ATTACHMENT 1

attachment 1 - Survey and Analysis

To ascertain industry's perceived needs and support for a national institute to address these issues, the Profit Foundation obtained information from in-depth discussions with members of the LCA Roundtable, a number of multinationals in the automotive and electronics industries, and from a survey of potential users and supporters in Australia.

The Profit Foundation also attended two LCA Roundtable conferences where issues were raised by the consultants, and discussed a number of the issues with industry, government and academic stakeholders.

The bulk of the consultations were focused around testing responses to a 'straw man' entity, an "institute", the role of which would be to coordinate and support a national response by industry to materials accounting issues. This institute was notionally entitled "The Institute for Materials Accounting and Sustainability" or IMAS. This conceptual model has been substantially redesigned on the basis of the feedback obtained in the consultative process.

Section 1 lists those who participated, and the organisations they represent. It also provides a list of other sources of information. Section II of this attachment provides an analysis of the resulsts of the consultation process.

Section I: Participants in discussions and submissions

LCA Roundtable

The following is a list of all roundtable participants many of whom were present when discussions of the issues encompassed within this document were exposed for discussion. All were given the opportunity to respond to survey questions regarding LCA and IMAS.

Abbott	David	DIST
Abel	Kaye	Environment Australia EPG
Adams	Mike	Foreign Affairs & Trade
Allan	Isabella	RAAL Australia
Arnold	Colin	Pioneer International Ltd.
Asian	M Jamal	James Hardie
Baweja	Daksh	Construction Materials
Bentley	Moira	BCA
Brotherton	Peter	Sustainable Solutions
Buckingham	David	Business Council of Australia
Carolin	Michael	Australian Business Environment
Chittick	Craig	Foreign Affairs and Trade
Coutts	David	AAC
Doig	Andrew	ACM
Faulkner	Rob	Auseon Corp & EA
Grant	Tim	Centre for Design, RMIT
Hemming	David	Department of Energy
Ho	David	CSIRO Victoria
Hogan	Steve	SRD NSW
James	Karli	VUT
Jones	Mike	DPIE
Jones	Del	DPWH
Kiernan	Ian	CRC WMPC
Lawson	Bill	Architecture Solarch
Leggo	Michael	Boral
MacDonald	Angus	Sydney
MacKellar	Michael	PACIA
Martin	Russ	EPA NSW
McFarlane	John	SRD DSG
McLachlan	Stuart	ACI
McMillan	Bill	CSR
Moore	Allan	BHP Engineering
Newland	Peter	EPA SA
Nichol	Ross	MONAH
O'Dea	Julian	DPIE
Outhred	Hugh	ACRC for renewable energy
Patterson	Belinda	AMPOL
Pesudovs	Dimi	PACIA
Petrie	James	University of Sydney
Pigdon	Suzanne	ASI/Coles/Myer
Prasad	Deo	UNSW Sch of Architecture
Pullen	John	ALCOA Australia
Richer	Bob	Boral
Rogers	Stan	UUT
Ross	Ian	Environment Professionals Australia
Rossiter	David	Bureau of Resources Sciences, MR & EB
Scandol	James	Enviornmental DSS
Schaife	Peter	BHP Research
Schapp	Harry	Electricity Supply Association of Australia
Silvey	Bill	DoE Qld
Sonneveld	Kees	Victoria University
Sweeney	Kim	SIRF
Tait	Hendrik	BHP Engineering
Thomas	Brett	Energetics Environmental
Todd	John	University of Tasmania
Tolliday	Ashley	Radian International
Van Rijwick	Gerard	ALC Inc
Verbeek	Ignatius	BHP Research
Vernon	David	Envrionment Australia
Wainberg	Ron	CRC WMPC
Waite	David	CWWT
Walsh	Ian	Department of Energy
Wibberley	Louis	BHP Research
Withycombe	Hugh	DPIE
Woods	Gary	

Individual survey responses or meetings

The following individuals either provided responses to the surveys or were participants in detailed face to face meetings where the issues canvassed in this report were discussed. The report attempts to synthesise the views expressed, but naturally does not purport to fully represent each opinion expressed:

Mike	*Adams*	Department of Foreign Affairs
Colin	*Arnold*	Pioneer
Mike	*Carolin*	ABA
James	*Cherian*	Qld Chamber of Commerce & Industries
Prasad	*Deo*	UNSW
Rob	*Faulkner*	Auseon Corp & EA
David	*Ho*	CSIRO
Neil	*Houghton*	ARRB Transport Research
Peter	*Israel*	Southcorp Packaging
Karli	*James*	Victoria University
Delwyn	*Jones*	Qld Works & Housing
Bill	*Lawson*	Architecture Solarch
Russ	*Martin*	NSW EPA
Allan	*Moore*	BHP Engineering
Peter	*Newland*	SA EPA
John	*Pullen*	ALCOA
Graham	*Redding*	RMIT
Steve	*Rickard*	CSR
Bob	*Ritchie*	Boral
Stan	*Rodgers*	AVTEQ Consulting Services
Ian	*Ross*	Environment Professionals Australia
Peter	*Scaife*	BHP Research
Harry	*Schaap*	Electricity Supply Association of Australia
Ron	*Scheele*	Polystyrene Australia
Kees	*Sonneveld*	Victoria University
Kim	*Sweeney*	Strategic Industry Research Foundation
Hendrik	*Tait*	BHP Engineering
Ignaz	*Verbeek*	BHP Research
David	*Vernon*	Environment Australia
Gary	*Woods*	DPWS

Section II: Analysis of Results from Consultative Process

The total 30 responses to the questionnaires and interviews were divided into four categories for analysis purposes: Government - three respondents; Industry Associations - five respondents; Consultants/researchers/education institutions - six respondents; Industry - 16 respondents. As well, the results were analysed in terms of issues: confidentiality and uses of data, engaging with environmental and consumer interests, awareness of materials accounting, initiatives using materials accounting techniques, problems in the adoption of materials accounting, need for an institute, requirements to make IMAS a success, possible models for the IMAS, possible the IMAS funding, and potential the IMAS partners.

Industry

For most respondents, materials accounting is synonymous with life cycle assessment.

With few exceptions, those surveyed and interviewed noted that Australian industry needed to become familiar with and use materials accounting techniques. The reasons for this spanned most of the factors raised in this document.The strongest themes were cost competitiveness and the need to match competitors in the provision of LCA data or certification. Only two manufacturers stated there was no need for them to engage with materials accounting, because the type of goods they produced did not lend themselves to such an assessment.

Most respondents noted that "needs" for the use of materials accounting techniques were driven by external pressure and that currently the pressure in Australia was not as great as in some other economies. Perceptions of the time frames in which the need for materials accounting data is likely to impact industry varied from five to twenty years. However, those respondents who have had experience with materials accounting technques continually stressed the lead times and complexities are such as to require immediate action.There was little recognition among those with limited exposure to the techniques of the complexity and scale of the task of preparing comprehensive LCAs that comply with ISO 14040.

All sectors surveyed noted the need to become familiar with and to apply materials accounting techniques to Australian goods because of international trends. These trends include the increasing use of materials accounting techniques overseas and the introduction of the ISO 14000.

It was typically the case that industry association leaders, who were more active in canvassing international trends, saw far more pressing needs than their members, who were more focused on the challenges of coping only with the current competitive climate within Australia or less sophisticated economies. Such individual firms were far more concerned about the added complexity and difficulty that might come with materials accounting requirements.

For those companies selling to international organisations who currently demand LCA information, the need for materials accounting data has already arisen. It seems likely from our investigations of some of these downstream purchasers that the demands will become more sophisticated once ISO 14040 is fully in place.

As well as international pressures, respondents noted the need to address pressure from consumers, the requirement to increase standards of production, their concern about the plethora of environmental legislation, and the need to communicate about environmental matters in a non-emotive way ensuring accurate data is being used.

A number of times the issue of un-coordinated information demands from government (for example for state of the environment and pollutant load reporting) were raised as a concern. One of the important issues for industry was getting synergy into the reporting requirements for government, and the information requirements for improved environmental and economic performance. Materials accounting techniques were seen as a sensible basis for finding the commonly required data and reducing wasted effort in reporting.

Government

The emphasis of government organisations was on the need to use materials accounting techniques to address environmentally sound procurement, sustainable management of their own activities (such as waste disposal and construction) and trade and international environment protocols. They are concerned to meet community demands for introducing environmentally sound methods of decision-making, whether this decision-making concerns procurement practices or development proposals (for example environment impact statements).

The government sector is also concerned to ensure that Australian industry is competitive globally, and that imports to Australia do not fall below standards demanded elsewhere in the world.

With the exception of a couple of state government authorities which have embraced LCA as a means for improving their own environmental performance (for example in waste management, and in the construction of buildings), the level of government awareness of materials accounting issues was low. This was particularly in relation to the international trend to use materials accounting in government purchasing, and the role of government in facilitating industry materials accounting capability and preparedness.

There was no evidence of any move towards a "whole of government" response to the interlinked issues of environmental reporting, government purchasing, the environmental information needs of government and the development of industry environmental management capabilities. The pursuit of holism which is evident in the leading international economies is not apparent locally.

Partially as a result of the consultations in the development of this report, a small number of federal government departments have elevated the status of materials accounting in their forward work plans, and there are fledgling moves at a federal level to look for the integrative possibilities within materials accounting techniques.

Industry Associations

Industry Associations emphasised that materials accounting techniques be used as a means for industry to remain competitive, and comply with various challenges imposed by the "Kyoto Summit", the ISO 14000 series, standards imposed by overseas buyers and compliance with environmental legislation. A number saw materials accounting as being either a sword or a shield in international competition, depending on how Australian industry and government embraced the issues. In all instances, the approach was one of supporting association members by providing them with information, and opportunities to engage with the issues (and develop their capabilities) through trial projects.

As noted above, leaders of such associations tended to be far more sensitive to the issues raised in this document than their members. Some of the associations and related bodies have translated this awareness into specific initiatives. Examples include:

- the plastics industry, through PACIA, with a substantial involvement in the use of whole of life analysis in the optimisation of packaging materials;
- the aluminium industry through the Aluminium Council, carrying out LCA analyses within the industry;
- the automotive industry, through the world car project coordinated by the Strategic Industry Research Foundation.

It was noted a number of times that government information requirements represent a major frustration for their members, and that a unified approach drawing on materials accounting data developed for competitiveness reasons may represent a more reliable and less onerous approach than the uncoordinated approach presently in evidence.

Information providers

Information providers (consultants, researchers and educators) frequently see materials accounting techniques as tools that can be used for benchmarking purposes, for informing the debate on environmental issues, and for assessing impacts of extractions, manufacture and assembly of goods. A number saw the IMAS as an important means for developing a market for their services and information

(through developing industry awareness) and for creating a mechanism for coordinated research and information diffusion.

There was no expressed divergence from the view that that IMAS would have to be fundamentally focused on meeting the needs of industry, and increasing the capacity of industry to compete through improved materials and resources management. There was some mild disagreement about the extent to which, and the means whereby, environmental and consumer stakeholders ought be engaged in this process.

Within this broad framework, however, there are a myriad of perspectives and a number of conflicting views. These are summarised as follows:

a. differences of opinion about the interpretation and application of materials accounting techniques. An example of such technical differences is between the proponents of LCA, and the proponents of cleaner production strategies. Whilst both agree there are synergies between the approaches, and both agree that each is important, there is a degree of jockeying for position. This debate seems not to be particularly important in industrial practice, but achieves importance in a situation where scarce research funds are being strongly competed for.

b. economic interest issues. Among these is a concern among some service providers (notably consultants) that the emergence of a national coordinating body with accreditation powers may endanger their particular service product. This seems to be a particular concern among educational service providers, and among some consultants who see ISO 14000 as a product extension for their ISO 9000 product lines[1].

All of the information providers highlighted the need to have a sound database to ensure the debate over materials' environmental impacts is well-informed. A number illustrated the difficulties associated with achieving this without clear protocols and mechanisms that preserve the confidentiality of sensitive industry data.

Confidentiality and the uses of data

Of those manufacturing organisations which have started gathering LCA data, a number have done so to put themselves in a position to defend themselves against wrongly based claims by others. A few see the need for materials accounting techniques to provide benchmarks for continued improvements in production processes. This represents the use of the data for a strategic purpose.

