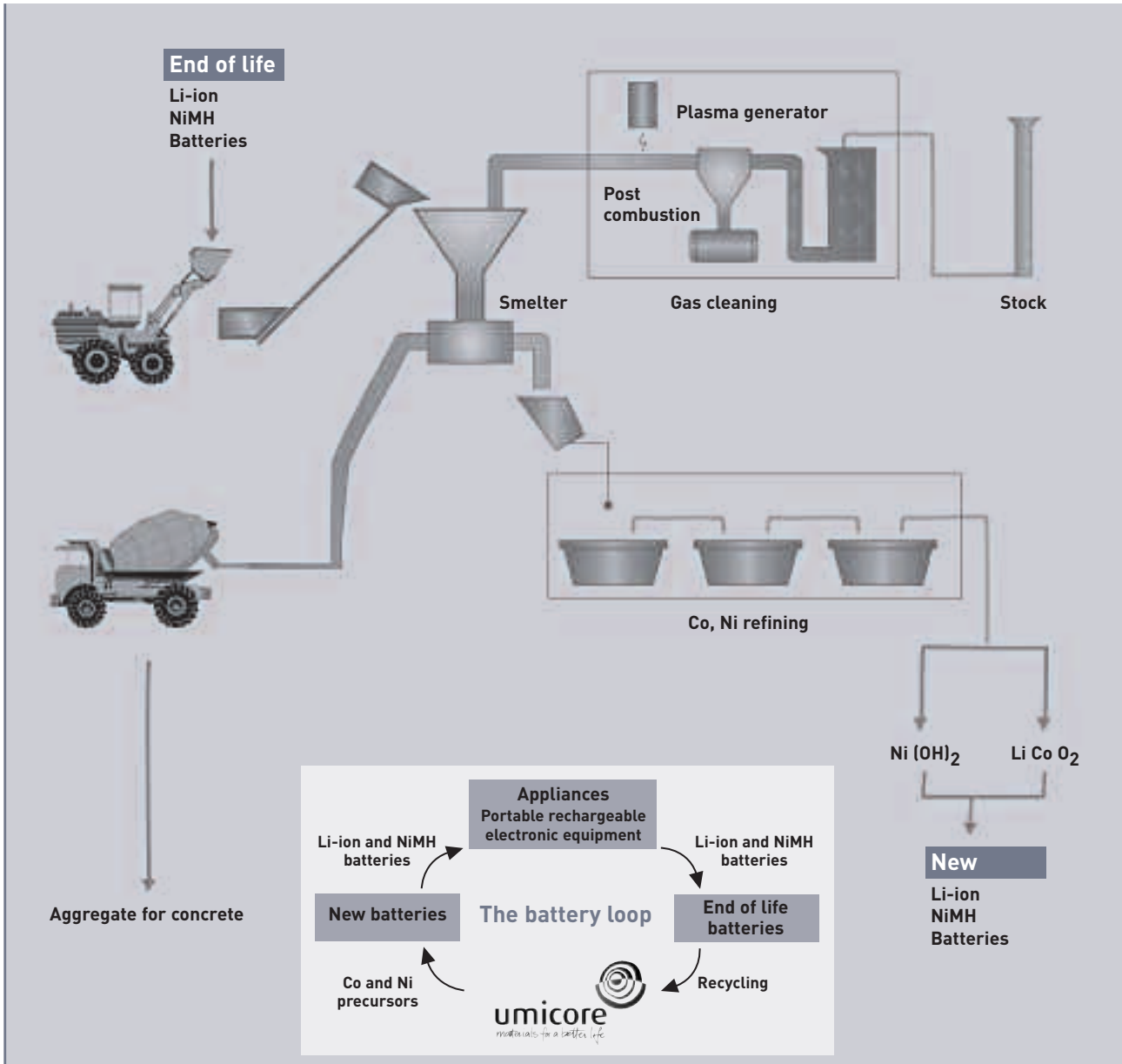
Current uses of copper and lead, in addition to other materials, demonstrate how emissions to the environment do not necessarily correlate with the highest tonnage uses. Much of the copper used today is in cables and plumbing, while the majority of copper emissions to the environment are suspected to come from low-tonnage, intentionally dispersive uses, such as agricultural applications or vehicle brake pads (copper dust from fertilizers, animal feed or automotive brake pads can enter the aquatic environment). Likewise, the largest use of lead is in batteries but batteries are not the largest emission source of the metal. The copper, lead and nickel industries are working on the evaluation of risks related to emissions from productions and product application and have strategies to communicate the metal's benefits but also risks associated with particular applications, to reduce emissions and promote effective uses of the materials. Materials stewardship is about better understanding all issues, positive and negative, to avoid undue risks and find opportunities across the life cycle.

