ICIS REPORT 3:
ENVIRONMENTALLY-RESPONSIBLE SPECIFYING - AN INTERNATIONAL SURVEY

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International Construction Information Society

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PREFACE

Architecture students in the 1970s were exposed to the ideas of Victor Papanek, Brenda and Robert Vale, and Ian McHarg. At the time these writers were seen by most as idealists, even extremists. Not any more. Their ideas are now in the mainstream. Perhaps because those students are now among the decision makers, environmental considerations are influencing all players in the industry. Designers are no longer voices in the wilderness - indeed some might argue that they are being left behind. Major purchasers have environment policies in place, major contractors are pursuing waste management policies, and certification of environmental management systems is becoming more common among manufacturers of materials and components. Designers, and specifiers in particular, must move with the times.

This Report discusses a number of issues influencing environmentally responsible project (and master) specifying, using examples drawn internationally. Issues external to the project (context and sources of information), and those internal to it (specification methods and production), are explored, and common ground, differences and points of interest are identified. A number of difficulties - barriers to rational green specifying - are flagged.

The Report in its present form represents work-in-progress - it is essentially the combination of two international surveys, augmented in a number of ways. It is expected that the contents will be expanded to fill gaps, mostly in national coverage, and that it will be updated from time to time.

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Paris

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1. INTRODUCTION

1.1 ORIGIN

Brief

Proposal from 1998 ICIS Delegates Assembly (Baltimore):

"ICIS:

- Notes the report of ECD but considers further work is required before it can be published,
- Adopts the Position Paper prepared by John Gelder,
- Resolves to appoint John Gelder under the direction of Colin McGregor to complete the content of an ICIS Report to be provisionally called Building specifications and environmentally responsible construction; an international review.

Budget $7000"

Preamble

ICIS, the International Construction Information Society, comprises 14 publishers of national master specification systems and/or costing information, from around the world (see Table 1). The members of ICIS have an interest in environmental issues and how they might be dealt with in national master specification systems, for the benefit of project specifiers. Accordingly in 1996 ICIS commissioned an "Environment Issues Paper" (prepared by John Gelder, then of Construction Information Systems Australia, an ICIS member), presented at the 1997 ICIS Delegate's Assembly in Lillehammer. This was followed by an "Environment Position Paper" (also prepared by John Gelder) and an "Overview of Environmentally Sustainable Design and Construction" (prepared by Marian Kempson, then of ECD Energy and Environment Ltd, UK). These were presented at the 1998 ICIS Delegate's Assembly in Baltimore, USA. At this meeting it was agreed that this effort should proceed to the next stage - the publication of a document which combined and expanded the two papers, re-orienting them to suit the interests of project specifiers.

This Report is the outcome. The two precursor documents explored the issue of environmentally responsible specifying, including specifying for health and safety, as it relates to the work of national master specifications organisations (i.e. ICIS members), and the context in which such specifying takes place. More responses from publishers of national master specification systems have since been obtained, some of the ideas have been developed further, and some new ideas and many more examples have been added. The material has also been restructured to accommodate the merging of the documents.

More importantly, as a Report for general consumption, the content of the original documents has been modified to apply it to the activities of both master and project specifiers (who may or may not be using a national master specification system). Many project specifiers also spend time developing and maintaining office master specifications - it is hoped that text originally developed for national master specifiers will prove of interest to them.

1.2 ISSUES

In considering the sustaining of the natural environment and human health, a number of issues arise which directly affect the design and preparation of project specifications.

Choices

For master specifiers (both national and office-based) the central issue is the obligation to provide for informed choice by project specifiers among all legal options, rather than simply compelling them to adopt environmental sustainability (or to go upmarket, or use local products, or whatever). This necessitates the provision of alternative text, prompts, and objective advice, integrated with the master text. This advice should consider context, and should be authoritative. This advice will assist project specifiers in the selection and deselection of alternative text, the completion of prompts, and the use or non-use of particular materials and components for a particular project.

Table 1.1: ICIS members

Europe
URS, Czech Republic
BII, Finland
GAEB, Germany
CROW, The Netherlands
STABU, The Netherlands
NBR, Norway
SBC, Sweden
NBS, United Kingdom
North America
CSC, Canada
ARCOM, United States of America
CSI, United States of America
Australasia
CISA, Australia
CIL, New Zealand
Asia
I^2BH, Japan

Specifiers might use any of a number of text sources - old project specifications, proprietary specifications, office master specifications or national master specifications. They need to be aware of the environmental choices made or to be made in these source documents. Old project specifications embody choices which may not suit the project at hand - environmental imperatives have moved quite quickly, dating many project specifications. The same may apply to office master specifications, which are often poorly maintained. These also contain choices to be made, as do the generally well-maintained national master specifications, in the form of alternatives and prompts. The choices available are shifting all the time (e.g. recycled content and embodied energy may be viable considerations now, as more information has become available on these subjects), as is the weighting given to different factors (e.g. a recent UK survey found that cost had slipped from 2nd to 5th place as a factor in product selection), so the choices need to be remade for each project.

Greenness

For master and project specifiers a major question is, how green do you get? Where do we draw the line on non-sustainability? One can exercise the pure Precautionary Principle, at a cost, or one can water it down by using only Best Available Technology (BAT), or also by Not Entailing Excessive Cost (together these are known as BATNEEC). Or one can simply wait for the statutory shifts which have recently deleted materials such as CFCs, organochlorines and asbestos from the designer's palette in many countries. Other than for alignment with statutes, this choice of approach is properly a decision for the project specifier, not for the master specifier. Therefore in terms of environmental issues, choices in the master specification might include a gradation from the very environmentally responsible to the irresponsible, clearly tagged as such e.g. in clause titles or in associated advice.

Even with an agreed green baseline, targets may be met in different ways in different projects. For example, Sydney Olympics projects have all responded to the same environmental parameters in different ways. There is no single right answer to this question for all projects.

A good (but non-environmental) example of Precautionary Principle cost not matching benefit is the recent attempt by the Australian Building Codes Board to deal with the strict requirements of the Disability Discrimination Act 1992. The required cost-benefit study found that full compliance was economically untenable, and practically unworkable, and so it is back to the drawing board. Currently compliance with the BCA does not equate to compliance with the DDA.

Another example is the move to ban white asbestos in Europe and Australia, put on hold while the cost, health and environmental consequences are more fully considered - available alternatives may not be an improvement.

Project process
From an environmental point of view, specification production is a small but important part of the project process. Materials and components selection, through consideration of embodied energy, waste generation, recycling, resource depletion, durability, toxicity and so on, plays an important part in the reduction of a building's impact on the natural environment. It can offset the negative impact of earlier design decisions such as poor orientation, and it can mitigate damage caused during the subsequent stages of construction and use. Because specification begins early in the project process, specification decisions should inform other design decisions and vice versa, creating a more environmentally consistent product.