The concern regarding potential abuse of data was expressed by the manufacturing sector which feared that mismanagement of materials accounting techniques may unfairly endanger the viability of their own products. The main concerns are:

- the risk of leakage of commercially sensitive information, which could provide competitors with insight into cost structures, manufacturing processes and other means for competitive advantage;
- the abuse of information, or misinformation, whereby the ecological credentials of a product or process are misleadingly presented or interpreted;
- the "politicisation" of data provided for materials accounting reasons, by interest groups which seek to shape that data to make particular political points.

It is worthwhile to note that while this issue was frequently raised, and seriously considered, no respondent suggested this was an insurmountable barrier to cooperation. The typical response was that this was an issue of significance which would have to be managed. In a few instances, respondents cited illustrations of where they had either provided, or received such data, with adequate safeguards to avoid such problems.

A number of manufacturer respondents identified the plethora of environmental legislation that imposes data demands on industry, as often difficult to comply with and sometimes contradictory. They hoped materials accounting techniques might be able to fill this need, by causing government to shape their information requirements to the types of data that would be more readily available once materials accounting data was widely used.

1 Economic competition and positioning issues are also likely to be important for international service providers seeking to transfer their existing frameworks into an Australian context – but this did not emerge as an issue in discussions.

Engaging with environmental and consumer interests

An issue which was discussed both in larger groups (the LCA Roundtable) and with individual respondents, was the extent and means of engagement with environmental and consumer lobby groups. It was generally felt this represents one of the significant challenges in the proper implementation of materials accounting techniques.

There is widespread support for the need to fully engage these interests in the development and implementation of a national response. There is a widespread view this ought be in a manner that is sensitive to the concerns of industry about potential abuse of materials accounting data. The generally preferred approach is to invite participation of these interest groups with industry in the development and application of materials accounting techniques, but to ensure that above all the IMAS is independent of all interests, and totally committed to the confidentiality of all data.

It was suggested that in such a framework, the involvement of environmental and consumer interests ought be placed on a professional rather than political basis. Under such an approach, it would be reasonable to remunerate community members for the substantial time and involvement that would be expected. It would also be reasonable to require normal conditions of confidentiality and commitment to protecting the integrity and perceived (as well as actual) independence of the IMAS.

Within such a framework, the response to working more closely with interest groups in furthering materials optimisation, for both competitive and environmental reasons, is positively viewed.

Awareness of materials accounting

Awareness about materials accounting techniques is reported by respondents to be relatively low but varies from industry to industry. In Sydney, among building companies and those supplying to them, the environmental focus of the purchasing requirements for the Olympic site has raised the overall level of awareness. In the aluminium industry, international requirements have led to a degree of interest in whole of life comparisons between aluminium and other materials. For the plastics and packaging industries, issues of waste disposal have led to a heightened interests in the whole of life management of materials. However, this interest is still relatively undeveloped. The primary focus in most instances is waste minimisation and recycling.

Awareness of how materials accounting technique can be used to drive efficiency improvements was very low, except among the small number of major industrials which have already adopted these techniques with cost efficiency as a major goal.

Researchers and consultants noted that in the aluminium, steel, electricity and food industries, there are increased expressions of interest in materials accounting techniques.

It would appear that where an organisation, whether in the private or public sector, has started using LCA it is because a person has championed the technique and persuaded decision-makers to devote resources to its development and use.

Almost all respondents noted Australian organisations were unlikely to seriously contemplate the use of materials accounting techniques until significantly pressured to do so. The forms of pressure that are anticipated range from downstream purchaser demands, through to legislated requirements.

Initiatives using materials accounting techniques

A number of initiatives are under development in different sectors. The following is representative of projects either underway or under consideration.

Government sector applications under development

- Qualitative and semi-quantitative assessment in strategic asset management of public estate
- Model for developing weightings for pollutants

Industry association applications under development

- As a technique to promote green labelling as marketing advantage

Consultant/research/education institution activities

- Development of training programs on materials accounting techniques
- Development of models on materials accounting techniques
- Development of an environmental research technique
- Establishing networks for data gathering and research backup
- Impact assessments
- Life cycle costing
- Development of guidelines for green products

Manufacturing organisations initiatives under development

- Profiling own products and competitor products
- Environmental data management
- Tool for product and process management
- Becoming familiar with the tool to meet possible later demands

Problems in the adoption of materials accounting

The survey sought to identify problems encountered in the application of materials accounting techniques, notably LCA.

A problem identified by many respondents is the complexity of the technique and the expense of data collection. Respondents noted it is necessary to specify boundary conditions and to have the appropriate data to specify those boundary conditions (eg. the transport component of product manufacture). Part of the difficulty of setting boundary conditions was a lack of local standards and protocols for conducting and reporting on LCAs.

In group discussion it was identified that the securing of data from upstream suppliers (such as electricity authorities) can be particularly difficult for all but the most powerful and committed of corporate customers. Those major companies which have seriously addressed the issues have sometimes had to create their own informed estimates, and then seek to have them verified (or otherwise) by the upstream supplier. Coordination of the provision of data, to ensure its availability without disclosure of sensitive intelligence, was frequently cited as a materials accounting need.

The lack of skilled and qualified consultants and advisers for industry to implement materials accounting techniques, particularly LCA under ISO 14040 standards, was noted. In one instance an industry association was obliged to import an overseas expert (using approaches and algorithms developed under overseas conditions) to be able to properly conduct an LCA.

Materials accounting techniques such as LCA are being resisted by some organisations. Their concern is that LCA is simply a costly add-on to what they already do, or non-relevant to the processes and issues they are dealing with. There is also a perception that the burden of producing LCA reports will be borne by "downstream" manufacturers who will then have their products unfairly scrutinised.

Another concern is that data collected and provided in the LCA process will give competitors access to product information, compromising competitive advantage.

The prime barriers to securing the benefits of well conducted materials accounting activities can be summarised as:

- ignorance of the competitiveness issues and materials accounting techniques;
- the costs and difficulties of data collection;
- the difficulties in sourcing independent, appropriately qualified experts.

The need for a national institute

Respondents overall were positive about the establishment of an Institute for Materials Accounting and Sustainability (IMAS), representing a national response to the materials accounting challenge. Almost all, however, also had reservations about its scope and its intent. The reservations were not uniform and at times conflicted with one another.

Most frequently, among respondents from all sectors, IMAS was seen as potentially able to provide or be a repository of well-researched and current Australian data. Although respondents wanted a home for data they could access, most were also adamant that proprietary data that was pertinent to their own products and processes should not be part of a public data set. Or, alternatively, that there be very strict protocols for data access, sufficient to maintain confidentiality of sensitive information.

It was suggested a national collector and repository of international information would be of significant potential benefit to industry. IMAS could act as a researcher on international experience, enabling Australian industry to benefit from solutions and techniques used internationally.

Those respondents who are already using materials accounting techniques, believe that a major role of IMAS should be to increase the level of awareness of these techniques in the private and public sectors. They believe that materials accounting techniques will not be able to make the contribution to productivity and environmental sustainability issues unless there is a critical mass in the knowledge base. In this they believe IMAS could act as a training and networking facilitator. A critical agenda identified in the survey is this need to bring Australian industry "up to speed" with materials accounting techniques to forestall the dominance of the materials accounting field of imported specialists with foreign databases and foreign models – all of which might not be the most applicable to Australian conditions or Australian products. A few respondents noted that unless Australian industry adopts materials accounting techniques, these techniques would be used against them as de facto trade and tariff barriers.

Most respondents see a role for IMAS in developing standards for data collection, for models and for reporting. All sectors believed that IMAS could be the vehicle to facilitate basic research on materials accounting techniques.

A few respondents, particularly from industry, thought that IMAS should have a role as an accreditation body. An equal number (generally not from industry) did not think that there was a need for an accreditation body and that accreditation should be left to those organisations which already carry out this function.

A perception stated explicitly in some responses and implied in others was that IMAS could act as an adviser on sustainability and materials accounting issues in discussions on environmental legislation.

Requirements to make IMAS a success

The overriding message from respondents is that IMAS needs to quickly demonstrate that it is relevant and adds value to industry. To do this, industry needs to be able to identify its needs for materials accounting analysis. In many cases the leadership role of government was highlighted, though the form of this leadership was not commonly agreed. Some respondents suggested it would be beneficial to back up the establishment of IMAS with legislative requirements. Another method suggested was to pressure industry and government to take an interest in materials and accounting techniques by demonstrating to them the significant trade downside if Australia remains inactive.

The messages regarding legislative backing for materials accounting were contradictory. In all sectors from which data was collected, it was noted that legislation would be required to move industry to take materials accounting techniques seriously and thus make IMAS a success. In the same breath, respondents would oppose such legislation and note that it would mean IMAS had not been succesful in providing leadership to industry. This is an understandable dichotomy. Whilst legislation is typically effective in moving industry to adopt mandated approaches, it is in the drafting and enforcement of legislation that major sources of inefficiency are embedded. Thus industry will frequently resist regulation, even when it agrees with the need for collective action, because it expects the regulation itself will impose major transaction costs and distortions. Self regulation is generally preferred for this reason.

One of the critical requirements respondents identified to make the IMAS a success revolves around a

database. Some respondents were adamant that the IMAS should create and keep a current, relevant and scrutinised database for industry use. Others were equally adamant that the IMAS should not concern itself with databases at all but only set the protocols and standards for data. There was more agreement between the parties with regard to the IMAS holding "baseline data". Baseline data should be accessible. One suggestion was that if the IMAS were to have a database, its confidentiality could be guarded by placing the data into several levels: site specific (top secret); annual data (top-price and secret); old data (widely available but with gaps to secure against misuse).

There was also disagreement about whether the IMAS should conduct its own LCAs. Some argued that the IMAS needed to do so to remain relevant, others argued that to do so would compromise the independence of the IMAS. There was, however, general agreement that IMAS should be involved in baseline research, model development, set protocols and standards – though not necessarily act as an accreditation body – and be involved in the education of all sectors on materials accounting techniques.

The need for independence of IMAS was a factor identified by respondents. For some, independence meant that all stakeholders were represented on IMAS. For others, independence meant that IMAS was a statutory body independent of direct influence by any potential users of materials accounting techniques.

Two respondents noted that for the IMAS' goal of increasing utilisation of materials accounting to be achieved, it is necessary for the institute to be involved in promoting boundary organisation systems to enable the potential benefits from materials accounting to be appropriately utilised. For example, the packaging industry may be able to reduce waste through recycling if they cooperated with councils to establish collection centres.

Possible models for IMAS

A favoured model for IMAS was small scale – like the Royal Australian Institute of Architects – operating at the federal level with groups of experts drawn from all sectors - which sets standards, acts as a think tank, and facilitates education and networking. A few respondents named existing organisations that might serve as good models for a national institute:

- Royal Australian Institute of Architects: This institute sets standards, provides education programs in the latest ideas, technology and trends in architecture, provides up-to-date advice on practice, law, cautionary and client notes, and produces a regular magazine and bulletin notes for members. The institute also conducts research on issues such as market conditions, staffing levels and practice operating costs, and it networks and is represented on dozens of national and state industry and government bodies and with international organisations such as the Union of International Architecture and the Commonwealth Association of Architects.
- EIDN: Established in 1994 as a three way partnership between the Department of Industry, Science and Tourism, the CRC for WM&PC and Environment Management Industry Association to seek out innovative, challenging, high profile projects in Australia and foster formation of consortia of Australian companies to pool skills and experience to provide total solutions for each type of project. It maintains a database of Australian technical skills, conducts market intelligence, facilitates projects, and assists in securing funds.
- CEDA: High level collaborative organisation concerned with industry and economic policy and advice to government.
- CSIRO: Set up with the Science and Industry Research Act 1949 and currently structured according the Science and Industry Research Amendment Act 1986. It seeks to serve the Australian community through outcomes which provide: benefit to Australia's industry and economy; environmental benefits to Australia; social benefits to Australians; support to Australian national and international objectives through world class research.
- NH&MRC: This was first constituted in September 1936 to advise the Australian community on the achievement and maintenance of the highest practicable standards of individual and public health, and to foster research in the interest of improving those standards. It does this through a

network of committees. In so doing the quality of its advice and activity is enhanced by the contributions of a wide range of people and organisations both in Australia and overseas. Its four principal committees are: National Health Advisory Committee; Australian Health Ethics Committee; Research Committee (Public Health and Medical); Strategic Research Development Committee.