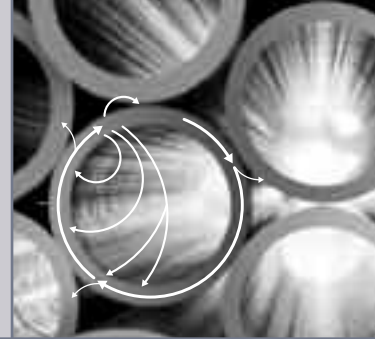
Contribute to the development of sustainable technologies to manage your material and products (Activity 3.9)

Lithium-ion rechargeable batteries power the majority of mobile devices, including laptops and cellular phones, however until recently these batteries could not be recycled without creating both hazardous and non-hazardous waste. In order to avoid the production of this waste while still being able to reclaim the cobalt, nickel, copper and iron contained in the batteries, Umicore developed a process called VAL'EAS (Figure 3). VAL'EAS is a closed loop process which uses the plastics in the batteries as fuel and recovers the metals in an alloy containing cobalt, nickel, copper and iron which is then refined into pure metal and metal compounds. The refined cobalt is then transformed into lithium cobalt dioxide for use in the production of new lithium dioxide batteries. Production of hazardous waste is avoided through a gas cleaning system that Umicore developed using plasma technology to avoid the formation of dioxin and furan and to capture vapours from metals. Melting conditions are controlled in order to produce a clean slag by-product, which can be used in construction and/or as aggregate for concrete. Umicore is a leading supplier of cobalt compounds for rechargeable batteries and as legislation from the European Commission and other similar initiatives increase the demand for recycling, it is positioned to supply cobalt through the VAL'EAS process as well.¹⁴

¹⁴www.batteryrecycling.umicore.com

Figure 3: Umicore VAL'EAS process for battery recycling





Xstrata (formerly Falconbridge) in its partnership with HP, demonstrates several elements of materials stewardship. In particular, it fosters technology for recycling low value, multi-material discarded products, contributes necessary infrastructure from collection of discarded products to separation and recycling, and involves regular interaction with HP's product developers.

Noranda Recycling, an Xstrata subsidiary, has been recycling metals for 60 years and recovering copper, precious metals, and other resources from electrical and electronic materials for over 20 years. The company now offers recycling services to brand owners, contract manufacturers, other businesses, governments and other entities in North America and other regions. Noranda first targeted high value scrap from manufacturing, repair and upgrading of electronic components and equipment and other recyclers. Two U.S. facilities receive, analyze and forward electronic materials to a Canadian copper smelter that also processes copper concentrate and other recyclable materials. In 1997, Noranda and the Hewlett-Packard Company established a strategic alliance in Roseville, California to recycle obsolete end of life equipment. Since then, Noranda has opened two more facilities to recover components, metals and other materials from end-of-life products. All facilities ship recyclable materials containing copper and precious metals to the copper smelter. Those that process end-of-life equipment also produce other recyclable materials for processing by other Noranda facilities or third parties. Xstrata facilities also engage in metal recycling, recovering nickel, cobalt and platinum group metals from a range of recyclable materials, including portable rechargeable batteries. As governments, businesses and consumers increase efforts to divert electronic products from disposal and establish policies, programs and funding mechanisms for collection and environmentally sound recycling, Xstrata expects this segment of its business to grow.



The Business Value?

- **Access to materials** – through its partnership with HP, Noranda Recycling has secured a source of materials for its North American refinery operations.
- **Market access** – demonstrating how copper, lead, nickel and other materials can be safely recycled from electronics will help secure continued use of these materials.
- **Cost savings** – from using materials efficiently and avoiding costs associated with hazardous waste disposal.
- **Reputation** – the industry's commitment and credibility will continue to improve as firms such as Umicore provide services that address legislative requirements on product-take back (batteries, electronics) and waste reduction (e.g., reduced landfilling). Taking used electronics helps solve a growing waste concern and supports the European Directive on managing discarded electronic and electrical equipment. Playing an active role in collecting waste electronics and re-using the materials from that equipment demonstrates the industry's commitment to sustainable development overall and materials stewardship in particular.

Theme 4

Contributing to a Robust, Accessible Base of Information to Support Decision Making

A public, reliable base of data and information spanning the full life cycle of your material is critical to materials stewardship. Sharing information with others in an open and transparent manner builds credibility and also demonstrates you are willing to learn from and collaborate with others. Reporting on materials stewardship can happen at a number of levels (e.g., at the company, or at the industry level, through your commodity association or through a regional mining association). It is important to balance information sharing with confidentiality and competitiveness concerns. The inherent business value of materials stewardship may result in competitive advantage for companies who are quick off the mark.

Stewardship activities

Is there a publicly available base of life cycle information for my material or product? If so, can I contribute to that information base? If not, can I initiate one?

4.1 Support and contribute to global modelling of flows for your material and the creation of company and commodity level life cycle inventory data. Life cycle information (including statistics on material flows, time in use, actual recycling rates) helps identify successes and leverage points to better optimize material flows. Compiling a shared database of life cycle information and material flows requires input from all players across the value chain. See examples from Umicore and Alcoa.

4.2 Continually seek to improve understanding of the potential life cycle environmental risks of your material in select applications.

Support and participate in risk assessments on your materials to better understand their impacts in the environment and on human health, and to develop action plans for managing any risks. For instance, this type of work may be done in collaboration with a commodity association. Communicate this information with all actors in the value chain who can use it to mitigate and manage risk.

- The *Metals in the Human Environment Research Network* is a collaboration of academia, government and industry. Among other accomplishments, it assisted with establishment of a risk management foundation for the safe use of metals (www.mithe-rn.org).

4.3 Share best practices regarding exploration, mining, refining and smelting operations.

Improving process stewardship activities will contribute to the overall performance of the material. Clearly document and share best practices that enhance the overall environmental profile of a given material.

Are there opportunities to share our materials stewardship activities in the public domain?