Vocation
Considering environmental issues is a part of the vocation of architects and engineers. In 1985 the UIA set down the fundamental knowledge and abilities of an architect, confirmed in the *UIA Accord on Recommended International Standards of Professionalism in Architectural Practice* (1998). These include the "ability to create architectural designs that satisfy both aesthetic and technical requirements, and which aim to be environmentally sustainable". This principle is implemented by national architectural associations. For example Element 1.1.3 of the AACA (Architects Accreditation Council of Australia) National Competency Standards in Architecture states:

> "Recognise the need to sustain the natural and the built environment, the needs and aspirations of building users and the community in the formulation of a design concept." (AACA 1993)

The associated performance criteria include the assessment and heeding of the impact of a design proposal upon the environment. These Standards are paralleled in the UK by the National Vocational Qualifications. They are used to assess the abilities of foreign-trained architects, and are being used in Australian schools of architecture. Indeed, in many countries, environmental sustainability forms a part of undergraduate and post-graduate education, and features in design awards. It is now, or is close to being, mainstream.

1.3 STRUCTURE

This Report discusses environmental issues for specifiers, running from the general to the particular. It begins with context for specifying (what externals influence green specifying?), then moves to sources of text and information (how does one determine what to specify) and finally to specification methods (how to specify). As far as possible examples are drawn from a wide range of countries, but there remains an Australian bias, reflecting the area of knowledge of the editor. It is hoped that the Report will become more even in coverage over time.

A series of conclusions and recommendations follow, with references, and several appendices expanding on material within the Report proper.

2 SPECIFICATION CONTEXT

2.1 INTRODUCTION

Environmentally sustainable construction is constrained and encouraged by a number of factors which are, for the most part, outside the control of the specifier. Nevertheless the specifier must be aware of them. Some are fundamental to specifying. To impart some order into the discussion, they are divided into voluntary measures and mandatory measures. The former include policies, environmental management systems and building environmental assessment schemes. The latter include legislation and contracts. Supplementary national material, provided through a survey of ICIS members, is included in Appendix A. Responses were uneven and in some cases have been augmented by other material.

2.2 VOLUNTARY: POLICIES

Government policies

Government policies on environmental issues should inform the development of project specifications, especially those which are prepared for public works authorities.

Agenda 21

The 1992 Rio Conference document, Agenda 21 Chapter 7, Promoting Sustainable Human Settlement Development, Programme Area G: Promoting sustainable construction industry activities, reads in part as follows:

> "Basis for action
> 7.67 The activities of the *construction sector* are vital to the achievement of the national socio-economic development goals of providing shelter, infrastructure and employment. However, they can be a *major source of environmental damage* through depletion of the natural resource base, degradation of fragile eco-zones, chemical pollution and the use of building materials harmful to human health.
>
> Objectives
> 7.68 The objectives are, first, to adopt policies and technologies and to exchange information on them in order to enable the *construction sector* to meet human settlement development goals, while *avoiding harmful side-effects* on human health and on the biosphere, and, second, to enhance the employment-generation capacity of the construction sector. Governments should work in close collaboration with the private sector in achieving these objectives."

Many governments are signatories to Agenda 21. This program area will clearly influence the development of national and pan-national policies for sustainable development.

Organisation for Economic Co-operation and Development

The OECD has just initiated a project on sustainable building, running from 1998 to 2001. The aim of the project is to "identify policy instruments and strategies favouring the adoption of sustainable practices in the building sector, while examining its related links with the broader field of public construction." (Ando 1998) The program has begun by collecting information on existing OECD member environmentally sustainable building policies and practices in this area, and will then analyse them in terms of

- resource use (eco-efficiency, life-cycle costing);
- energy use (efficient use and conservation of energy, reduction of CO_2 emissions); and
- system approach (environmental management systems, green purchasing).

In each of the four years, a workshop will be held to exchange information and a report will be published. The final stage will be the proposal of a range of environmentally sustainable building policies for each of the OECD member countries.

Europe
Sometimes international commitments drive government policies. For example, the Communique of 1st European Ministers Conference on Sustainable Housing Policies announced that represented governments will look to improving environmental quality of housing stock by measures such as

- integrated urban planning;
- reduction of transport demands;
- water and energy savings;
- refuse handling;
- indoor climate improvements;
- development of community participation in planning;
- maintenance and adaptation of existing housing;
- use of sustainable new building materials; and
- free trade in building materials.

The European Union (EU) plays an important role in setting environmental legislation in member countries. It tends to concentrate on the issues relating to trans-boundary and global matters, whereas country legislation will include more localised issues. The directives are implemented by national legislation. Current and planned EU directives include the following issues:

- Public access to environmental information.
- Promotion of eco-labelling of products.
- Environmental management and eco-auditing.
- Integration of environmental issues into other policy areas.
- Waste management at sites.
- Waste and packaging waste with targets for its recovery and recycling.
- Handling, transport and disposal of toxic and hazardous wastes.
- Export and import of waste and hazardous material.
- Recycling.
- Water quality.
- Integrated pollution prevention and control.
- Exhaust emissions from vehicle.
- Energy tax.
- Measures to establish standards for cleaning-up contaminated land.

Clearly a number of these will affect European project specifications.

National governments
In 1998 the UK government issued a consultation paper, *Opportunities for Change: Sustainable Construction*, with a view to developing a UK strategy for sustainable construction. Points for consideration include

- global environmental change e.g. global warming, acid rain, loss of biodiversity, ozone depletion, depletion of fossil fuels, release of persistent toxic chemicals into environment;
- town planning e.g. site planning, impact on local environment;
- the (design and) construction process e.g. whole life cost, environmental management systems;

- construction resources e.g. embodied energy, recycled products;
- waste minimisation e.g. Making Waste Work (1995) targets, DETR/BRE Materials Information Exchange;
- rehabilitation of the existing stock e.g. maintenance;
- energy efficiency in buildings e.g. review of Building Regulations Part L, National Home Energy Rating Scheme, photovoltaics;
- use of water in buildings e.g. recycling grey water;
- environmental labelling e.g. European Ecolabels;
- efficiency, productivity and profitability of the construction industry and its clients e.g. integration of construction team resulting in reduction of waste.

In the USA, the federal government energy-and -water-efficiency purchasing policy, for example, will affect American government specifications. The US Federal Energy Management Program argues that "Agencies that participate in the Federal Procurement Challenge and use these guidelines to buy efficient products can realize significant operating cost savings, contribute to energy savings, and prevent pollution. As the world's largest consumer, the Federal government can help "pull" the overall commercial market towards greater energy efficiency."

Government policies might also be expected to affect the development of master specification systems. Indeed, the Canadian government's NMS has been moving to adopt an environmentally responsible stance in direct response to government policy. STABU likewise is greening itself in response to Dutch government policy (the National Environmental Plan). Yet MASTERSPEC, which is used by the US General Services Administration, NATSPEC, which is partly owned by public works authorities, and the Japanese Ministry of Construction's master specification, have not yet greened themselves to any extent, in spite of the long-standing environmental policies of these significant user groups (e.g. Australia's National Greenhouse Response Strategy, ANZECC's WasteWise, and the Japanese MoC's Recycle Plan 21).