- Standards Australia: The local arm for the dissemination of international standards which encourages best practice by local industry and government. Its primary role is as developer and disseminator of standards.
- The Australian Quality Council: Operates as a mechanism to facilitate industry adoption of quality processes. Its functions include accreditation, and information dissemination. A characteristic of this organisation is its capacity to secure the widespread support of senior executives for quality programs, through demonstration of economic and management advantage through the adoption of these processes.

Another model was that of a consultant organisation – one that people could go to for help on how to do an LCA. In this model, IMAS would have both a consulting arm and promote LCA as a fair and reasonable tool – perhaps starting with putting together a generic template for LCA reporting.

A number of respondents believed the IMAS should have an adaptive model, starting small then evolving as need arises from sectors using materials accounting techniques. Initially, the role of IMAS would be to promote LCA, particularly to target groups such as marketers who need to understand the environmental impacts of products they sell, and environmental managers who need to understand how LCA can help them do their job.

All-encompassing models were also suggested where a board would govern two parts of the IMAS organisation. One part would be concerned with data management and supply of information which acts as a clearing house for data and working within the guidelines of the second part of the organisation. The second part would focus on standards, methodology, peer review and potential research. The two would be independent to safeguard the integrity of their functions. As with other model proposals, a proposed key to the success of this model would be its capacity to adapt to the needs of stakeholders (community, government, private sector). Initially with a strong education and research component then moving to other coordination roles as the tools develop and become integrated into management practice.

Possible funding for IMAS

Most respondents believed that, at least initially if not long-term, government should provide funds for the establishment of IMAS. The motivation of government to do so would be:

1. to help find the tools to counter adverse effects from greenhouse gas emissions;
2. maintain Australia's competitiveness and high standards of production at an international level;
3. to assist government in its own roles including environmental policy and regulation, trade negotiations, and information gathering and dissemination.

Most respondents also believed the private sector should be a significant contributor to the IMAS.

Having noted these two funding sources, there was also a degree of disagreement about how IMAS should be funded. Most of the disagreement arises because of the unclear purpose of IMAS at this stage. If IMAS is to be a standards setting body, argued some respondents, then it should be funded by government. If IMAS is to be a representative body of industry and work to provide industry with the tools and the data, it should be substantially industry funded – though perhaps initially started with government funding, or through an affiliation of the large industry associations.

Other respondents believed that IMAS should be self-funded, making its money through selling databases, carrying out consultancies, education programs etc.

Potential partners for IMAS

The question "with whom should any national institute be affiliated?" was canvassed, with the following responses.

- State government department of environment and EPAs
- National professional associations in the field of manufacture, agriculture, building construction, consumer organisations, business associations
- Nature Conservation Council
- Total Environment Centre
- SIRF
- Australian Consumer Association
- Moody's rating agency (and the like) - assessing the environmental credential of a company for ethical investment companies
- Australian Stock Exchange - assessment of environmental profiles (risks) of companies
- Trade Practices, Consumers Affairs – eco-labelling issues
- University research centres
- ISO accreditation/certification bodies and consultants
- CSIRO

Summary

In summary, the survey showed the need for some national response to the growing international trend towards the use of materials accounting is unquestioned by industry, researchers and government. All recognise that materials accounting represents a signficant strategic challenge to which Australia must respond. The concept of a national insitute to focus this strategy was well received. Respondents were concerned the mission of the insitute should be well defined, as should its membership. Membership should be properly representative. Respondents also expressed their concern that in the formation and processes of the insitute sensitives involving confidentiality, ownership and use of data should be controlled.

attachment 2 - A Description of Materials Accounting Techniques

Introduction

The following explanation of materials accounting techniques and some of the key issues in their application has been prepared by the consultants largely on the basis of inputs provided by Professor Stephen Moore of the School of Civil Engineering[1], The University of NSW.

Any errors in compiling or interpreting this information are those of the consultants. A glossary of terms and a listing of references is provided in the body of the report at page 9.

The flow of materials as resources from the environment, to the modern industrial economy (in physical terms the "anthroposphere"), and then as wastes into receiving environments, is illustrated in Figure a2.1.

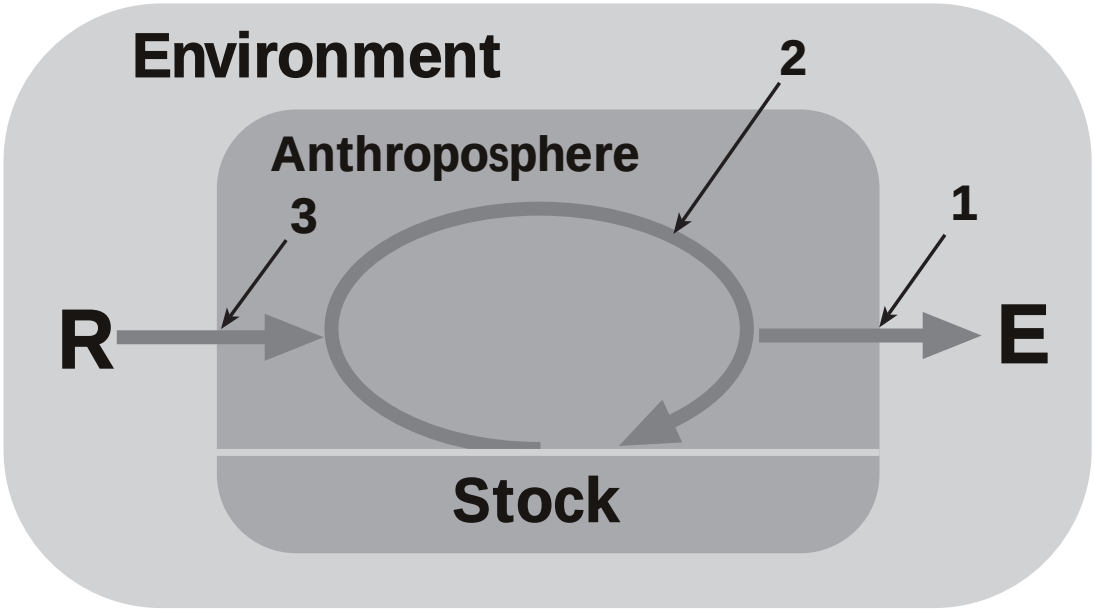


Figure a2.1 : Flow of materials induced by anthropogenic activities, and control strategies: Environmental protection by: 1 "filter" strategy, 2 recycling and optimum use of resources, 3 front end reduction of resource flows. For sustainable development all three are necessary, but emphasis has to be laid on 2 and 3 (Brunner et al, 1994).

Conventionally, the quality of the air, water and soil compartments of the receiving environment is monitored and contamination levels are reported publicly, and used as information to design policies and facilities to improve that quality. In addition, information systems such as the State of the Environment (SoE) Reports (CSIRO, 1996) and the Australian Waste Database (Moore, 1997, and Morrow and Keating, 1997) report on the pressures which lead to a decline in environmental quality. Goals for reducing these pressures, such as the 50% reduction in per capita waste to landfill over the period 1990-2000, or the reduction of packaging waste by recycling, have been prepared and are monitored by these information systems.

This monitoring approach leads to a reactive strategy for regional environmental management. After the "State" of the environment declines to an unacceptable level under the "Pressures" from the anthroposphere, "Responses" are developed to remediate and control ongoing deterioration in the State (OECD, 1993). The time taken to identify unforeseen environmental quality deterioration, to explain it, to develop concepts on how it may be controlled, and then to implement controls has taken decades in the past; for instance in the control of eutrophication in Swiss lakes (Baccini and Brunner, 1991). Similar environmental problems may have to actually occur in other regions before action is taken to understand

1 *Moore and Brunner (1998).*

region specific influences, and to implement controls, hopefully with a shorter response time. This reactive approach requires long lead times because of the inertia within the anthroposphere against change. There may also be some environmental problems, such as ozone depletion, for which there are no remediation technologies available.

While these indices do allow a better understanding of the performance of broad economic sectors in waste minimisation, related to the relevant general causative factors, they do not provide information on the flow of materials through processes which would enable predictions to be made. In order to prevent future problems from arising, there is a need to develop anticipatory information, derived from knowledge of the material inputs, build-up of stocks of materials before they become wastes, and dispersive losses. Energy use associated with this flow of materials also needs to be considered. Care has to be taken to avoid merely shifting the pollution problem to another phase, place or a future time, and information that would warn of this is required.

Materials Accounting Techniques

Environmental Management Systems developed for regions and facilities require indices to be defined and measured, in order to determine whether the processes in the systems are sustainable. One of these indices, or set of indices, relates to the sustainable extraction, utilization and disposal of material resources, at both facility level and within the region. The facility and the region will be sustainable from a materials perspective if the following material utilization objectives are met:

- Renewable resources are harvested at a sustainable rate;
- Non-renewable resources are mined at a rate, and in a manner, which recognises that other materials will need to replace the material once it is exhausted from available ores;
- Materials are disposed into the environment at a rate which does not interfere with the preferred environmental quality.

That is, in order to be sustainable, the metabolism of the regional economy has to be at a rate, where the fluxes of materials through it can be sustained into the future. The "rucksuck" (Lehmann and Schmidt-Bleek, 1993) of emissions in other regions for materials brought into the region has also to be considered. This paper reviews some of the emerging materials accounting techniques that can be used to assess the environmental performance of a facility and the region in which it operates, and which can provide guidance on how to move towards better materials management that will lead to improved environmental performance.

Material input per service unit

The Wuppertal Institute, under the leadership of Schmidt-Bleek, has developed a proxy measure of the environmental impact of materials use called the "Materials Input per Service Unit" or MIPS (Schmidt-Bleek et al, 1993). The MIPS is a coarse, screening level life cycle assessment which quantifies weighted material inputs to the provision of a service by goods made of materials.

Weights for materials ranging from movement of overburden to access ores, through raw material inputs to form materials and goods from these materials, have been initially determined by a discussion among experts. These weights will be reviewed by developing methods and broader consultation as the MIPS method develops. The measure includes all material and energy inputs to form materials and goods, but does not include land area or waste outputs. The amount of weighted material input is reduced to equivalent kilograms per unit of service provided by the system being examined. In a service providing system being examined, production and transport are the two types of processes used to describe the metabolism of materials in the anthroposphere. Complex interacting systems can eventuate, and "CAMA" software has been developed to assist in the analysis (Lehmann and Schmidt-Bleek, 1993).

The aim of applying the method to environmental management of goods, and the supply of a range of, or all, services in a region, is to satisfy needs and wants with a decreasing level of material inputs – to dematerialise the regional economy, while maintaining or improving quality of life. This requires design of "smaller" durable and reusable goods, using recyclable materials. It also points to the need to alter the method of ownership and sales – away from ownership of goods towards lease and sharing arrange-

ments. It also encourages provision of services, such as education, through methods that do not consume large amounts of materials – eg, Internet delivery to homes, rather than requiring students to travel to remotely located centralised classrooms.

Preliminary studies undertaken by Schmidt-Bleek and others (1993), indicate that a reduction in global materials use (with current population) of 50% is desirable, and that industrialised economies should be aiming for a significant reduction, to enable other economies to expand their service consumption with attendant increase in material consumption. A "Factor 10 Club" (1995) of individuals has been formed, with aims of:

> *"… In industrialised countries, the current resource productivity must be increased by an average of a factor of 10 during the next 30 to 50 years…(by)..generating new products, services, as well as new methods of manufacturing."*
>
> *"…The relative cost of labor will have to decrease in industrialised countries….by revamping subsidy systems and through taxing resource consumption instead of work…."*

Schmidt-Bleek notes (1993) that reducing MIPS will lead to a reduction in waste, and that from an environmental and economic view, existing infrastructure should not necessarily be dismantled to move quickly to lower MIPS.

MIPS has been consciously designed as an initial screening technique, identifying preferred approaches to system and goods design, so that economies can be moved in the preferred direction. It recognises the advantages that LCA and environmental risk assessment can provide for more detailed analysis, but appreciates the difficulties in obtaining all the data and criteria in order to quickly apply these more comprehensive methods.

Materials flux analysis

Baccini and Brunner (1991) developed Materials Flux Analysis (MFA) at EAWAG in Switzerland in the 1980s to address two basic questions:

1. How much time is left to efficiently reduce existing man-made hazardous impacts on our essential resources, on water, air and soils?
2. What should be done first to prevent hazardous anthropogenic material fluxes with respect to man and the biosphere?