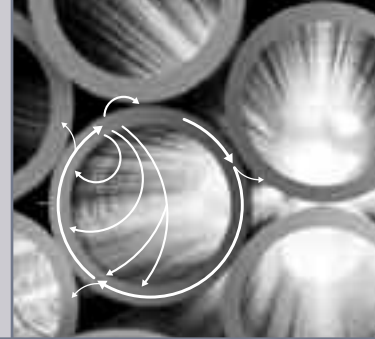
4.4 Share information and challenges related to your materials stewardship activities in public forums.

Write a paper or speak at a conference to share your company's successes and challenges related to materials stewardship. This demonstrates transparency, invites feedback on your own initiatives, and creates network opportunities to collaborate and address common challenges.

- On its website, the Nickel Institute posts life cycle study findings and information on nickel allergic contact dermatitis (www.nickelinstitute.org).
- The Green Lead initiative posts papers and presentations on its website (www.greenlead.com).

4.5 Select metrics relevant and meaningful to your business.

Track and report regularly on progress for each metric you select and continually raise the bar on performance expectations. Rio Tinto Borax uses a pyramid framework to link its strategy for sustainable development with clear metrics and targets (see Figure 5).



Do we openly and honestly communicate environmental risk information about our material or product to relevant stakeholders?

4.6 Report publicly on performance. At each stage of the material life cycle (Figure 1), there are opportunities to report on impacts, accomplishments and future plans to address impacts. Report publicly to demonstrate your awareness of the impacts associated with your materials and their applications. Providing a balance of information on both challenges and success stories helps to build transparency and credibility among broad groups of stakeholders (such as investors, regulators, insurers, local and global communities, non-governmental organizations and the media).

4.7 Work with the developers of decision-support tools and evaluation methodologies related to materials and material selection to balance impacts and value across the life cycle. Architects, product designers and engineers use many tools to select materials and it is important these tools recognize attributes different materials have across the life cycle and capture specific benefits or impacts. For instance, durability extends a product's life and can help offset the environmental impacts of creating the material.

Is there an opportunity to involve independent 3rd parties in the planning and verification of our materials stewardship activities?

4.8 Work with commodity associations to better understand current and potential uses for your material and develop a stewardship checklist to support consideration of impacts and benefits of the material. A simple checklist or set of evaluation questions can be used to flag potential opportunities or problems before an application or use is developed. Commodity associations can be a key partner as they are more directly involved with the users of materials and are better positioned to develop sector action plans and implement materials stewardship activities in a cost-effective way.

4.9 Seek independent verification of your stewardship activities. Involving third party stakeholders in each of the activities mentioned above adds credibility to your stewardship activities and communications.

Support and contribute to global modelling of material flows (Activity 4.1)

Materials stewardship involves identifying how materials flow from mining through use in products, in order to optimize these flows and uses (i.e., by increasing the time a material is in use, recovering it from a discarded product, or improving recycling infrastructure in a certain region). A clear picture of material flows, materials residing in products and re-use and recycling rates will highlight priorities and opportunities for optimization. It will also help identify which players can work to bring about a particular improvement.

Umicore and the Öko-Institut recently published *Material Flows of Platinum Group Metals*, which delivers an in-depth analysis of the topic.



In an effort to highlight and improve the environmental profile of aluminium products, the aluminium industry has developed a quantitative modelling tool to better understand the global aluminium flows (Figure 4). The model was created by Alcoa for the Global Aluminium Recycling Committee of the International Aluminium Institute and models data based on comparisons between annual regional and global statistics on primary and recycled aluminium processing with anticipated annual recycled aluminium supply.

Among other things the model is used to identify markets where aluminium is not highly recovered or is lost from the system. Examples of information obtained through the modelling process include:

- The industry's average metal supply from 'old' (post-consumer) and 'new' (customer/fab) scrap has increased from 17% in 1960 to over 33% today, and is predicted to increase to 39% by 2020;
- Since 1888, 678 million tonnes of aluminium has been produced. About 75% of this total is still in productive use.

The combination of recycled metal from old scrap (post consumer), new scrap (customer returns) and internal scrap generation is now about equal to the amount of primary aluminium processed each year on a worldwide basis.



The Business Value?

- Market development – the quantitative model of global aluminium flows is a valuable source of data. It highlights what is working well and also flags opportunities for better managing or recovering aluminium from certain uses. It also helps point to which players may be positioned to capture those opportunities.
- Communication with customers and regulators – working to identify flows, losses and improvements – is a credible demonstration of the industry's commitments and it helps foster an informed dialogue with regulators (e.g., on greenhouse gas emissions) and customers (e.g., on future access to recycled aluminium for their products).

Working with commodity associations to better understand materials use (Activity 4.8)

The International Zinc Association (IZA), founded in 1990, is demonstrating the importance of commodity associations in materials stewardship. During development of its sustainable development strategy, IZA noted consultative processes across the metals sector that indicated the responsibility for product stewardship should rest heavily upon industry associations and senior managers.¹⁵ Consequently, the IZA set out to develop action plans to efficiently manage the potential adverse impacts of zinc use whilst at the same time highlighting the broad attributes of the metal, specifically the durability that zinc adds to various materials as well as its excellent potential for recycling. IZA has viewed corporate and sector approaches as complementary actions towards a long-term goal of increasing materials efficiency and minimizing the life cycle impacts of zinc use. An essential part of IZA's approach is a structured assessment of the product stewardship priorities for each major zinc product/market segment.