Professional association policies
Project specifiers who are members of professional associations (e.g. architects, engineers) which have environmental policies might be expected to adhere to them (even where not mandatory for members), and to expect that the tools they use (e.g. master specifications) adhere to them too.

Ownership of national master specifications
Some national master specifications are owned by professional associations and/or other organisations which have environment policies. These may oblige the master specifications to "go green" in spite of any lack of project specifier or purchaser interest. For example, CISA has 20 shareholders of which at least three (the RAIA, the Institution of Engineers, NSW DPWS) have environment policies. New Zealand's MasterSpec is part-owned by the NZIA, which has an environment policy. NBS (UK) is owned by the RIBA, which has an environment policy. The American MASTERSPEC was owned by the AIA, which has an environment policy, and SpecText was published by CSI, which also has an environment policy. Arguably, these policies should be made manifest in the content of these master specifications.

International Union of Architects
In 1993 the UIA (International Union of Architects) and AIA (American Institute of Architects) issued the joint "Declaration of Interdependence for a Sustainable Future", at the Chicago World Congress of Architecture. This was adopted by various UIA members e.g. RAIA (Royal Australian Institute of Architects) adopted it in October 1993. It states, among other things, that:

> "We commit ourselves, as members of the world's architectural and building-design professions, individually and through our professional organisations, to

- place environmental and social sustainability at the core of our practices and professional responsibilities;

- develop and continually improve practices, procedures, products, curricula, services and standards that will enable the implementation of sustainable design;

- educate our fellow professionals, the building industry, clients, students and the general public about the critical importance and substantial opportunities of sustainable design;

- establish policies, regulations and practices in government and business that ensure sustainable design becomes normal practice; and

- bring all existing and future elements of the built environment - in their design, production, use and eventual reuse - up to sustainable design standards."

The UIA has programmes on Sustainable development of the built environment (led by Norway), Healthy buildings (led by Sweden), and Architecture and conservation of forests (led by Brazil).

Design office policies
Many design offices, not just those specialising in environmentally sustainable architecture, have informal or formal environmental policies. Some of these offices include public-sector organisations. Specifiers working for these practices must follow such policies. The master specifications produced and maintained by these offices should also reflect these policies. Well-known examples include ECD Architects (UK) (contributors to BREEAM, and developer of PERFORMA, aligned to ISO 14001), and Hellmuth Obata + Kassabaum (HOK) (USA). HOK is greening its master specifications but, more interestingly, has put its Healthy and Sustainable Building Materials Database onto its web site. ECD Architects' associated non-design practice, ECD Energy & Environment, is involved in the greening of NBS, and HOK is perhaps to be involved in the greening of MASTERSPEC (Leibowitz & Mendler 1997).

Purchaser policies
The project specifier is acting in the interests of the purchaser, who is generally interested only in certain attributes of the finished building and its constituent components, such as the following:

- Capital cost.

- Running cost, if the purchaser is to be the owner or is to let to a cost-conscious tenant.

- Fitness for purpose, including durability.

- Appearance, for visible items and for concealed items which may affect appearance of visible items e.g. through corrosion.

- Legislative compliance.

Attributes outside of these, such as the construction and manufacturing processes, or sources of labour and components, are usually of no interest to the purchaser. To constrain them in the specification will be to act against the interests of the purchaser, by limiting choice, a competitive response, and perhaps even the contractor's ability to satisfy those attributes the purchaser *is* interested in. In the case of processes, their specification may well be in breach of contract since construction methods are often stipulated as being the affair of the contractor only (see below).

Nevertheless, some purchasers have policies in place which address some of these other attributes, including environmental considerations. Sometimes such policies exist only for demonstration projects, sometimes they are global.

Examples include the *EcoLycee* program of France's Ile de France, for green schools, and the Olympic Co-ordination Authority's environment policies for the 2000 Games in Sydney. The USA NAVFAC (Naval Facilities Engineering Command) also has an environmental policy in place, as of June 1998, requiring all

facilities and infrastructure design and construction to incorporate sustainable design principles. Greenpeace is another example, though it doesn't commission buildings very often (its London HQ is one fairly recent example). The US Audubon HQ is another example. Environmentally-aware individuals and companies (e.g. those with environmental management system certification to ISO 14001) will also seek out "green" architects (and specifications) for their houses and offices. Government purchaser policies are discussed above. Some of these purchaser policies operate indirectly e.g. government support of the Australian Paint Approval Scheme results in progressive reduction of the VOC content of paints (via application of the APAS specification, GPC-D-181).

Environmental outcomes for consultants for the Sydney Olympics, by way of example, are given in Table 2.1 (Olympic Co-ordination Authority 1995). For comparison, NAVFAC's definition of sustainable design is summarised in the right-hand column (anon 1998). They have many points in common, and many points which will influence specifications.

Where the purchaser does not have such a policy in place, it could be argued that the designers have no business unilaterally limiting selection of products to those which are environmentally sustainable. Such a restriction may be against the purchaser's interests.

Clearly master specifications need to provide for project specifiers driven by purchaser preference to select green materials and components, but must also allow these specifiers to select non-green options where there is no such pressure. Once again, choice is the key.

Some of these project/purchaser-specific policies might influence broader policies, as this quote from a recent Australian web report (Australian Broadcasting Commission site, December 1998) indicates:

> "**Campaign to extend Olympic environmental standards**
> Eighteen prominent Australians, including author Tom Keneally and athlete Cathy Freeman, are backing a campaign to extend the Olympic building program's high environmental standards Sydney-wide.
> Environmentalists want developers to continue to meet the new standards.
> Olympic environment monitoring group Green Games Watch 2000 is behind the campaign. Its chair Jeff Angel says they want to "insure the principles and guidelines of the Olympic Games are applied to developments across the entire city, so that Sydney is clean and green in the next century".
> Green Games Watch would like their policy, when finalised, to be introduced into the next session of state parliament after the March election. Those backing the campaign include unionist Jack Mundey, musician Peter Garret and actor John Clarke." [Ed - proposal now released]

2.3 VOLUNTARY: ENVIRONMENTAL MANAGEMENT SYSTEMS

Environmental management systems (EMS) are likely to be relevant to building specification through the third party certification of the EMSs of building product manufacturers and to a lesser extent of contractors. Uptake of EMS certification schemes varies considerably between countries. Uptake by the construction industry appears to be poor in the UK, Canada, Australia, New Zealand and Japan although there is an estimated 10% uptake in Sweden.