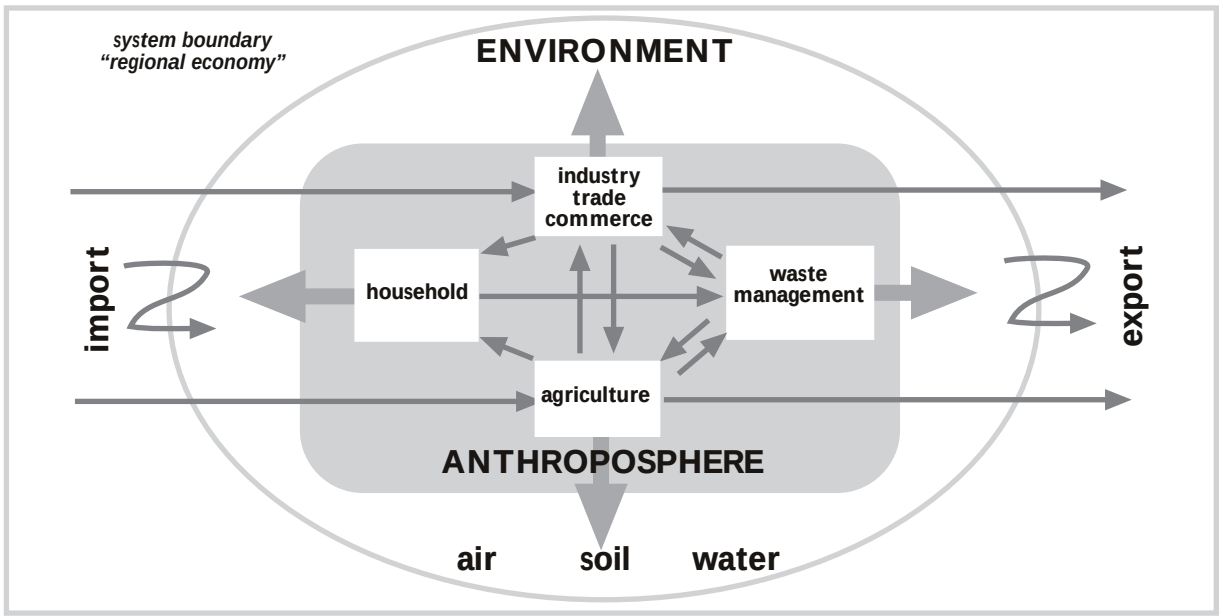


Figure a2.2 : Scheme of the essential interactions between the anthroposphere in a regional economy. The thin straight arrows indicate material fluxes influenced by the market. The curved arrows symbolise the geogenic fluxes. The wide arrows indicate emissions which can be limited by environmental protection measures. (from Baccini and Brunner, 1991).

The system of the anthroposphere, the sphere of human activities and infrastructure, as shown in Figure a2.2, is studied quantitatively in order to determine the flux of materials through it. In order to understand whether the material fluxes through the anthroposphere are sustainable, ie whether the anthroposphere can be successfully embedded in the regional environment, a materials flux analysis is undertaken on individual elements (or compounds) to understand:

- the input of the material to processes in the region;
- the accumulation of stocks of the material in processes;
- the current outputs of materials from anthropogenic to natural environments.

This provides a transparent analysis of materials flows for alternative infrastructure and production facilities in a region, and should be a requirement for EISs and feasibility studies.

The MFA method attempts to provide an holistic understanding of resource depletion and environmental quality degradation, beyond the understanding provided by waste pressure indices. In the development work for the Australian Waste Database, Moore and Tu (1994) came to understand the limitations of only accounting for waste outputs from a series of processes in particular regions, as recognised by Baccini and Brunner (1991), " …The quantity and quality of this operationally defined class of waste reflects not only the region's consumption habits but also its system of collection (and waste management). Therefore, comparisons of waste fluxes from different regions have to be interpreted very cautiously."

The results from the MFA method provide an understanding of the accumulation of elements in process infrastructure; these stocks will become wastes to the processes, and the method can be used to predict outputs from the region's infrastructure in the future under various materials management scenarios. It can be used as a management tool to anticipate and alter regional economies to prevent or minimise future problems at the interface between the anthroposphere and the regional environment.

The MFA method is essentially a materials balance for an element (and possibly compounds in the future) in the anthroposphere in a region. The general elements are as follow.

- Choose an element, or set of elements of concern (to date heavy metals and nutrients have been studied).
- Define the region to be studied (this is not straight forward, and will be influenced by the element and processes involved).
- Choose the significant goods and processes that are important for the element (this is most difficult, and can require iterative approaches and the development of artistic feel for the method based on experience).
- Undertake a materials balance for the significant goods through the significant processes, and then, knowing the concentration of the element in the goods, derive an element balance for the region's economy.

With this information, examine the current and future anthropogenic fluxes of the element through the region, and compare them with geogenic fluxes in order to assess the sustainability of the emissions to the environment. Broader global regions would need to be studied in order to assess resource depletion issues.

The method is initially very resource intensive, but with the establishment of databases of element concentrations in materials in various goods, and with a development of understanding of the partitioning of elements into different materials through processes, the method becomes more economically available.

Life Cycle Assessment

Life Cycle Assessment (LCA) has been developed in North America and Europe to examine and improve the whole of life environmental performance of goods designed to provide particular services. Only a brief review is provided here in order to place the LCA technique into the broader context of other materials accounting techniques. The method is now being standardised in ISO14040, and a

number of pieces of software (eg Simapro) and databases (eg by IKP at Stuttgart University) are being developed and made available to assist with implementation.

The method consists of three main steps (the US EPA divides these into five) :

- Inventory analysis, where the goals of the LCA and its system boundary in space and time are defined, before determining an inventory of material and energy inputs and outputs from each phase of the life of materials in, and operation of the good. Wastes are also included in this analysis.
- Impact assessment then attempts to convert the various units of different material and energy inputs and outputs, from processes in the life of materials in the good, into common terms which can be compared against acceptance criteria, or which can be used to compare one good with another providing the same service. This task is not straightforward, and is still being developed. It is sometimes difficult to get agreement that two different products are providing the same service, especially when human preferences are involved. The task of converting $kgm^{-2}year^{-1}$ of lead on soil and gm^{-3} of dioxin in exhaust stacks is also a difficult technical and social problem. Attempts have been made, based on existing regulatory standards for various emissions (Guinee et al, 1993).
- Improvement analysis finally uses the information on sources of major impacts to improve the environmental design of the newly designed or existing good.

The LCA method has been used in designing new or improving existing products, undertaken within a manufacturing company's operations; and has been attempted to be used as providing information for marketing of goods. It has also been attempted to be used as a method to assist in making purchasing decisions by consumers. These latter attempts have often not met the original intentions of the LCA study because of the problems introduced by inconsistent system boundaries; and the lack of available data and sometimes small differences between competing goods.

Other materials accounting techniques

A range of materials accounting or materials flow analysis techniques are being developed to improve the environmental management of facilities and regions. This paper has concentrated on three of the major techniques which cover a wide range of applications. Other techniques that are being developed include :

- Sustainable Process Index (SPI) by Narodoslawsky et al (1994) : the SPI provides a measure of the sustainability of a process producing goods, and again uses geogenic reference levels to attempt to determine when a process can be "embedded" into a region's environment in a sustainable way. The unit of measure is m^2 of land, and is calculated from all the land required to provide raw materials, process energy (solar derived), infrastructure and production facility, and disposal of wastes. Lower "land" requiring processes are preferred, and the sum of all land required to provide all services to an individual will be limited in a region to that available per capita.
- Materials Input/Output analysis (Pearce and Turner, 1990) attempts to extend monetary input/output analysis for a region to include supply of environmental commodities of resource supply and acceptance of waste materials. Investment can then determine material inputs to and outputs from the region's economy. This is a difficult approach, and the authors have not examined a successful application of the method, but would welcome information in this area.

Summary

All material accounting tools at least consider the inflows of materials to systems, while most also consider the outputs, and some the stocks for the materials balance of the system. Beyond the materials balance aspect, the tools then measure the impact of the use of materials against different sets of acceptance criteria. These criteria may be used for comparative analysis, or to measure impacts against a regional sustainability criterion. These are briefly described below, with more complete descriptions available in the references provided. A summary of this description is provided in Figure a2.3.

Tool	Bulk materials	Goods	Materials	Typical Time Scale	Geographic Scale	Evaluation
MFA		★	★	Year	All	Geogenic reference
LCA		★	★	Varies	Region	Environment impact assessment
SPI/EF		★		Year	Region, nation	Available land area
MIPS	★	★		Year	Nation	10 times Factor reduction
TMR	★			Year	Nation	Comparative evaluation

Figure a2.3 : Summary of approach used by Material Accounting Tools

Total Material Requirements (TMR) (Adriaanse et al, 1997) and MIPS (Schmidt-Bleek, 1993) only consider inputs in the indexes derived; this is based on the fact that inputs deplete resources and will eventually lead to emissions to the environment, and therefore these indexes will be a simple measure of the pressure on the environment over a medium time scale. Comparisons among alternatives may be undertaken by preferring the lower valued TMR and MIPS systems. The methods can be used to derive a material intensity of an economy, i.e. the ratio of materials use to Gross Domestic Product (GDP). Lower material intensity is preferred from a system, and targets of a 10 times improvement over the next 50 years in the efficiency of use of materials have been set by researchers in this field. The time scale is normally a year, the geographic scale is a region to a nation, and the materials considered are bulked materials, which may or may not have environmental importance weights attached to them.

LCA (Consoli, et al, 1993) looks at the total inputs and outputs in providing a service by a good over its entire life time, with a preference for goods with low total inputs and outputs as measured by a developing set of environmental impact assessment indices. These indices provide a measure of greenhouse warming potential, ozone depletion potential, and often include acid rain formation potential, eutrophication potential, carcinogenicity and ecotoxicology. The time scale is set to the life of a good providing a defined service unit, the geographical scale may be region specific or more generally representative, and the material scale is that of the goods required to provide a defined service unit.

Sustainable Process Index (Narodoslawski, 1994) and Ecological Footprints (Wackernahgel and Rees, 1996) express materials and energy consumption and emissions in square metres of equivalent land area consumed. SPI works at a geographic scale of a region, for material scales associated with the processes required to provide a good to satisfy a person's needs for a year; comparisons among different goods can then be made. Ecological Footprints consider the material and energy requirements of nations, and compare these derived areas to the available national area.

Materials Flux Analysis (MFA) (Baccini and Brunner, 1991) and Substance Flow Analysis (van der Voet, 1997) provide an account of the inputs, stocks, and outputs from a regional system of processes, for a particular material or substance, for a period, normally a year. This account can be used for comparative analysis, or the anthropogenic flux of the material to the environment in a region can be compared with an acceptance value, derived from geogenic fluxes of the material through the region.

In summary, these material accounting tools yield results which provide useful indicators for comparative analysis and can be compared to proposed sustainability target levels. The methods themselves do not generally attempt region specific ecotoxicologically based environmental risk assessments; however, their results would be useful inputs to such studies, if they were considered necessary and able to be undertaken with reasonable confidence.

All material accounting techniques can be used for improving regional environmental management; and they can be done in a complementary manner. For instance, MIPS could consider the best transport system to be provided for a city over the next 50 years; MFA, for the range of infrastructure and goods required, could advise on which metals and nutrients should be minimised as inputs, recycled at certain minimum rates or disposed at certain allowable rates; and LCA could advise on preferred material

choice for vehicle components. All methods can be used in conjunction with, and sometimes as inputs to, other environmental management methods such as environmental risk assessment. The materials accounting measures are generally separate indices to GPD, and generally do not attempt to "green" the GDP calculation; they are separate indices that should be used in conjunction with GDP and other welfare measures to obtain an indication of welfare in a region.

Materials accounting measures do not attempt to provide the whole answer to the sustainability question. They recognise they are only dealing with material welfare and impact on material quality of the environment – the indirect links to biodiversity are recognised, but are not attempted to be exactly quantified. The importance of other welfare factors such as health and literacy are also recognised as indices that need to be separately included in welfare considerations.