Risks for human health and environment, scope for improved materials efficiency, life cycle environmental performance are all assessed prior to development of a dedicated action plan for each zinc use. The outcomes are then addressed through collaborative activities with zinc users and/or through integration in existing zinc industry activities. For example, the IZA is implementing a project with the International Lead Zinc Study Group and Common Fund for Commodities to develop the hot dip galvanising industry in China.¹⁶ The project will bring the benefits of improved durability of China's infrastructure with obvious improvements in material use. Importantly, IZA's product stewardship sector action plan has ensured that accident prevention training, energy efficiency, waste acid recycling and zinc recycling are all integrated into the project's training and technical support activities.



¹⁵ Product Stewardship Survey. Non Ferrous Metals Consultative Forum on Sustainable Development (2003).

¹⁶ Technology Transfer and Promotion of Demand for Hot Dip Galvanizing in China.

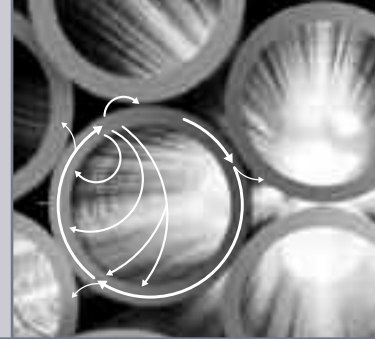
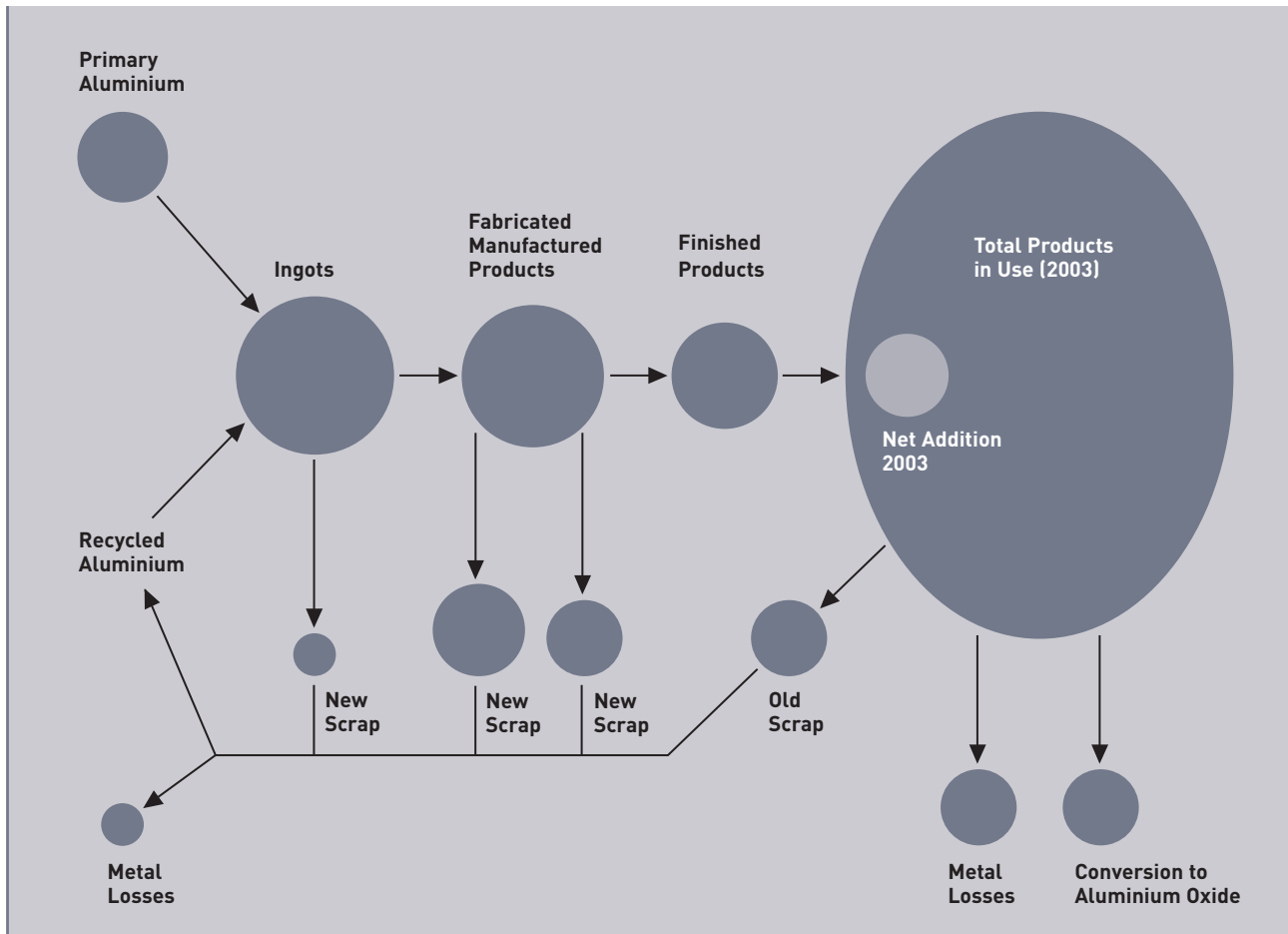