Certification under these schemes must be used critically. They are not necessarily all they could be. For example, the schemes do not set environmental performance criteria (perhaps impossible for a single standard intended to apply across all industries - hence the Responsible Care program of Australia's plastics industry, represented by PACIA, for example) and so certification does not of itself guarantee a standard of environmental performance acceptable to the purchaser. The range of topics to be addressed is covered. The standard of environmental care is not - it is up to the entity being certified to set its own EMS standards. But at least these must be published, so that purchasers can assess them (BS 7750 clause 4.2). Certification also indicates a commitment to continual improvement of environmental performance (BS 7750 clause 4.2), though this could be off a low base, and the increments could be very small. The schemes can be used, therefore, simply as a means to grab gullible market share:

> "... critics claim that even environmentally filthy businesses can get the new standard - so long as they write down precisely how filthy they are, promise to do better and describe how they intend to improve." (Johnston 1993)

Table 2.1: OCA and NAVFAC environment policies

Performance Area		**Environmental Outcomes**	**NAVFAC**
Conservation of species	Flora and fauna (ecosystems)	Enhance the remaining natural ecosystems during development and protect them throughout ongoing use of the sites.	Improve interior and exterior environments, leading to increased productivity and better health.
	People (their environment)	After redevelopment, OCA sites must offer a high quality of life to those who live or work at the sites, and highly desirable recreation destinations.	
Conservation of resources	Water	Minimise the demand for potable water from Sydney's main supply.	Use resources and materials efficiently, especially water resources.
	Energy	Minimise (compared to contemporary development) the use of energy from sources which are non-renewable or emit greenhouse gases in energy generation or consumption.	Increase energy conservation and efficiency. Increase use of renewable energy resources.
	Construction materials	Minimise the use of materials which deplete natural resources or create toxic pollution in their manufacture, use or disposal.	Select materials and products based on their life-cycle environmental impacts. Reduce or eliminate toxic and harmful substances in facilities and their surrounding environments.
	Open space	Preserve significant areas of open space as a resource for generations to come.	
	Topsoil	Minimise importation of topsoil.	
Pollution control	Air	Minimise negative impact on Sydney's air quality and avoid ozone depleting substances.	Employ facility maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment.
	Noise	Minimise the impact of noise.	
	Light	Minimise the impact of night lighting on environmental conservation and residential areas.	
	Water	Improve the quality of water entering adjacent waterways.	Improve interior and exterior environments, leading to increased productivity and better health.
	Soil	Remediate the results of polluting activities of the past and ensure protection of soil and sediments within the developed area.	
	Waste management	Reduce waste generation and maximise the appropriate use of recycled or recyclable materials.	Increase use of materials and products with recycled content. Recycle construction waste and building materials after demolition. Reduce harmful waste products produced during construction.

More importantly, EMS certification, like quality management system certification (QA), is about processes - the systems of management (environmental and quality, respectively). It is not about products, so the fact that a manufacturer, contractor or designer is certified to ISO 14001 (see below), no matter how rigorous the standards, tells us nothing about the environmental sustainability or otherwise of its products, buildings or designs, respectively. It is no substitute for environmental product certification (eco-labelling) or, failing this, second party checks (Gelder 1997).

EMAS

The European Commission's Eco-Management and Audit Scheme (EMAS) is a similar scheme which aims to demonstrate continuous environmental improvement. There are over 1,237 registered sites throughout Europe. The requirements of the draft EC Eco-Audit Regulation (December 1991), for a registration under a voluntary scheme, were as follows:

- Environmental protection systems.
- Assessment of impacts on the environment.
- Minimisation and saving of energy, materials and waste.
- Selection and planning of product and production processes.
- Prevention and mitigation of accidents.
- Assessment of emissions and consideration of impacts.
- Regular policy, objective and program review by management.
- Employee training and awareness.
- Prior assessment of new activities, products and processes.
- Assess and monitor current effects on environment.
- Minimise environmental effects.
- Reduce waste and conserve resources.
- Prevent accidental releases.
- Verify and record compliance with policy.
- Plan corrective action in case of non-compliance.
- Prepare contingency procedures for accidents.
- Publicise information and respond to public concern.
- Advise customers on products.
- Contractors to operate to company standards.
- Environmental audit.

ISO 14001

The international standard ISO 14001 derives from the British standard BS 7750 (1992), which was developed to complement the EC Eco-Audit Regulation, to specify the requirements for an EMS as a foundation for registration under the Regulation.

ISO 14001 for environmental management systems is applicable to any organisation that wishes to

- develop, implement and maintain an environmental management system;

- assure itself of compliance with a stated environmental policy; and

- demonstrate such compliance to others.

The organisation may also seek certification of its environmental management system by an external (third party) organisation. Environmental management system requirements are under the following headings:

- Environmental management system.
- Environmental policy.
- Organisation and personnel.
- Environmental effects.
- Environmental objectives and targets.
- Environmental management program.
- Environmental management manual and documentaion.
- Operational control.

- Environmental management records.
- Environmental management audits.
- Environmental management reviews.

To give some idea of the environmental scope of the standard, under the subheading "Environmental effects evaluation and register" BS 7750 clause 4.4.3 states:

> "The organization shall establish and maintain procedures for examining and assessing the environmental effects ... of its activities, products and services, and for compiling a register of those identified as significant. The procedures shall include ... consideration of:
> a) controlled and uncontrolled emissions to atmosphere;
> b) controlled and uncontrolled discharges to water;
> c) solid and other wastes;
> d) contamination of land;
> e) use of land, water, fuels and energy, and other natural resources;
> f) noise, odour, dust, vibration and visual impact;
> g) effects on specific parts of the environment and ecosystems."

This register is not intended to be published. The ISO scheme has been in existence since 1996. By October 1997 over 2,314 certificates (now over 5,000) had been issued world-wide although figures for building related industries were not available. Public works authorities are beginning to require consultants and contractors on major works projects to have environment management systems in place. One example is the NSW (Australia) Government (CPSC 1998), which allows either certification to ISO 14001, or accreditation of the EMS by another NSW government construction agency.

2.4 VOLUNTARY: BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

Building environmental assessment schemes impact on specification through their requirement to satisfy set criteria. Specification is an important tool to ensure that the criteria are met, for example in the specification of low flush WCs, particle board with reduced formaldehyde content, or sustainably sourced timber.

The schemes tend to focus on the building-in-use and site issues. Materials and components are included but often only to a limited extent. More detail is given in Appendix A. The ultimate aim of these schemes should be to look at the life cycle of the building. It has not been possible to obtain any figures for the current uptake of schemes. Schemes include Europe's BE2AM, the Swiss/Dutch ECO points methodology, Finland's Ecological criteria in buildings, the Dutch DUBO, Norway's EcoProfile for Buildings, the UK's 1990 BREEAM (and its derivatives), the USGBC's LEED, Canada's 1993 BEPAC, BREEAM Canada and Green Building Challenge (now international), Australia's ESDAM, and New Zealand's BRANZ Green Home Scheme. Some of these are discussed below. Rush *et al*. (1998) say "Because of its straightforward approach, its usability, the clear plan it offers, and its single rating, BREEAM has endured as the most widely used practice."

Issues of concern in building environmental assessment schemes include resource depletion, the effect on the indoor environment, the effect on the local environment and ecology, carbon dioxide emissions due to energy use, ozone depletion and the impact of manufacturing processes, ensuring adequate ventilation for indoor air quality, to material manufacture, disposal of construction waste, and use of scarce resources. Subject matter of some building environmental assessment schemes is summarised in tabular form in Appendix B.