While Life Cycle Assessment (LCA) has been developing since the mid 1970s, other material accounting tools have only been developed in the last decade. They are continuing to develop, and a detailed evaluation of which tools may be most appropriate for particular questions may still be premature. Further development of tools, application to environmental questions, and comparative studies on outcomes will be required before a clearer evaluation can be undertaken. Energy use needs to be considered in making decisions on material use and waste management; some material accounting methods include this as a use of fossil fuel material amounts (Material Inputs Per Service unit (MIPS), and LCA) while others require separate accounts of energy use (Material Flux Analysis (MFA)). This paper will concentrate on the materials aspects.

ATTACHMENT 3

attachment 3 -

Summary of Activites related to Materials Accounting and ISO 14000 in 25 countries

This table is the result of enquiries within each of the countries.This overview does not identify all of the activities and initiatives in each of the countries but is indicative of the range of action.

	Government		Industry		Linked activities*
	Programmes	Regulations	Actions	Issues	Programs
Argentina			Used mostly by multinational companies. metallurgic and plastic sectors apply LCA concepts in the development of new products.	Concerned LCA requirements and eco-labelling will be non-tariff trade barriers. Concerned by the high cost associated with LCA.	UIA (the Argentine Industrial Union) is organising an information seminar on ISO 14040
Australia	Funding an initial study on need for government involvement in LCA development. Some public purchasing incorporating LCA technology.	Various legislation on pollution control (waste management).	Mostly multinational companies are incorporating LCA principles for management and new product development..	Concerned by the high cost associated with LCA. Concerned that LCA may be used by other trading partners as a non-tariff trade barrier.	Packing and Aluminium industry research projects Roundtable on LCA and its implementation
Brazil	Established a voluntarily-financed fund to support industries or companies interested in incorporating LCA concepts. Finances research by a "green studies and projects fund".		Multinational companies using LCA as a marketing tool and incorporating LCA concepts. Other interest predominantly in packaging and shoe and leather industries,		ABNT (association for technical norms) have a group looking at the application of ISO 14000 Academic papers being produced on LCA
Britain	Principally involved in development of EU eco-labelling scheme. About to release a best practice guide (aimed at SMEs) designed to encourage the business sector to adopt LCA as a manufacturing tool. Regards LCA as a tool for policy makers and industry.	Seeking to pass legislation conforming to EU legislative requirements.	Widespread research and application of LCA by principally amongst market leaders.		Participates in several European research projects
Canada	Government publications providing forum. Specialised reports targeted for SMEs. Development of database for life cycle inventory.	Pollution prevention legislation mooted.	Experimenting with practical applications of LCA.	Concern there may be possible future adverse impacts of eco-labelling requirement from EU.	Development of eco-efficiency indicators Member of SETAC CSA works within ASTM to develop LCA standards under ISO TC-207.

	Government		Industry		Linked activities*
	Programmes	Regulations	Actions	Issues	Programs
Chile	INN (the Chilean National Standards Institute) aims to start ISO 14000 certification by the end of 1998.			Multinational companies interested and applying. Generally negative industry response because of cost. Concern that eco - labelling with be used as non tariff barriers by industrialised countries.	
China	Successfully piloted ISO 14000 implementation in Ziamen. Considering certification.	Increasing number of environment protection laws and enforcement of them.			
Czech Republic	Indication that the government is in the process of creating international standards according to ISO series 14040.	Mooted legislation regulating methods for establishing technical requirements for products which have a potentially negative effect on the environment.			
Denmark	Encourages Danish companies to carry out LCAs. Produces a computer model of UMIP method which companies can purchase to do their own LCAs. Provides grants to companies to undertake LCAs.	A non compulsory industry code for cleaner technology and products, incorporating LCA to be introduced in Denmark.	The Confederation of Danish Industries promotes a holistic approach to production based on LCA.	Some companies expect suppliers to follow LCA standards. Experience difficulties getting realistic LCA data from other countries and how to assess the data.	Developed a method for conducting LCAs in Denmark (UMIP)
Finland	Support through funding for research. Support of eco - labelling.		Predominant use in forest and paper sectors. Promotes and uses eco-labelling process to address consumer concerns as well as a marketing tool.	A boycott of Finnish paper products by Sweden and Holland on ecological grounds.	
France	Regional bodies provide information, advisory bodies, guidebooks to the use of the LCA norms. Local government "green purchasing" network.		Little uptake of LCA concepts.		Forefront of development of LCA theory and methodology. AFNOR (French Standards Association) assists firms in the interpretation and use of norms derived from ISO 14000

	Government		Industry		Linked activities*
	Programmes	Regulations	Actions	Issues	Programs
Germany	Has and is funding several studies in packing industry and other industries through BMU (Federal Environment Ministry), UBA (Federal Environment Agency).	Closed Cycle and Waste Management Act. Packaging Ordinance. Product-related Environmental Protection Policy.	Mostly packaging and consumer goods companies have been involved in LCA. Industry bodies have nominated company representatives to formulation of ISO standards.		FZJ (Research Centre) and Aachen technical university carrying out a study of material flows for metallic raw materials.
Hungary	Government adopted ISO 14040 in June 1998 and ISO 14041. EU requirement may focus more attention in the future. Finances LCA programs.		Hungarian Gas and Oil Company has supported the endorsement of ISO 14040.		
Indonesia	Demonstration project (funded by Germany) planned on LCA processes in leather, textiles and paper manufacturing				
Japan	Five-year program launched in 1998 to develop a national standard for impact assessment and construct a public inventory database.		LCA used to increase production and service efficiencies. Life Cycle inventory databases being established by a number of companies.	Provision of confidential data for public database. The LCA system developed must be transparent to avoid accusations of imposing technical barriers to trade. Suspect future mpact of "Green" procurement programs and the provision of information to the consumer.	JCLA studies the significance, methods, applications and problems facing LCA
Korea	Working on an LCA inventory database. Expecting to put in place a system of eco labelling by the end of 1999.		Some large corporations assessing the environmental impact of their products		
Malaysia	Disseminates information on developments with ISO 14000.		Sony Electronics, Penang and Guthrie Palm oil have conducted their own LCA for inventory purposes.	Concern that without standards imposed some industries in Malaysia might try to pass off products as LCA compliant when they are not.	

	Government		Industry		Linked activities*
	Programmes	Regulations	Actions	Issues	Programs
Norway	LCA important part of the government' s environmental policy plan. Support various LCA initiatives. Uses LCA in evaluating regulations and charges related to packaging.	Environment policy has been developed where producers have to consider the total LCI of their products. Voluntary agreements between government and industrial sectors based on LCA standards. Several EIS' have required LCA.	Integrated into product development and marketing activities of larger companies.	A few companies have changed suppliers because of LCA but this is not widespread.	The Federation of Norwegian Industry and Business have been involved in standards developed based on LCA ORF (Ostfold Research Foundation) which initiated LCA research in Norway and is still active in its development
Poland	EU requirement for harmonising Polish legislation with the EU is focusing government attention on ISO 14000.	LCA will be used for assessment of products applying for the "Eco sign' "standard series (a voluntary certification system).			No action by industry associations as yet
Philippi-nes	Discussion of ISO 14040 and LCA at the technical committee level of government. Initiating programs to provide technical assistance for implementation of ISO 14001.				The steel industry is concerned by lack of involvement in ISO 14040 by the Filipinos
Russia	Little attention to LCA and ISO 14000.				Vernadsky fund holds seminars and conferences on ISO related matters
Sweden	Close cooperation with industry and industry associations to develop LCA.		High level of industry of industry awareness. LCA used as a competitive tool for Swedish companies. Some companies have developed supplier evaluation tools.	Some companies report they can show that using LCA has given them a competitive edge.	CPM (a national competence centre for LCA) has established a LCA database and LCA inventory tools The CPM advises Government and Industry on policy development and ISO 14040 (LCA) implementation
Taiwan	Sponsoring a voluntary environmental labelling project which uses LCA as its basis for product criteria.				ITRI developing technical tools to assist local industries to met the ISO 14000 series standards. One of the tools would be an LCA databank
Thailand	Used as a tool of environmental management systems and as a principle to set up product criteria under the Thai green label programme.				TEI (Thailand Environment Institute) organises seminars and publication to raise awareness of LCA
USA	Coordinate efforts on LCA in industry and government and dissemination. Some local authorities place companies with LCA at lower auditing level. Developed an LCA that facilitates the evaluation of supply and demand sides of energy systems.	Annual reporting on LCA activities of the Federal Government. Clean Air Act. Government procurement to be on a "holistic view" of the product. All New Federal Government regulations to conform with ISO 14000).	Used as an internal management tool. Study on generic motor car by the big three automobile manufacturers. Development of LCAs on forest and paper products and plastic resins.	LCA was hoped to stop the proliferation of local and national environmental standards. That it be understood that LCA is but one part of overall environmental management.	SETAC - workshops on LCA, monthly journal, advisory group to advance LCA application ASTM - develops LCA standards under ISO TC-207

** organisations/associations (industry, academic, environmental, NGOs, roundtables incorporating public and private sectors, etc.) who have been active in promoting ISO 14000, green labels, cleaner production, etc*

attachment 4 - Life Cycle Assessment, methodology and issues

Based on material provided by Leanne Philpott, CRC for Waste Management and Pollution Control, University of NSW. Additional material provided by the consultants.

LCA offers a systematic approach to decision making using a comprehensive understanding of the environmental attributes associated with a product, system or service. The assessment encompasses the entire life cycle of the product, process or activity, encompassing extraction and processing of raw materials, manufacturing, transportation and distribution, use/reuse/maintenance, recycling and final disposal (SETAC, 1993).

Life Cycle Assessment provides a methodology for:

1 Quantifying the materials and energy use and waste and pollution generation at each stage in the life of a product or service (from the "cradle to grave" or Raw Materials Extraction; Manufacture; Distribution; Products Use and Maintenance; and Waste Disposal);

2 Assessing the environmental impacts arising from the materials and energy flows (across all environmental media of air, water and land);

3 Identifying options for process and product improvement.

A Four Step Process

The four steps in the methodology of LCA are:

1. Scoping and Goal Definition
2. Inventory Analysis
3. Impact Assessment
4. Improvement Assessment.

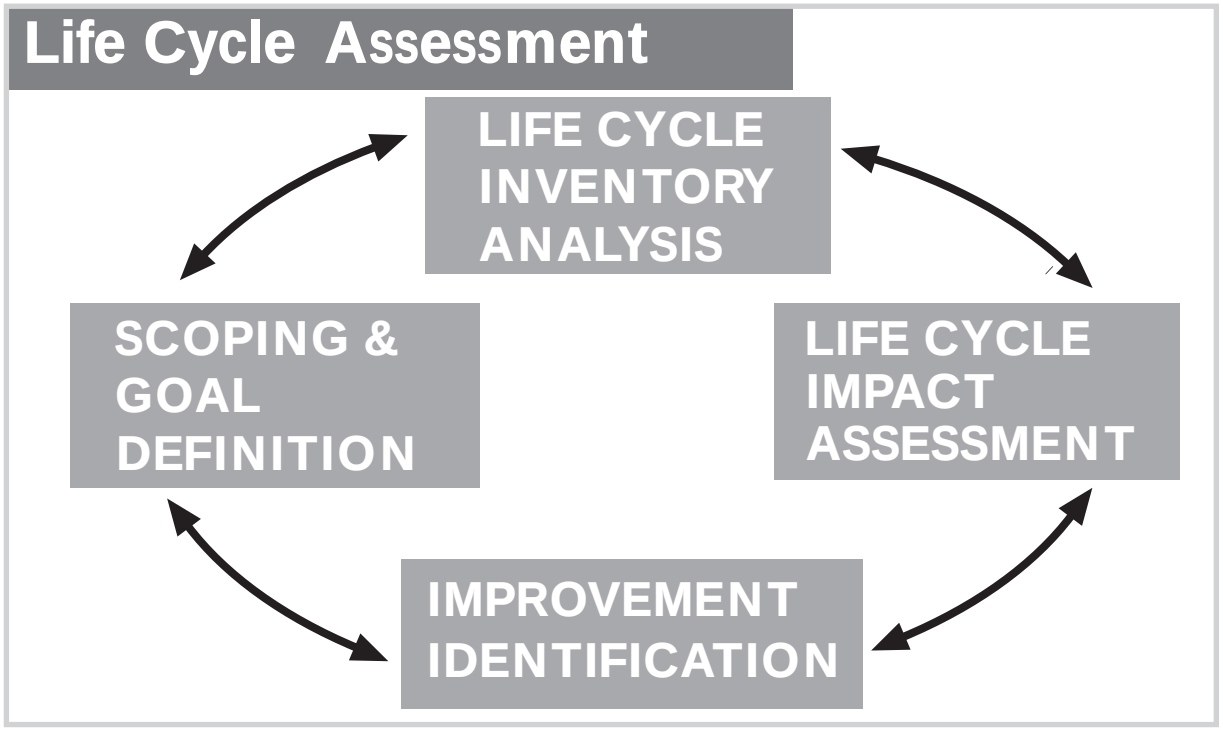


Figure a4.1: The four steps in the methodology of LCA

1. Goal Definition and Scoping

The preliminary phase of LCA (establishing goals and boundaries for the study) is a critical phase. The goal, scope and type of assumptions made at this stage in the study will influence the direction and depth of the study and the final results.The scope of the study, and all assumptions, need to be acknowledged in any comparison or communication of final results.