Figure 4: Modelling global aluminium flows



4. Integrating Materials Stewardship into Decision Making

As with any new initiative, positioning materials stewardship within your organization's strategy and business objectives (see *Managing Change*) is critical to successful implementation. Developing a strategy to move forward (Figure 5) may become clearer once you begin, in Theme 1, to identify priority issues or achievable business opportunities such as process efficiency improvements, the impact of emerging material evaluation protocols on your markets or a customer interested in a contract for closed-loop recycling. Key implementation success factors include:

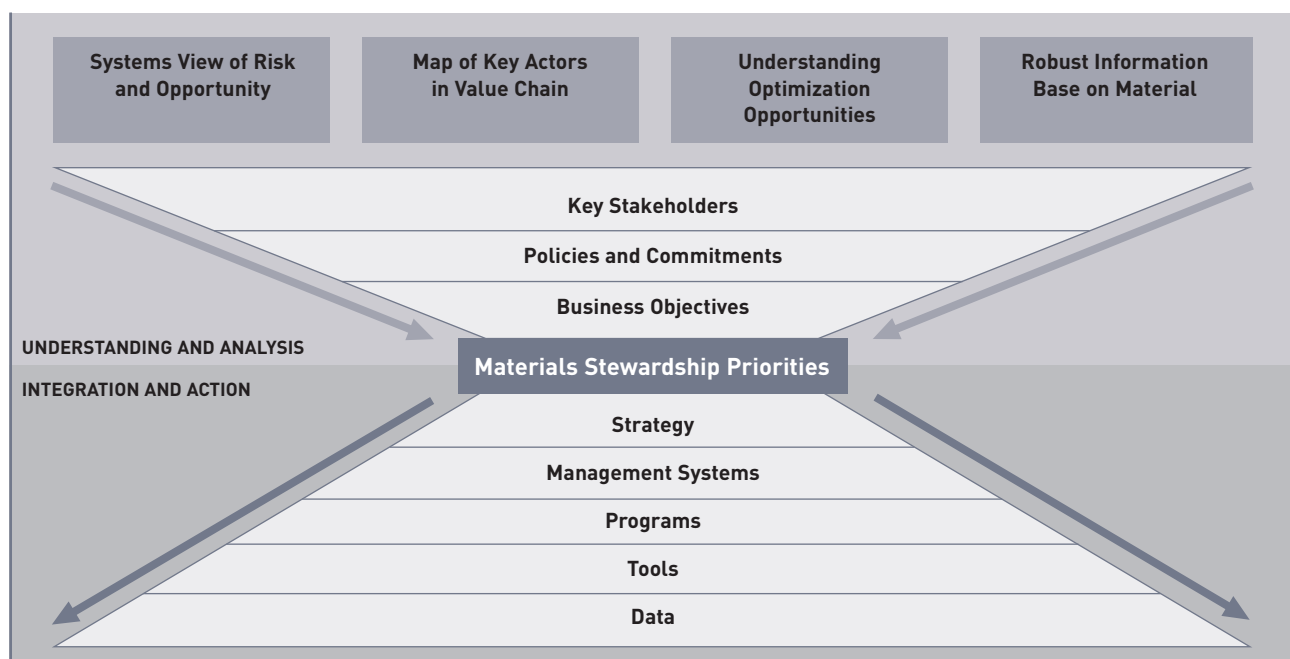
- Senior management engagement and leadership;
- A well articulated business case including an analysis of risks and opportunities;
- Establishing clear objectives, performance measures and targets;
- Engagement of key business functions (e.g., research and development, operations, procurement) and processes (e.g., business planning, sales and marketing). This includes raising awareness of how materials stewardship can help improve these functions and processes;
- Case studies that demonstrate how materials stewardship can protect value (e.g., by helping reduce risks) and create value (e.g., by building

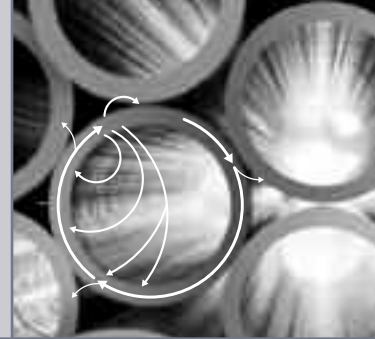
deeper relationship with the users of your material). Ideally these case studies would be available from existing activities within your company as these will have more relevance to your organization;

- Training of key personal who can influence materials stewardship performance;
- Developing or adopting tools to support integration and implementation of materials stewardship. This includes decision support tools such as life cycle assessment and risk assessment as well as communication tools such as environmental profiles of your material for engaging customers and users of your material; and
- Monitoring progress, documenting success and communicating internally and externally on your materials stewardship activities.

Having these factors in place will help ease the implementation of materials stewardship activities in your organization. It is important to remember that moving forward on materials stewardship is, in part, about building internal and external relationships which are developed one conversation at a time. The key to success is to be prepared for

Figure 5: Integrating materials stewardship into business decision making





this conversation and understand how materials stewardship helps support the objectives of the person you are engaging.

Managing change and identifying effective partners are also essential to implementing materials stewardship within business operations and decision making.