Scoring

Building assessment schemes are usually credit based, credits being awarded against a defined set of criteria. These criteria are usually set by a panel of experts, often on a country specific basis as it is generally accepted that they have to vary between countries.

Some schemes provide a profile of the building under a number of categories relating to environmental impact. Others provide a simplified overall rating which may or may not include weighting of the individual credits.

There is currently considerable debate over the weighting of credits to give an whole building score. At the moment it is not possible to do this quantitatively and any weighting is qualitative, usually carried out by a panel of experts.

Green Building Challenge '98
Green Building Challenge '98 is a two-year program of international building performance assessments which aims to inform on advances in green building performance and to test and demonstrate an improved method for measuring building performance. The project has been initiated by Canada, but is being carried out in partnership with representatives from eleven other countries (see Appendix A), who form an International Framework Committee. There are six performance categories:

- Resource consumption i.e. energy, land, water and materials.
- Environmental loadings i.e. airborne emissions, solid waste, liquid waste.
- Indoor environment i.e. air, thermal, visual and acoustic quality and controllability of systems.
- Longevity i.e. adaptability and maintenance.
- Process i.e. design and construction and building operations planning.
- Contextual factors i.e. building location and its immediate context.

A performance profile is produced in graphical form, which illustrates the relative performance in each of the major categories. There is no single overall score.

BE2AM
BE2AM is a European Commission funded scheme which aims to provide a common and recognised system of assessing the energy and environmental impact of buildings across Europe. The scheme is applicable to both domestic and non-domestic buildings and is used to assess their performance at the design stage. At present the tool has been developed for use in Spain, Netherlands, Denmark and the UK although it is not yet commercially available.

BE2AM brings together three existing European environmental assessment methods and allows them to be used as part of a single framework. It draws from BREEAM, the Environmental Preference Method in the Netherlands and embodied energy data from the Danish Building Research Institute. The building's performance is compared with that of typical buildings in the region it is being built. This recognises that current standards of energy efficiency and environmental awareness vary considerably across Europe. The output is a profile of the building's performance in terms of energy in use, environmental design opportunities and embodied energy.

BREEAM
The Building Research Establishment Environmental Assessment Method (BREEAM) was developed in 1990. There are five different schemes relating to new office designs, housing designs (*The Environmental Standard*), superstore designs, industrial unit designs and existing office buildings. The aim of the Method is to set criteria for good environmental performance in buildings.

The assessment is carried out at the design stage or, in the case of existing offices, during a building survey. BREEAM is an example of a pragmatic approach to uncertainty on environmental and health issues - it steers clear of topics which its authors believe are unresolved:

> "[BREEAM] only includes assessments of issues for which there is good evidence of the environmental problems they cause, for which performance criteria can be defined, and which can readily be assessed at the design stage ... There are many environmental issues which have quite deliberately been omitted as they do not meet these criteria ... Some of them will be included in future updates as evidence making possible their objective assessment becomes available." (BRE 1995)

Project specifications might adopt a similar tack, even though this will lead to some gaps in coverage, and therefore perhaps unwarranted action or inaction on the part of project specifiers. While what is excluded in BREEAM might also be excluded in project specifications, what is included serves as a guide to the topics for which a project specification might include as specification text (though not all BREEAM topics are directly

relevant to specifying, and vice versa). See Appendix A.1 for BREEAM criteria (bear in mind that some topics are well covered by UK legislation and so are not addressed in BREEAM).

The design or building is assessed against a set of defined criteria and credits are awarded where these criteria have been met. Issues are divided into global issues and use of resources, local and indoor. These range from carbon dioxide emissions resulting from energy use in the building to natural resources and recycled materials, water economy, ecological value of the site, cyclists' facilities, hazardous materials, environmental and purchasing policies.

An overall rating of Fair, Good, Very Good and Excellent is awarded, depending on the number of credits achieved under global, local and indoor categories.

BREEAM is now widely used in the UK, and similar schemes have been developed in Canada, USA, Norway, New Zealand and Hong Kong. BREEAM-based criteria are also being incorporated in the BE2AM European assessment scheme and have been used in the development of the Schools' Environmental Assessment Method (SEAM) in the UK, and BEPAC in Canada (Rush, *et al*. 1998).

Embodied energy
Because of BREEAM's approach to uncertainty, one subject not dealt with is the embodied energy of building materials (often equated simplistically to CO_2 production), since reproducibility of assessments is very difficult - at present there is no single internationally acceptable method for determining embodied energy. This is being tackled in part by the ISO 14000 series, one of which deals with life cycle assessment of materials and products (ISO 14040).

There have been few publicly available assessments done in any case, since they are so complex and tend to be specific to a brand, a place, or a time. For example, embodied energy calculations done for Australian PVC and stainless steel in 1996 would have been out of date in 1997 when Australia stopped domestic manufacture of vinyl chloride monomer and phthalates, and ceased cold-rolling of stainless steel. For this reason, too, USA or European calculations for PVC and stainless steel would not be relevant in Australia, since they would assume local manufacture and cold-rolling respectively. Similarly, USA calculations for linoleum would not be relevant in Europe - it is made in Europe, but imported into the USA. (see *Environmental Building News* 7/9 - still the case?)

The international Green Building Challenge participants also recognised the difficulty and decided to not include embodied energy in the criteria at this stage (see below). (*Environmental Building News* 7/10)

Other building environmental assessment schemes
The Netherlands
The Dutch Building Industry Association (NVOB) initiated a national package of "sustainable measures" (DUBO) with the aim of reducing confusion about the measures required for so-called "sustainable" buildings. Stichting Bouwresearch, a building research association, created an assessment package with the aid of a wide range of organisations in the building industry.

The national package consists of around 160 voluntary measures and is primarily for new homes. It is expected to form part of national legislation in the future. All phases of the building process are covered. Each measure has a sheet of specifications or "criteria". The measures are divided into fixed and flexible measures. Fixed measures can be adopted as standard, irrespective of the specific nature of the project. Flexible measures are those whose implementation method depends on the project, the availability of materials and location.

Norway
Ecoprofile for Buildings was developed by the committee for Development of a National Method for Eco-assessment of Buildings, appointed by the Norwegian Government. It is intended as a voluntary classification system and aims to provide:

- an analysis of the building's environmental risk;
- greater eco-efficiency in management, operation, maintenance and development; and
- documentation for interested parties.

The scheme uses 142 "variables" (issues) which are classed in four main areas i.e. energy, indoor climate, pollution, external environment. Each of these variables is weighted on a scale of 1 to 3. Examples of variables are: insulation levels, water consumption, daylight, demolition waste, car and bike access.

Canada
The Building Environmental Performance Assessment Criteria (BEPAC) program evaluates new and existing office buildings with respect to a declared set of criteria under the categories of global, local and indoor environments. BEPAC was inspired by the BREEAM assessment method and was developed by the University of British Columbia.