2. Inventory Analysis

The second phase of LCA, is a methodology for quantifying the material and energy inputs; and the environmental releases and material outputs, at each stage in the life of a product, process or service:

Life Cycle Stages are:

- Raw Materials Acquisition (exploration, extraction or harvest & refining);
- Product Manufacture (multi process manufacture, fabrication, assembly);
- Distribution;
- Product Use (use, reuse and maintenance); and
- Waste Management.

3. Impact Assessment

Life Cycle Impact Assessment (LCIA) is a methodology for identifying the relative environmental impact of materials use and pollutant loads, as documented by the Life Cycle Inventory. LCIA is both a quantitative and qualitative process, which proceeds by classifying, characterising and valuing the magnitude and significance of environmental impacts.

4. Improvement Assessment

The final phase of LCA includes identification of improvement opportunities including cleaner production, eco design and waste minimisation approaches.

Source: Canadian Standards Association, February 1994

Life Cycle Inventory Analysis

Systems and Boundary Definition

Within Inventory Analysis, the product or process of study is defined as a system – a collection of materially and energetically connected operations which perform some defined function. For the purpose of study, the system has a boundary which separates it from its surroundings.

Inventory Analysis is a quantitative description of all of the flows across the boundary either into or out of the system. Systems are often composed of a range of interlinked subsystems and techniques in process flow modelling should be used to represent the groups of operations.

Figure a4.2: A systems Approach to LCA

Data Collection

- Data is collected on the material and energy flows across the systems boundary in a systematic way, according to data format requirements. Parameters such as data source and type; data collection method; geographical and temporal issues etc, are recorded with the data to ensure provision for data quality indicators.
- Data is validated by techniques such as mass balance, engineering process modelling, comparative analysis and identification of anomalies.
- Each subsystem should be mass and energy balanced.

Data Calculation

- After mass and energy balancing of the subsystems, data are presented in a standardised format by normalisation with respect to a given functional unit of output for each subsystem.
- Data is allocated to products and co-products and aggregated for the product system.
- The contributions of each subsystem to the overall system are calculated by multiplying the normalised data by mass output (ISO CD 14 041.1 November, 1995) (Batelle, Nov 94).

Data Quality

Assessing and reporting data quality in LCAs is the key to the proper interpretation and reporting of results (SETAC, 1993). Data quality issues must be integrated from the start of inventory development, including specificity for geographical coverage, time period for data relevance, technology coverage, data source type and critical review process.The draft ISO standard, CD 14041.1, identifies additional data quality indicators for consideration to include:

- Precision (variability of data values for each data category)
- Completeness (per cent of primary data values from those potentially available in a unit process);
- Representativeness (qualitative assessment of data representativeness);
- Consistency (qualitative assessment of uniformity of approach);
- Reproducibility (degree to which independent analysis will produce the same results).

LCA Data

Inventory data should record and account for:

- material selection to be studied;
- data sources;
- data types;
- specifications on the unit processes to be studied;
- inventory flow items.

System boundary criteria influence the data inventory requirements through each of the above variables.

Data Source Issues

Data accuracy requirements are dependent on the scope and intended application of any LCA study (ISO CD 14041,1 December 1995). Well characterised, process and site specific data (of primary source) is typically the most accurate and least prone to error, but is not always available.

Primary Sources of Inventory Data

Site specific process data (government & industry sourced)

LCA study specific results and established data

Audit, accounting or engineering reports.

Secondary Sources of Inventory Data

Environmental statistics

Consumer and marketing studies

Published product composition analysis

Regulatory licences and environmental reporting data

Technical encyclopaedias and handbooks, material science publications

Industry association generic data

Existing LCA data and studies, public databases.

Life Cycle Impact Assessment

Life Cycle Impact Assessment (LCIA) is a technical, quantitative, and/or qualitative process to characterise and assess the effects of the environmental burdens identified in the inventory component (SETAC, 1993). LCIA is conducted within a methodological and scientific frame defined by the LCA methodology.

The three steps of Impact Assessment are:

1. Classification;
2. Characterisation; and
3. Valuation.

1. Classification

Environmental pressures identified in the inventory are grouped in the environmental impact categories according to the general areas of:

- resource depletion;
- human health;
- ecological health.

2. Characterisation

Analysis and quantification of environmental impacts, within the impact categories, is conducted. This step should be based on scientific knowledge about processes and non-linear cause and effect relations should be recalculated.

3. Valuation

Includes the weighting of impact relative to each other. Reflects subjective and objective assessments and may be based on a range of techniques such as expert group assessment; environmental economics valuations; multicriteria support using best available data etc.

LCIA involves the application of a matrix of environmental effects or a classification model to the quantitative inventory of environmental interventions to give an environmental profile.

Issues and uncertainties

Embedded within this well specified systems approach is a myriad of opportunities for legitimate debate, divergence of approach, and alternative weightings. The basic task of defining systems boundaries (for example) can result in radically different outcomes from the analysis. The results of conducting an LCA on a mining project (for example) will vary markedly depending on whether the boundaries are drawn at the site gates, or whether the system takes into account the myriad of related inputs and outputs that flow through those gates. An LCA on compostable waste management will give markedly different outcomes to an LCA on a total waste stream.

There are also legitimate differences in the weightings attached when valuing impacts. The relative importance given to (say) air quality versus economic utility, or water consumption versus air pollutant emissions, can lead to markedly different comparative assessments.

But these are only some of the issues that require consideration in a truly professional application of these techniques.

While many people may agree conceptually that LCA is potentially a valuable tool for assessing the impacts of products and services on the environment, the jury is still out on what is the best methodology for LCA assessment and its feasibility. Development of the LCA tool hinges around accessing a sound database for inventory and around relevant algorithms to manipulate the data and produce meaningful and creditable results. Both data gathering and use of the algorithms require a depth of knowledge and experience not currently held in most organisations, especially SMEs.

In part, this knowledge and experience can be learnt through the formal education processes: seminars; tertiary education courses; books; and the like. Relying predominantly on these avenues, however, will short-change organisations – and society in general – on the real benefits of LCA. Experience in the application of the tools is a significant determinant of the quality of the application of the tools.

A review of the international literature highlights a number of significant issues for the implementation of LCA by industry.

LCAs are neccessirily "data hungry". Firms find it hard to develop the database because of the unwillingness or unability of other organisations to provide required information about inputs and outputs to products and processes. Issues of confidentiality are a chief stumbling block. For example, in arguing its case against the (US) EPA's expansion of the Toxic Release Inventory reporting program, chemical producers highlighted the extensive problems for the industry on loss of confidentiality and disclosure of proprietary processes, products and other trade secrets worth billions of dollars (Richards, 1996). Nevertheless, with increasing pressure for use of LCA, data gathering techniques are being developed (Ehlers and Volk, 1997).

A further problem with developing the inventories arises when trying to decide what sort of information should be gathered. A number of LCA models have been developed. Each model requires different sets of inventory data.

Hertwich et al (1997) lists different methods for comparision and evaluation of an inventory's dissimilar pollution loads and resource demands:

- The health hazard scoring (HHS) system uses the analytical hierarchy process (AHP) to weight workplace toxic effects and accident risks.
- The material input per service-unit (MIPS) aggregates the mass of all the material input required to produce a product or service.
- The Swiss eco-point (SEP) method scores pollutant loadings based on a source's contribution to an acceptable total pollution load and an environmental scarcity factor.
- The sustainable process index (SPI) determines the area that would be required to operate a process sustainably, based on renewable resource generation and toxic degradation; an extension of the dilution volume approach.
- The SETAC LCA impact assessment method aggregates pollutants with similar impacts to equivalency potentials (measured in kg CO2 equivalent, kg benzene equivalent, etc.) and uses decision analysis to assign weights to different adverse impacts. The environmental priority system (EPS) characterizes the environmental damage caused by equivalency potentials and expresses it in monetary terms, derived from enviornmental economics.

These are just some of the hidden variables that have a significant influence on the effectiveness of the application of LCA techniques. Access to skilled and experienced experts, an accessible pool of well structured and reliable data, and the collected experience of other enterprises which have grappled with the same issues, seems to be one road to the effective application of these techniques within industry.

ATTACHMENT 5

attachment 5 - Life Cycle conceptual example

The following simplified example illustrates a Life Cycle Impact Assessment comparison between alternative waste disposal practices. This example is conceptual rather than empirical – the proper examination of the comparative effectiveness of waste disposal alternatives is dependent on a number of situation specific variables requiring detailed assessment.

The alternatives considered in this example are incineration, landfill, organic digestion, or composting.

Step 1: Identify the elements within the materials inventory

The diagramatic example below represents the key elements in this approach. The process first requires identification of the entire process throughout the life of the system under review ("Cradle to Grave"), in this case a notional landfill, for which no prior excavation was required (such as infilling a natural land depression or collapsed cave). The next steps in preparing an inventory are to identify all inputs and outputs, and convert them to the basic units of analysis (such as carbon dioxide, carbon, sulphur dioxide, metals, and the like). What is included within the inventory will vary with the technique in use, and the inclusion of elements like total land utilised, water, energy and so forth is likely in most comprehensive approaches.