Elements of successful implementation and integration

Strategy

- Strong leadership for the initiative – champions in key business units, clear direction from the CEO and corporate action plan on sustainable development
- Clear understanding and awareness throughout the company of the business value
- A well articulated policy or vision statement that addresses or include materials stewardship

Systems

- Link to existing management systems, such as ISO 14001, as a means for issue identification, impact assessment, target setting and continual improvement
- Integrate materials stewardship into appropriate business planning processes and reward or incentive systems

Programs

- Training and awareness raising programs for business units and departments where skills need to be developed – for instance on life cycle thinking, risk assessment, material flows, knowledge of environmental issues across the life cycle and in end-use markets, regulatory environmental trends
- Engagement programs – with suppliers, downstream manufacturers, users, recyclers and other stakeholders to identify opportunities for improving production, manufacture, use and end-of-life management of materials
- Measuring and reporting programs – develop targets and indicators for materials stewardship and report publicly to enhance reputation and accountability
- Commodity specific stewardship plans – develop in conjunction with other actors in the value chain

Tools

- Assessment and decision support tools – eco-efficiency, design-for-environment, life cycle assessment and thinking, risk assessment and management, materials flow analysis

Data and other information

- Life cycle inventories, risk assessments (environmental, health and safety), material flow analysis (common templates for compiling and communicating resource flows), recycling rates data, use/application data
- Organizations and contacts along the value chain

Managing Change

Implementing materials stewardship requires changing mindsets, behaviours and decision-making processes. These changes are easier if your materials stewardship is clearly aligned with your company's overall business strategy. As you choose from activities presented throughout this guidance document, consider how each one fits within your current strategy and programs, as well as what programs, tools, and data your company may need.

Recognizing key Actors and Partners¹⁷

The stewardship activities suggested in this guidance document have varying degrees of relevance to medium-sized firms, 'juniors', large multi-nationals and fabricators. Likewise, recyclers, contractors, product manufacturers, governments, employees and consumers have key roles in certain activities. The report *Breaking New Ground* presents 'a profile of the minerals sector'. Actors from that profile are listed below with the materials stewardship activities of particular relevance.

Material providers range from large multinationals to small family-owned companies. The largest explore, mine, smelt, refine and sell metal concentrates and metals to markets globally. Given their range of operations, many of the activities in this guidance document will be of some relevance. An additional factor may be choosing how to co-ordinate materials stewardship efforts – at the corporate level, at each business unit or operation, by material group or otherwise.

Traders purchase concentrates and refined metals from smaller mines and sell those to smelters and fabricators respectively in appropriate volumes.

Fabricators cut, shape, form, bend, coat and weld primary metals into useable products. While some companies conduct operations from mining through fabrications, others conduct only one step in the chain. For these smaller actors, activities emphasizing their contribution to the materials information base may be of particular relevance.

¹⁷ Adapted from *Breaking New Ground – the Mining Minerals and Sustainable Development Final Report*, Chapter 3. Earthscan Publications. 2002.

Product manufacturers integrate environmental and social considerations into the product development process, to be weighed alongside price, quality, functionality, safety and other conventional considerations. Product and industrial designers are doing this in more and more sectors, from electronics to packaging, transportation to building construction. It may be a response to regulations, an effort to please customers or an attempt to innovate solutions that will secure new markets. Regardless, companies manufacturing products are looking to suppliers for information about the environmental and social attributes of materials and components, measured across the life cycle from mining operations to how the material will behave in a product when it is disposed. They also work with downstream users, recycling operations and governments. These companies, many of which are leaders in corporate sustainability, do this as part of their own commitments to product stewardship.

Scrap merchants, pre-processors, smelters and refiners are crucial players in the highly interlinked recycling chain. They collect, sort and upgrade material from secondary production, recovering the metal in specialized smelting and refining operations, sometimes in combination with primary feed. From 'mom and pop' sized collection and dismantling facilities to medium-sized mechanical pre-processors to complex, large scale metallurgical operations, these actors are key to many of the materials stewardship activities put forth in this guidance document, including those that emphasize their role in optimizing materials flows (Theme 4).

Contractors and companies supplying the industry with services, such as construction, drilling or equipment, come into play in activities on working with suppliers to understand issues, opportunities and to continually improve performance.

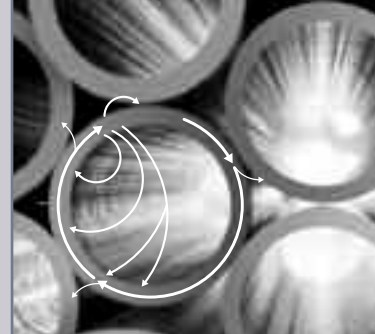
Employees are key actors. Just as the participation of actors from across the life cycle is key to materials stewardship, so is buy-in and participation from employees. Specific activities in Themes 1 and 2 call upon the expertise of employees.

Commodity associations represent producers of a particular commodity, nationally or globally. Their role includes promoting the effective use of the materials, responding to public inquiries about the material and its uses, establishing working partnerships and engaging interested stakeholders. Commodity associations often provide resources on common issues for their members, conduct research and serve as a forum for members to interact. An association may develop a sustainable development policy (e.g., the International Zinc Association) or communicate knowledge to support sustainable management of a material (e.g., the Nickel Institute).

Research institutes, non-governmental organizations, civil society, communities and consumers are important stakeholder groups for any stewardship initiative. The activities throughout the guidance document recommend specific topics upon which to engage various groups as sources of knowledge, as third-party verifiers and as solution-oriented partners.