The following topic areas are covered:

- Ozone layer protection.
- Environmental impact of energy use.
- Indoor environmental quality.
- Resource conservation.
- Site and transportation.

United States of America
LEED (Leadership in Energy and Environmental Design) is a whole building assessment scheme managed by the US Green Building Council. It is designed for new and existing commercial office buildings and hi-rise residential. Other buildings will be covered under a separate rating system. Green building certification is awarded to buildings on a scale of platinum to bronze depending on the number of credits achieved. Credits are assessed against a set of criteria. There is also a Green Building of the Year award. Credits cover topics such as building commissioning, indoor air quality, building materials, construction waste management, energy, use of existing buildings, landscaping, recycling facilities, operations and maintenance facilities, siting, transportation, water use and water quality.

LEED is backed by the US Navy Facilities Command (NAVFAC) and the Department of Energy. It is not yet implemented.

New Zealand
The BRANZ Green Home scheme assesses new homes at the design stage. It is a credit based scheme where credits are assessed against a set of criteria. As with BREEAM, on which it is based, an overall environmental rating of Fair, Good, Very Good or Excellent is given depending on the number of credits gained. The credits are grouped into three areas: global, local and indoor issues. Assessors audit the initial credit rating, with the opportunity to improve the design before a final audit is carried out after which the certificate is issued.

2.5 MANDATORY: LEGISLATION

Environmental legislation relating to buildings tends to fall into very broad areas. It is also often very regionalised, especially in state/federal countries such as Australia, Germany and the USA. Examples of legislation are given in Appendix A. Perhaps the most interesting is New Zealand's *Resource Management Act*.

Legislation: Energy efficiency

Building codes increasingly are addressing the energy efficiency of buildings, with implications for specifiers.

Europe

In the UK, The Building Regulations 1991 "Approved Document L: Conservation of fuel and power" is substantial (70 pages) and far-reaching. The regulations have a cold-weather focus. The core requirement reads as follows:

> "Reasonable provision shall be made for the conservation of fuel and power in buildings by:
> (a) limiting the heat loss through the fabric of the building;
> (b) controlling the operation of the space heating and hot water systems;
> (c) limiting the heat loss from hot water vessels and hot water service pipework;
> (d) limiting the heat loss from hot water pipes and hot air ducts used for space heating;
> (e) installing in buildings artificial lighting systems which are designed and constructed to use no more fuel and power than is reasonable in the circumstances and making reasonable provision for controlling such systems."

The first four apply to dwellings and to other buildings larger than 30 m^2, and the last point applies to buildings with over 100 m^2 of artificial lighting, but excludes dwellings. The document is split into deemed-to-satisfy provisions for dwellings and non-dwellings. Each describe three methods for heat loss calculation - elemental, target U-value, and energy rating. Many products are affected by the deemed-to-satisfy components of the document e.g. lamps should be high efficiency (e.g. compact fluorescent rated above 11 W), 120 L hot water vessels should have a maximum heat loss of 1 W/L and hot water pipes should be insulated with up to 40 mm of insulation with maximum conductivity of 0.045 w/mK, and roofs should have a U-value of 0.25 W/m^2K (e.g. by providing insulation between joists 170 mm thick, with a conductivity of 0.03 W/mK). Specifiers must obviously be familiar with the contents.

North America

The USA has three model building codes, used in many jurisdictions. Other jurisdictions (which may be cities, counties or states) use codes of their own devising, so the situation is difficult to summarise. It will be made easier with the move to a set of single national model codes under the International Code Council, due for completion in 2000. By way of illustrating the current situation, the substantial (46 page) *Model Energy Code* (1995), which is a national model code already (promulgated jointly by the three model code agencies and to be maintained by ICC), affects much the same territory as the UK code:

> "101.2 Intent. The provisions of this code shall regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, service water-heating and illumination systems and equipment which will enable effective use of energy in new building construction."

That this has a specific affect on the specification is made clear in clause 104.2:

> "Details. The plans and specifications [submitted to the building official] shall show in sufficient detail pertinent data ... including ... design criteria, exterior envelope component materials, U-values of the envelope systems, R-values of insulating materials, size and type of apparatus and equipment, equipment and systems controls and other pertinent data to indicate conformance ..."

The Code offers three alternative methods of residential building design - systems analysis, component performance approach, and acceptable practice - and covers non-residential buildings by citing ASHRAE/IES 90.1-1989, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (1993). Both hot-weather and cold-weather conditions are dealt with. The code affects many products e.g. for shower heads a maximum flow rate of 0.158 L/s at 551 kPa is stipulated, HVAC temperature controls for heating and cooling

must have a range of 12.8 - 29.4 ° C, and vapour retarders must have a maximum rating of 1 perm. Again, specifiers must clearly work to these requirements.

Australasia
The Building Code of Australia (1996) only deals with energy efficiency in two jurisdictions, and only for housing, though it is likely that national provisions for this will soon be in force (and dealing with commercial buildings). Both hot-weather and cold-weather conditions are considered. The ACT performance requirement FP6.1, which applies to housing other than private houses (covered separately), states:

> "A building, including carpets and internal fittings, must achieve an annual energy consumption rate for heating and cooling not greater than 255 Megajoules/m^2 based on the ACT climate zone."

The deemed-to-satisfy provisions for this require buildings to achieve a 4 Star ACT House Energy Rating, particularly through provision of thermal insulation. The Victoria performance requirement FP6.1 (same scope as ACT) states:

> "A residential building must have a reasonable level of thermal insulation to conserve energy used for internal heating and cooling."

The deemed-to-satisfy provisions for this require attainment of certain R values, or achievement of a 3 star House Energy Rating. Again, insulation is the key. These are quite primitive requirements compared to those in other countries' building codes, though the energy rating calculations take into account a wide range of factors.

The New Zealand Building Code (1992) clause H1.3.1, which applies to housing, states:

> "The building envelope shall be constructed to ensure that the building performance index shall not exceed 0.13 kWh."

The Code goes on to say, for other buildings over 50 m^2, in clause H1.3.2:

> "Where any space within a building is intended to have a controlled temperature, construction of building elements affecting energy use shall take account of:
> (a) Thermal resistance to heat loss through the building envelope.
> (b) Heat gains ... through the building envelope.
> (c) Airtightness.
> (d) The contribution to space heating of heat losses from building services ...
> (e) Control systems for heating and ventilating, and for other services, and
> (f) Utilisation of waste heat from internal processes."

Both heating and cooling are considered. The requirements will affect the specification of the walls and roof, particularly the provision of thermal insulation, glazing, and sealants. It will also affect design and specification of building services.

Legislation: Product bans and mandates
UN Framework Convention on Climate Change
There are a number of international agreements relating to environmental protection. The Climate Change Convention agreed at the Rio Earth Summit in 1992, and more recently the Kyoto Protocol (1997), are the most well known. The original aim was to maintain greenhouse gas emissions to 1990 levels by the year 2000. However there has been considerable debate over the setting of targets and effectiveness of the agreements. The Kyoto Protocol sets a target reduction for Europe of 8% below 1990 levels by 2008/2012, for six main gases (e.g. CO_2). Some countries have got away with lesser targets (e.g. Australia), and some have opted for stricter targets (e.g. UK, through its government's manifesto promises). Consequences for specifiers will be widespread.