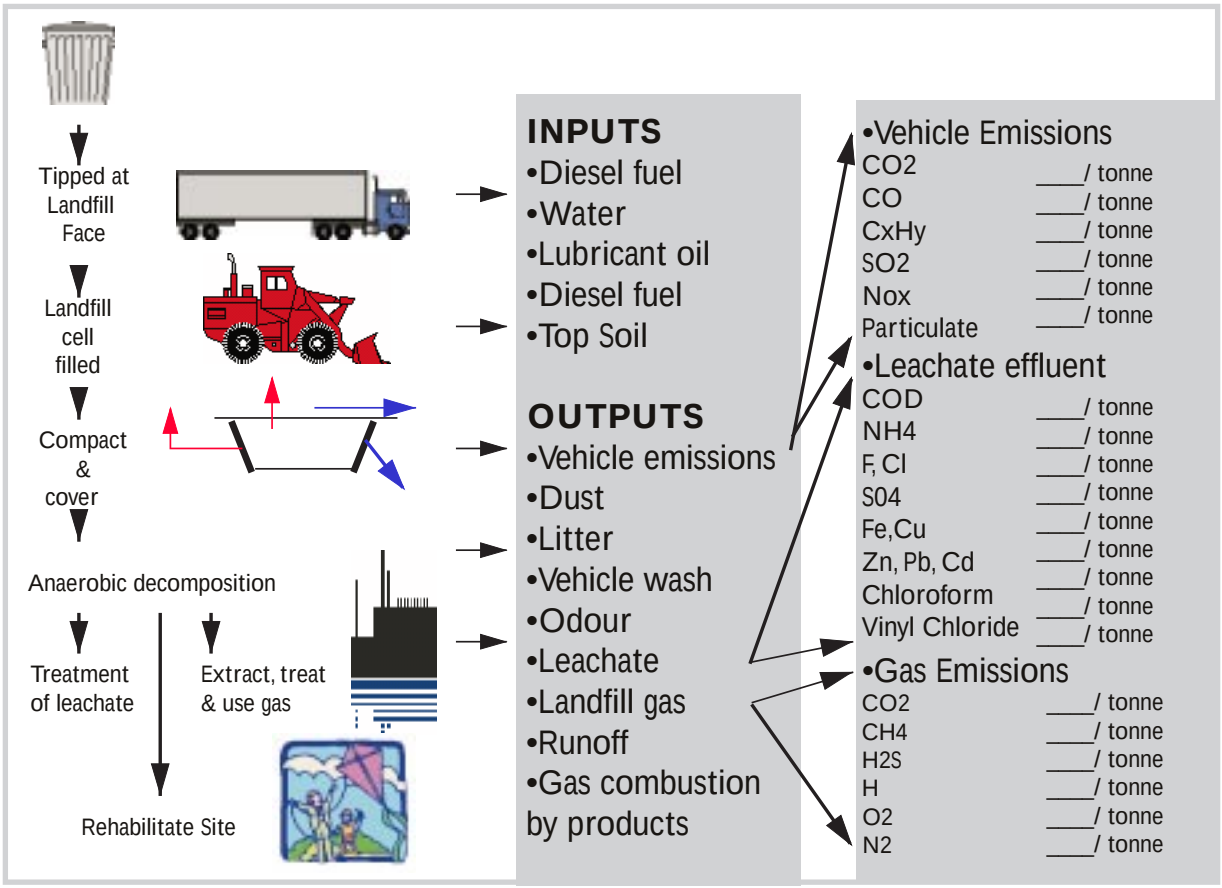
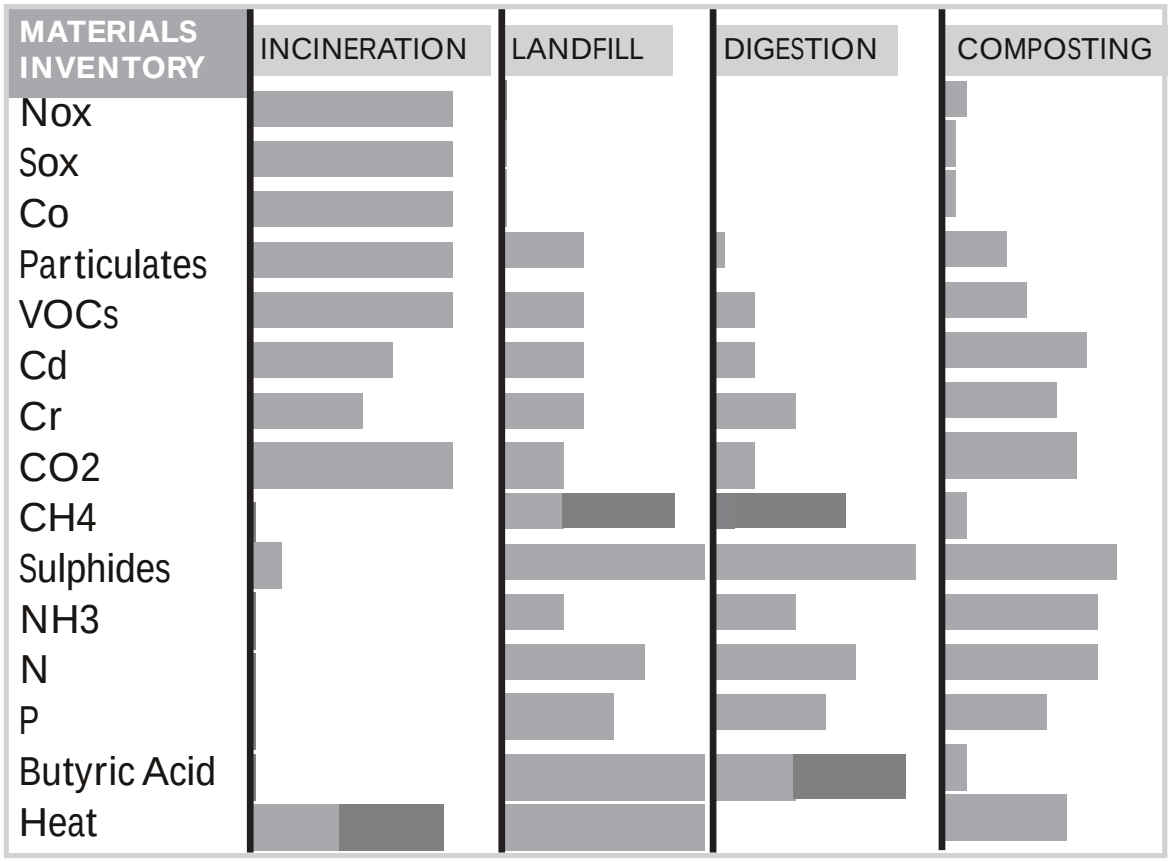
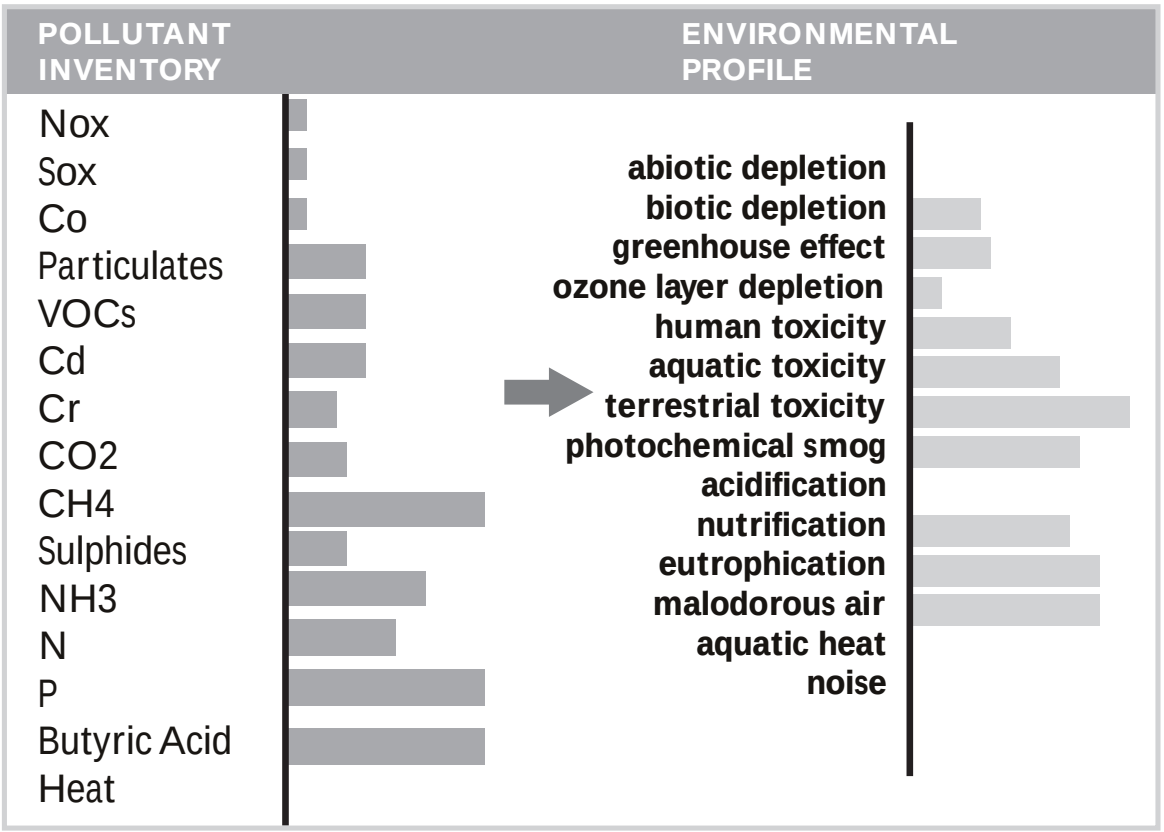


Figure a5.1 - key elements in materials inventory

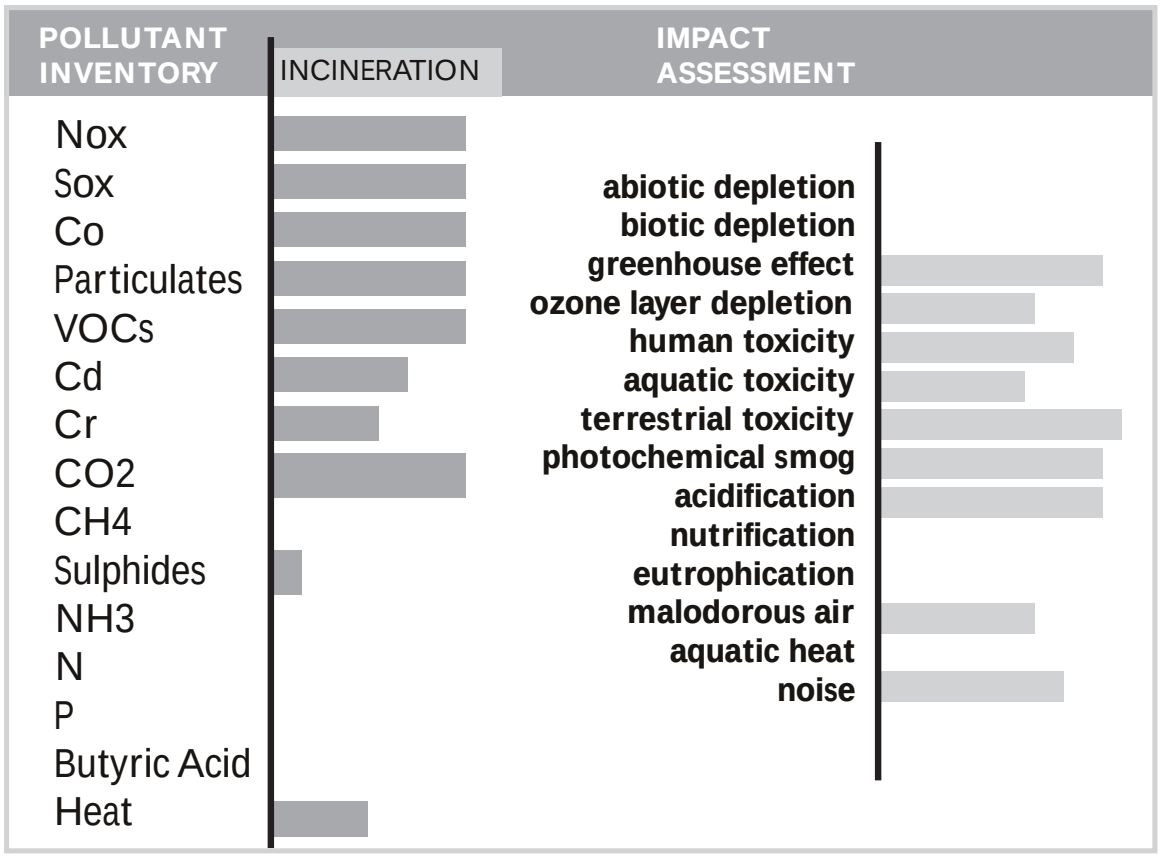
Step 2: Develop materials inventories for the alternatives.