Governments provide frameworks and rules for markets to function, social progress and economic development. They provide environmental protection policies, standards, product regulations and definitions and rules for trading products, materials and 'wastes'. Governments can play an important role in helping to optimize materials flows (activities in Theme 3). In absence of stable or active governments, there may be an even greater role for companies to publish independently verified reports on their performance and to collaborate with industry associations, consumer advocacy groups and participate in multi-stakeholder projects (activities in Themes 2 and 3, in particular).

5. Practising Materials Stewardship – Today and Tomorrow



The drivers for the industry to adopt sustainable development and materials stewardship strategies and actions are increasing. Market demand for more sustainable materials and regulatory pressure for the safe and efficient use of these materials are growing daily. Through the sustainable development and materials stewardship activities of ICMM, the industry is expanding its response to this challenge. The good news is as the pressure increases the business value of undertaking materials stewardship will also rise. Understanding the life cycle risk and opportunities related to materials, creating and expanding relationships with other actors in the value chain, optimizing the use and application of materials and building a solid information base on materials are all activities that will help protect and grow the market for minerals and metals.

While not prescriptive, the themes and activities recommended in *Maximizing Value* provide a comprehensive set of actions that will help initiate or expand current materials stewardship programs in your organization. Improving the understanding, awareness and implementation of the process and product components of materials stewardship will help your organization better its performance by managing risks and creating relationships that may lead to new business and market opportunities.

It is important that the minerals and metals industry take action today to demonstrate its understanding and commitment to materials stewardship. It is also important to recognize that putting materials stewardship into practice will require the input and co-operation of a range of stakeholders across the value chains of minerals and metals – the users, product designers and engineers, regulators, the recycling industry and non-governmental organizations. *Maximizing Value* will help stimulate ideas to promote such co-operation.

Through both co-operative and individual efforts materials stewardship will continue to grow as an important basis for improving the sustainability performance of our materials and our industry.

6. Resources

Sustainable Development in the Minerals Industry

Initiated in April 2000, Mining, Minerals and Sustainable Development (MMSD) was an independent two-year process of consultation and research with the objective of understanding how to maximize the contribution of the mining and minerals sector to sustainable development at the global, national, regional and local levels. One outcome of the process is the report *Breaking New Ground: Mining, Minerals, and Sustainable Development* (May 2002), intended to outline an agenda for global change. MMSD also created working papers on various areas of knowledge in the sector.

www.iied.org/mmsd/what_is_mmsd.html

The Minerals Council of Australia published *Enduring Value - the Australian Minerals Industry Framework for Sustainable Development*, to help “minerals industry managers implement the industry’s commitment to sustainable development in a practical and operational manner that is targeted at the site level.” Of particular relevance to materials stewardship, one of the 10 Principles in *Enduring Value* is about facilitating and encouraging responsible product design, use, re-use, recycling and disposal of ‘our’ products.

www.minerals.org.au/enduringvalue

The Mining Association of Canada’s *Towards Sustainable Mining* is intended as both a strategy for improving the mining industry’s performance by aligning its actions with the priorities and values of Canadians; and a process for finding common ground with communities of interest.

www.mining.ca/english/tsm

Stewardship has been one of the themes of the *Leading Practice Sustainable Development Program*. Chaired by the Australian Government Department of Industry Tourism and Resources, the Program has developed a soon to be published *Stewardship Handbook* for the mining industry.

www.industry.gov.au

UNCTAD/UNEP – Mineral Resources Forum

The Mineral Resources Forum is an information resource on issues related to minerals, metals and sustainable development.

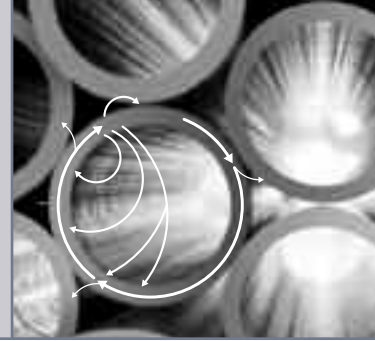
www.natural-resources.org/minerals/index.htm

Eco-efficiency

WBCSD – the WBCSD has worked in recent years to make eco-efficiency more user-friendly for business. The organization has gathered case studies on eco-efficiency from all over the world and published them in print and on the web. Visit www.wbcd.org and select ‘Eco-efficiency’ from menu on left side of page

European Eco-Efficiency Initiative (EEEI) – www.epe.be/programmes/eeei/index.html

Eco-efficiency and Materials. Five Winds International. International Council on Metals and the Environment, 2001.