Montreal Protocol
The treaty which has had the most significant impact on buildings is the Montreal treaty. In 1987 many of the world's governments signed an agreement in Montreal to reduce emissions of CFCs and halons into the atmosphere. This agreement has been reviewed and extended to phase HCFCs out by 2030 (2015 in the European Union). The Ozone Protection Acts of Australia and New Zealand are a direct consequence of the Protocol. This is one of the most successful international agreements relating to the environment and has a significant impact on building specification through the exclusion of CFCs and phasing out of HCFCs and halons, as refrigerants, fire extinguishants and in the manufacture of blown insulants. Work sections on these subjects must accord with the Protocol.

CITES
The Convention on International Trade in Endangered Species forbids trade in 10 timber species, mostly hardwoods (Appendix I - e.g. Brazilian rosewood, *Dalbergia nigra*, and *Abies guatemalensis* and *Fitzroya cupressoides*), and limits trade in some others (Appendix II - e.g. Caribbean mahogany, *Swietenia mahogoni*, affrormosia, *Pericopsis elata*, very popular in the UK, and *Swietenia humilis*). *Araucaria araucana* is listed in both Appendices I and II (different populations). Trade in bigleaf mahogany (*Swietenia macrophylla*) from Costa Rica, Bolivia, Brazil and Mexico is controlled via Appendix III. Neotropical populations of this species were proposed, by the USA and Bolivia, for inclusion in Appendix II in 1997.

National legislation
Use of certain construction materials and components may be banned by legislation, due to unwanted impact on the environment, occupational health & safety and/or public health. A schedule of some materials controlled through legislation is given in Appendix C. Materials banned nationally in the Australian construction industry include CFCs (see above), PCP, PCBs, lead in paints (above 0.1%), chromates in paints (above 5%), and asbestos (still able to be used in brake linings).

Asbestos is an interesting case - controls vary from country to country. Canada, for example, does not ban use of chrysotile (white) asbestos. Indeed, in May 1998, the World Trade Organization (WTO) received a formal request from the Government of Canada for consultations with the European Commission "concerning certain measures taken by France for the prohibition of [chrysotile] asbestos and products containing asbestos." If successful this challenge through WTO of a national ban could have far-reaching consequences for the banning of other materials, which could also be challenged as constituting Technical Barriers to Trade. France banned asbestos in construction in December 1996. Other EU states which have banned asbestos include Belgium (1998), Austria, Denmark, Sweden, Finland, Germany, Italy and the Netherlands. UK regulations ban blue and brown asbestos (crocidolite and amosite respectively), and there is a 1999 proposal to extend this to white asbestos (Bell 1999), though the UK would prefer to do this within the security of a European ban.

The International Construction Institute resolved in 1998 to increase its efforts "to accelerate the implementation of a total ban on chrysotile asbestos." The International Association of Heat and Frost Insulators and Asbestos Workers has pledged its support for a total ban on asbestos in the UK. The International Federation of Building and Wood Workers, the European Federation of Building and Wood Workers and the Nordic Federation of Building and Wood Workers called for a "world-wide prohibition of mining, processing, commerce and use of asbestos." The Spanish Trade Union Confederation and the Spanish trade union, Comisiones Obreras, are also lobbying for national and European bans.

Naturally, banned materials must be excised from project specifications. Materials which are unpopular with building workers, such as asbestos and synthetic mineral fibres, might also be considered for exclusion from specifications.

Conversely, materials and components deemed good for the environment may be mandated in law. Legislative use of Standards (such as SAA MP64 and SUSDP#10 in Australia) drives the greening of some products. The first mandates the use of 6/3 L dual flush cisterns for new installations, the second effectively encourages the use of water-based paints. In New Zealand, the *Building Code* mandates (Section B) certain durability performance for building elements (see below).

In the USA, various Federal Executive Orders have a similar effect. For example, EO 12902 (March 1994), coupled with the Energy Policy Act 1992 and the Federal Acquisition Regulations, compels agencies to strive to purchase products

- considered to be environmentally preferable (based on EPA guidance);
- in the top 25% of their class for energy efficiency, or at least 10% more efficient than the minimum level meeting Federal standards;
- which eliminate or reduce generation of hazardous waste and the need for special procesing (handling, storage, etc.);
- which use non-hazardous and recovered materials;
- which bring life-cycle cost savings; and
- promoting cost-effective waste reduction.

Backing these requirements are programs such as the DoE/Federal Energy Management Program (FEMP) *Buying Energy Efficient Products* guide, the source of the *Product Energy Efficiency Recommendations* (short format, and available on-line, covering, for example, central air conditioners, water heaters, showerheads, fluorescent ballasts, and large electric chillers). EOs 12843, 12844 and 12845 (1993) tackled Federal recycling, pollution prevention, alternative-fuel vehicles, energy-efficient computers, and early phase-out of ozone-depleting chemicals.

Regulatory requirements often vary within countries. For example, via the Building Code of Australia, Victoria mandates thermal insulation for Class 2, 3 and 4 buildings, and the ACT mandates a maximum energy consumption rate for them. Other jurisdictions have no such requirement. Use of organochlorine termiticides was at one stage permitted in the Northern Territory (but only north of the Tropic of Capricorn) but banned in all other states of Australia (it is now banned completely). Likewise use of certain products containing PVC is controlled in some German jurisdictions but not others. Some local authorities impose their own environmental requirements, as in Leichhardt Municipal Council's (NSW, Australia) insistence on solar water heating for new houses. It is difficult for master specifiers to be aware of all these variations, or to deal with them properly. Project specifiers are therefore expected to be familiar with local issues.

Legislation: Product controls

Just because a material is known to be hazardous does not mean that it will be banned - the decision whether or not to ban a material is more pragmatic than scientific. Nevertheless, if not actually banned, hazardous materials may be subjected to legislative controls. A good example is vinyl chloride monomer, a proven human carcinogen, but essential in the manufacture of PVC. Very few jurisdictions have banned it, but most have controls in place (e.g. maximum permitted discharges, maximum permitted exposure, labelling and handling rules). The same applies to

- arsenic (a human carcinogen), which continues to be used in timber preservatives such as CCA (copper chromium arsenic);
- organophosphates (used in termiticides);
- formaldehyde (a probable human carcinogen), used in timber adhesives and in UF foam thermal insulation (controlled in the UK via the Building Regulations (1991) requirement D1 Cavity insulation);
- fibreglass (a possible human carcinogen), used in bulk thermal insulation;
- HCFCs (ozone depleting chemicals), used in refrigerants and extinguishants; and
- VOCs (defined by WHO as organic compounds with a boiling point between 50 and 260 ° C, and so excluding very volatile compounds such as formaldehyde, ammonia and isocyanates!), restricted for health reasons in some jurisdictions and for smog-generation potential in others.