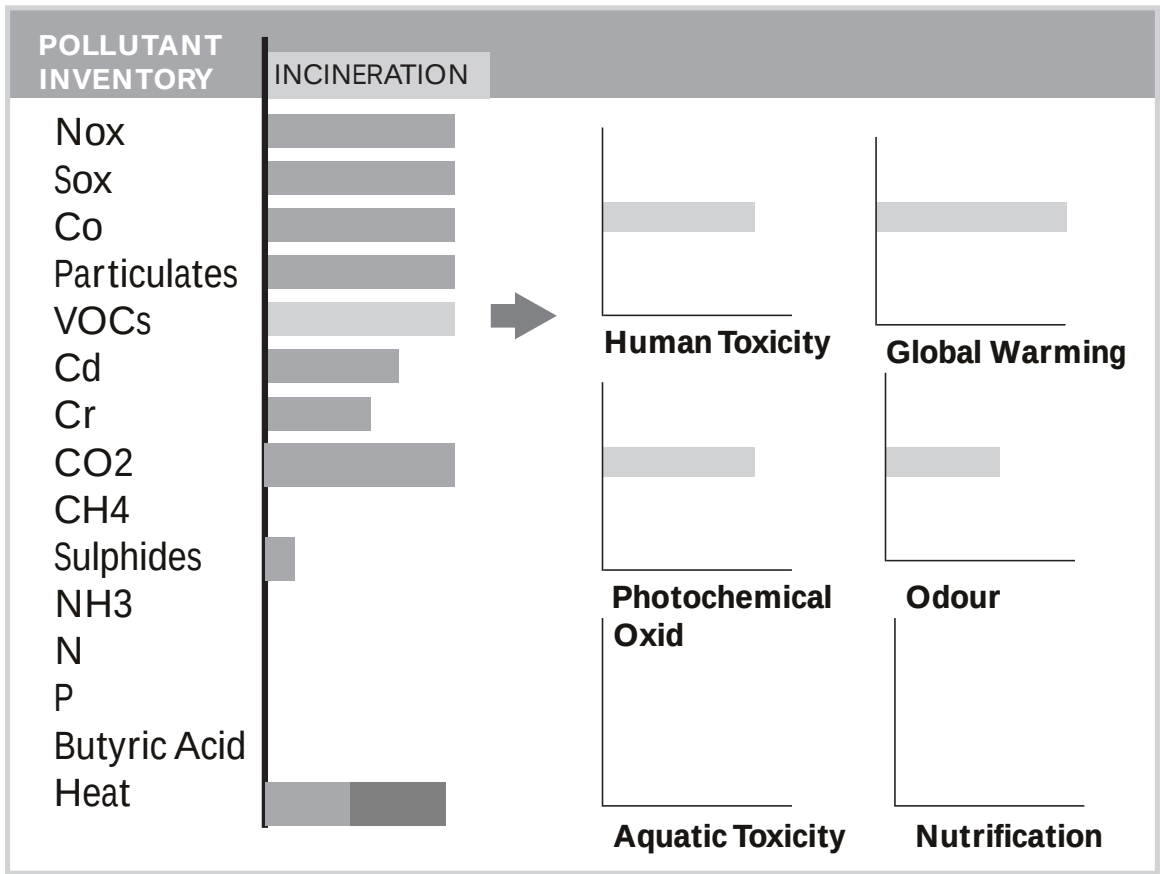
Step 3: Develop an understanding of potential environmental impacts



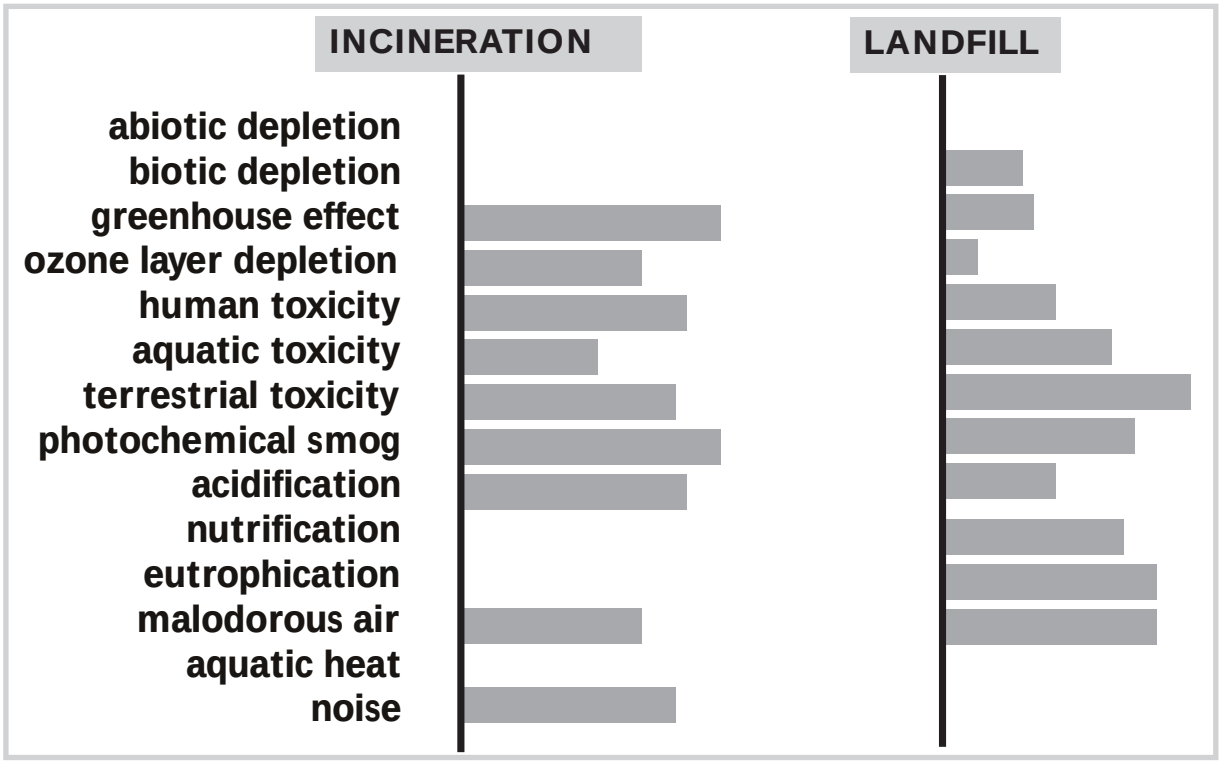
Step 4: Evaluate each alternative and its potential impacts ...



Step 5 . . . with careful attention to the nature of the potential impacts on key environmental and human values



Step 6: Compare the alternatives



This approach enables industry and the community to separate the scientific issues and the embedded values in the choices they make. The related strategic benefit for enterprises is that it facilitates focus on those activities and materials most significant in a business and environmental sense.

attachment 6 - Euro Label Accredited Products

The effect of ISO 14003 will be to establish LCA as the exclusive international basis for eco-labelling. But eco-labelling is already a powerful mechanism for demonstrating environmental credentials, particularly in Europe.

The following list of 190 Euro-label accredited products, taken from the European Eco-Label web site, is illustrative of the sorts of product categories that are eco-labelled, and the types of international firms which are seeking this method of brand differentiation.

Euro-labelled products

Product Group	Manufacturer	Product Model
Indoor paints and varnishes	NordsjöAB(Akzo Nobel)	Innetak 2 and Takfä rg 2 indoor paint
Indoor paints and varnishes	HP Flügger	Flügger Takfä rg 3; Polytex M3; Flügger Vä ggfä rg 7;Polytex M7; Flügger Vä ggfä rg 20; Polytex M20
Indoor paints and varnishes	Alcro-Beckers AB	Bell I Tak; Bell Sidenmatt; Elegant Takfä rg;Elegant Peinture Latex Plafond; Deckefarbe Ceiling Paint;Elegant Vä ggfä rg matt; Elegant Væggmaling Mat;Elegant Peinture Latex Deco Mat; Matte Latexwandfarbe;Flat Wallpaint; Milltex Allgrund; Milltex Helmatt 2;Milltex 2; Milltex 2 Plus; Milltex 7; Milltex 7 Plus;Milltex Halvmatt 20; Milltex 20 Plus;Scotte 3; Scotte 7; Scotte 20; Scotte Tak;Crème Décor Plastifiée Brillant Neige
Indoor paints and varnishes	ICI Paints	Dulux Quick Drying Gloss
Indoor paints and varnishes	Tintas Dyrup SA	Dyrumat Ecológico (refs. 5730-800, 8365, 8331,3504, 3121, 6779, 6060, 5140, 4659)
Indoor paints and varnishes	Sadolin Farver A/S	Sadolin Loft/væg 3; Pansorlux 3 (refs. 299-0999,299-0006, 2199-0001/0003/0006)
Indoor paints and varnishes	Alcro-Beckers AB	Snickerifinish 40; Snickerifinish 70;V-Mill Halvblank;V-Mill Blan
Indoor paints and varnishes	Akzo Nobel Decorative Coatings Ltd	"Do-It-All" Long-Life Gloss
Indoor paints and varnishes	Akzo Nobel Decorative Coatings Ltd	Crown Retail Long-Life Gloss
Indoor paints and varnishes	Tintas Robbialac S.A.	Ecolac Ref. Z 057-0101
Indoor paints and varnishes	Tintas Robbialac S.A.	Ecolac Ref. Z 057-0301; 0302; 0303; 0304; 0305; 0306
Indoor paints and varnishes	Alcro-Beckers AB	Scotte Grund Vit; Webetonex; Aqua Decor Latextempera Antikvit;B-Milltex; Akvalin Temperafä rg Äggskalsvit
Indoor paints and varnishes	Alcro-Beckers AB	Äkta emulsionsfä rg Vit
Indoor paints and varnishes	ICI Paints	Dulux Trade Ecolyd High Solids Gloss
Indoor paints and varnishes	Industrial Quimíca Parrot S.A.	Parrocril Inter-Eco

Product Group	Manufacturer	Product Model
Indoor paints and varnishes	Tikkurila Paints Oy	Eko-Joker A; Valtti Eko-Joker A; Dickursby Vä ggfä rg and shades of Monicolor Nova
Indoor paints and varnishes	FSW Coatings Ltd.	Fleetwood Decorative Gloss Paint, White
Washing machines	Frenko Verkoopmij	EDY models W515, W513, W512, W510, W508,WA1150, WA1000, WA800, T712, T710; Nordland models W1490, W1290, W890,WA1285, WA1085; Blucher models M8120, M8100,M8140, M7115, M7100; Protech models AWB1400, AWB1200, AWB1000, AWB800;Hilton models H1150, H1000; Hanseatic models FR800, FR1000, Top 40801, Top 401001; LLoyds Oko Super models 960, 1060, 1260; EBD models WA9610, WA9612and WA9614
Indoor paints and varnishes	NordsjöAB	Bindoplast; Kids Colours; Extra; Vä ggfä rg
Bed linen and T-shirts	Tissage Watrelot	Linge de lit polyester coton uni “Tertio” (coloris pêche, marine, champagne)
Bed linen and T-shirts	Joseph Hacot	Linge de lit 100% coton uni “Tertio” (coloris champagne, safran, mimosa)
Bed linen and T-shirts	ITC	Linge de lit 100% coton uni “Tertio” (coloris vert d’ eau, lys, pacific, terracota, espace, vert irlandais)
Bed linen and T-shirts	Hacot Colombier	Linge de lit polyester/coton uni “Tertio” (coloris lavande, vert d’ eau, pacific, terracota, lys, espace, mimosa, vert irlandais, champagne
Bed linen and T-shirts	Novotex A/S	“Green Cotton” T-shirts
Washing machines	Hoover Ltd	Hoover New Wave Plus 5, model numbers A2100, A2101, A2117
Washing machines	Hoover Ltd	Hoover New Wave Plus 5, model numbers A2150, A2153, A2163, A2167
Washing machines	Hoover Ltd	Hoover New Wave Plus 5, model numbers A2140, A2141, A2147
Washing machines	Hoover Ltd	Hoover New Wave Plus 5, model numbers A2120, A2121, A2137
Laundry detergents	Reckitt & Colman	Lessive Poudre “Maison Verte” Eco-Recharge 2 Kg; “Down to Earth” Concentrated Automatic Washing Powder
Indoor paints and varnishes	Teknos Tranemo AB	Biora 02 Tak; Biora 03; Biora 07; Biora 20 and Biora 35
Indoor paints and varnishes	Kalon Decorative Products	Do-It-All Interior Quick Drying Varnish Matt; Do-It-All Interior Quick Drying Varnish Satin (Clear and colours); Do-It-All Interior Quick Drying Varnish Gloss (Clear and colours)
Indoor paints and varnishes	Industrias Proa S.A.	Pintura Plastica Interior “Proa” (PI-100)
Indoor paints and varnishes	Alcro-Beckers AB.	Akvalin Temperrafarg Bas A; Aqua Decor Latextempera Bas A; Scotte 5 Bas; Scotte 7 Bas A; Scotte 20 Bas A; Milltex 20 Bas A; Vaggfarg Matt Bas A and Bell Sidenmatt Bas A
Refrigerators	Vestfrost	Upright refrigerator/freezer, Models BKF 350 Prestige Line; KG 3500 B, NL 362 P, KG 350-S; KS-TF 350. 1-IB, V-BKF 350, KG 350 B, KG 3500 EB, KG 350-W, KG 350-ES
Indoor paints and varnishes	Libert Paints and Co	Romacryl Special Plafond

Product Group	Manufacturer	Product Model
Bed linen and T-shirts	Tissage Fremaux	Linge de lit 100% coton uni "La Maison de Domitille"
Indoor paints and varnishes	Pcolor Farg AB	Mastar Tak glans 2, Mastar Vagg glans 7
Indoor paints and varnishes	Berling S.A.	Water based paint for indoor use "Petite"

Eco-labelling is acquiring a sharp competitive focus in Europe. It will become even sharper once the ISO 14000 series and the requirements of the World Trade Organisation make materials accounting based assessments the exclusive means for making comparative environmental performance claims.

ATTACHMENT 6

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