Risk Assessment

ICMM, together with Eurometaux and Eurofer, are developing mineral and metal-specific guidance on risk assessment including:

- A guidance document on environmental risk assessment (MERAG);
- A guidance document on human health risk assessment (HERAG); and
- An outreach strategy for MERAG and HERAG, including participation in risk assessment policy discussions at the OECD level.

www.icmm.com/integ_materials.php

International Risk Governance Council – The IRGC is an independent foundation that involves a public-private partnership, which supports various sectors such as governments, business and other organizations in developing and developed countries.

www.irgc.org/

APELL is a program developed by UNEP in conjunction with governments and industry with the purpose of minimizing the occurrence and harmful effects of technological accidents and environmental emergencies.

www.uneptie.org/pc/apell/

Life Cycle Assessment

UNEP/SETAC Life Cycle Initiative – This initiative's mission is to develop and disseminate practical tools for evaluating the opportunities, risks, and trade-offs associated with products and services over their entire life cycle to achieve sustainable development. The programs aim at putting life cycle thinking into practice and at improving the supporting tools through better data and indicators.

www.uneptie.org/pc/sustain/lcinitiative/home.htm

US Environmental Protection Agency – Provides a list of publications, books, standards and web-sites that contain additional information on both managing and conducting an LCA. While this list is not comprehensive, it serves as a starting point for researching LCA.

www.epa.gov/ORD/NRMRL/std/sab/lca/index.html

ISO 14040 series of standards (14041-43) on Life Cycle Assessment provides requirements and guidelines for preparing, conducting and critically reviewing life cycle inventory analysis, conducting impact assessment and interpreting LCA results.

www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=23151

or

www.life-cycle.org/

Product Stewardship and Related Initiatives

Integrated Product Policy – all products cause environmental degradation in some way, whether from their manufacturing, use or disposal. The European Commission's Integrated Product Policy (IPP) approach seeks to minimize these by looking at all phases of a product's life cycle and taking action where it is most effective.

<http://europa.eu.int/comm/environment/ipp/home.htm>

Green building – The Green Building Council of Australia is developing a suit of green building rating tools called 'Green Star', and calling for economic incentives, government initiatives and programs to facilitate the adoption of new technologies and access to new knowledge. In the U.S., the Leadership in Energy and Environmental Design *LEED* Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Members of the U.S. Green Building Council representing all segments of the building industry developed LEED.

www.gbcaus.org/greenstar/page.asp?id=117
www.usgbc.org/DisplayPage.aspx?CategoryID=19

The UNEP Production and Consumption Branch promote extended producer responsibility as an important approach to reconcile environmental protection and economic growth.

www.uneptie.org/pc/pc/tools/epr.htm

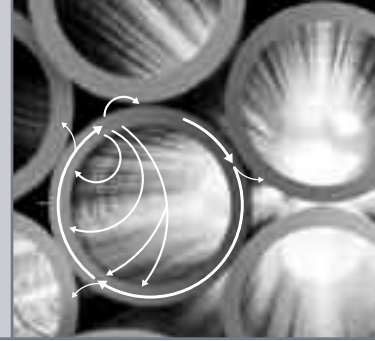
The OECD presents extended producer responsibility as a government measure to expand private sector responsibility for conserving resources and energy and reducing pollutants and wastes.

An ISO Technical Report, 14062:2002, covers concepts and current practices relating to the integration of environmental aspects into product design and development. An emerging Directive in the European Union from the Commission's DG on Enterprise and Industry, will also cover environmental considerations in product design. The Directive is titled Environmentally-friendly design of Energy-using Products: framework Directive for setting eco-design requirements for Energy-using Products (EuP).

http://europa.eu.int/comm/enterprise/eco_design/

Social Accountability International promotes workers' rights primarily through a voluntary SA8000 system. SA8000 is an ethical workplace management system, based on the International Labour Organization (ILO).

www.sa-intl.org



Reporting and Communication

Global Reporting Initiative (GRI) - Mining and Metals Sector Supplement. The GRI is intended to elevate economic, environmental and social reporting to routine practice and to the highest standards of rigour and comparability through development of a generally accepted reporting framework.

www.globalreporting.org/guidelines/sectors/mining.asp

ISO 14063 is an environmental communication document, residing in the 14000 family of standards. The purpose is to develop a guidance standard on environmental communication, providing principles linked to referenced examples from published works available globally.

www.globalreporting.org/about/iniiso14063.asp

The Global Ecolabelling Network (GEN) is a non-profit association of third-party, environmental performance labelling organizations founded in 1994 to improve, promote, and develop the 'ecolabelling' of products and services.

www.gen.gr.jp/whats.html

The ISO 14020 series set out general principles and specific requirements for labelling schemes and environmental claims to promote accurate, verifiable, relevant information. ISO 14021 covers environmental claims made by the producer of a good or service. ISO 14022 promotes the standardization of terms and symbols used in environmental claims, e.g., 'recycled content'. ISO 14024 covers guidance on programs that verify the environmental attributes of a product via a seal of approval (including the German Blue Angel and US Energy Star).

www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=34425

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Maximizing Value was compiled and edited by Five Winds International - a management consultancy focused on creating value for organizations by helping them to improve the environmental, social, and financial performance of their core business processes, products, and services. Five Winds has completed over 600 sustainability projects, including a substantial number along the minerals and metals value chain. The company utilizes its business, engineering, environmental, and social science expertise to help clients develop the strategy, management systems, tools, and information needed to create materials, products, and services for the marketplace of the 21st century.



The views expressed in this publication do not necessarily reflect those of ICMM.

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ICMM – The International Council on Mining and Metals

The International Council on Mining and Metals (ICMM) is a CEO-led organization comprising many of the world's leading mining and metals companies as well as regional, national and commodity associations, all of which are committed to improving their sustainable development performance and to the responsible production of the mineral and metal resources society needs.

ICMM's vision is a viable mining, minerals and metals industry that is widely recognized as essential for modern living and a key contributor to sustainable development.

Our library at www.goodpracticemining.com has case studies and other examples of leading practices.

www.icmm.com

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