There are many other examples of permitted hazardous chemicals. See Appendix C for a fuller listing of controlled products. The controls applied to the use of these materials may have cost implications - tighter controls in a project specification certainly would, and should be resisted. Risk remains in spite of the controls, which incidentally increase cost - so alternatives should be considered where available. But use of non-hazardous alternatives may also have cost consequences e.g. they may not be as durable or as effective, or they may take longer to install on site.

Legislation can also control classes of materials, rather than individual materials. For example, the Building Code of Australia (1996), at clause EP2.2 (a)(iii) tackles materials toxicity in fire:

> "In the event of fire in a building the conditions in any evacuation route must be maintained ... so that ... the level of toxicity will not endanger human life."

Specifiers will need to know about the toxicity in fire of materials which might be used in evacuation routes. One would expect use of MSDSs (material safety data sheets) to become widespread.

Legislation: Construction site
The construction site is subject to a variety of legislative controls of interest to the specifier.

Occupational health and safety (OH&S)
In some jurisdictions legislation requires designers to consider construction hazards in design, in general terms. Specifiers will have to consider these in terms of, say, toxicity and flammability of construction materials such as paints, use of explosive-driven fasteners and post-tensioning, and even safe manual handling e.g. affecting sizes of stone blocks. Examples of legislation include

- the UK's *Construction (Design and Management) Regulations 1994* (flowing from the EU's Temporary or Mobile Worksites Directive) in which, for example, "Every designer shall ... ensure that any design he prepares ... includes among the design considerations adequate regard to the need ... to avoid forseeable risks to the health and safety of any person ... carrying out construction work or cleaning work in or on the structure at any time ...";

- South Australia's *Development Regulations 1993* Schedule 5, in which the specification submitted for approval is to "show that the building work will ... provide satisfactory levels of safety on or about the site";

- Western Australian OH&S legislation (Section 23(3a)) states that "A person who designs or constructs a building or structure ... for use at a workplace ... shall so far as is practicable, ensure that the design and construction ... is such that ... persons who properly construct, maintain, repair or service the building ... and persons who properly use the building ... are not, in doing so, exposed to hazards"; and

- New Zealand's *Building Code* functional requirements F1.2, F2.2 and F3.2, which state "Buildings shall be constructed to avoid the likelihood of people within the building being adversely affected by hazardous agents or contaminants on the site", "Building materials which are potentially hazardous, shall be used in ways that avoid undue risk to people" and "Buildings where hazardous substances are stored and hazardous processes undertaken, shall be constructed to provide adequate protection to people and to other property".

One consequence of the UK regulations is that use of brittle roofing materials (perhaps including use of those that embrittle over time) is discouraged - but not actually banned - by the authorities:

> "The HSE [Health and Safety Executive] considers that designers should not specify fragile materials in their design unless they have a very clear justification for doing so." (Blyth 1997)

The list of materials affected in this way can only get longer over time. In Australia (NSW), erection hazards posed by fragile roofing materials are covered by state-based OH&S regulations for safe erection of roofs, which require installation of safety mesh below such materials - another approach to the same problem. Erection hazards for structural steel are covered in a Standards Australia handbook (HB[...]), which places some of the

responsibility on the design engineer. NATSPEC flags both of these in its Commentary, and provides text for the safety mesh.

Contaminants
Treatment of site contaminants (e.g. methane, radon, asbestos, corrosive liquids, waste) may be covered by legislation, too e.g. the US Comprehensive Environmental Response, Compensation, and Liability Act (aka Superfund), and the UK Building Regulations (1991) requirement C2:

> "Precautions shall be taken to avoid danger to health and safety caused by substances found on or in the ground to be covered by the building."

For solid and liquid contaminants prescribed relevant actions in the Approved Document might involve removal, filling or sealing, assuming at least 100 mm of concrete will be laid over the ground e.g. for loose asbestos, filling or sealing is advised. Dealing with gaseous contaminants is more difficult. Site decontamination is of course a matter for specification (e.g. the Canadian NMS's *Contaminated sites* work section).

Pests
Treatment of site pests is often covered in building codes. Examples include the treatment of softwood in roofs against infestation by the house longhorn beetle in some parts of the UK, in the UK Building Regulations (1991) "Approved Document to support regulation 7", reflected in the NBS *Fungus/beetle eradication* work section. The deemed-to-satisfy provisions for termite protection in the Building Code of Australia (1996) under clause B1.3 Materials and forms of construction: Protection from termites, are dealt with in the NATSPEC *Termite control* work section.

Legislation: Product defaults
Recycled materials
Use of new construction materials may be a legislative default, as it is in the Australian *Local Government (Approvals) Regulation NSW 1993* Part 2 Division 1 Clause 7(5)(b), which states:

> "The specification of the building is ... to state whether the materials will be new or second-hand and give particulars of any second-hand materials to be used."

Queensland (Australia) regulations have a similar requirement. This of course militates against the use of recycled materials, a mainstay of green construction. In these circumstances any proposed second-hand materials must be specifically identified at the time of seeking building approval - which may be too early in the design sequence for such decisions to have had proper consideration. Accordingly designers may opt early on (consciously for expedience, or inadvertently by failing to even think about the subject) to use new materials throughout, and find themselves stuck with these decisions when specifying later. Interestingly, Boulder, Colorado (USA), has a piece of legislation which is specifically designed to permit the use of recycled lumber (Section 10-5-2, B.R.C. 1981). In part this reads as follows:

> " Reused wood members otherwise regulated by this chapter are acceptable for all uses in Group R-3 and U structures even if they are not identified by the grade mark or a certificate of inspection issued by an approved agency, so long as they conform to the applicable standards and grading rules specified in this building code and are also approved by a professional engineer registered in this state."

Legislation may have more subtle influences on recycling. For example, according to *Environmental Building News* (March 1977), local regulations in the USA allow only one week for the demolition of a condemned property, which obliges contractors to demolish (which may take just a few days) rather than deconstruct (which may take several weeks). This would limit the applicability of a deconstruction work section (e.g. based on the Canadian NMS's *Deconstruction of structures*).

Durability
Some building codes tackle the durability of materials and components. This clearly has an environmental impact in terms of conservation of resources, embodied energy, and so on. The longer a building and its component parts last, the better. The UK Building Regulations 1991 "Approved Document to support regulation 7" is interested in durability. It states, under the heading Short-lived materials:

> "1.3 Some materials ... may be considered unsuitable because of their rapid deterioration in relation to the life of the building. It is not possible to set down any specific criteria from which the length of life of a material can be considered ...
> 1.4 A short-lived material which is readily accessible for inspection, maintenance and replacement may meet the requirements of the Regulations provided that the consequences of failure are not likely to be serious to the health or safety of persons ...
> 1.5 Where a short-lived material is not readily accessible ... and the consequences of failure are likely to be serious ... it is unlikely that the material will be suitable. ..."

In the Building Code of Australia (1996) Section I:1 Maintenance: Equipment and safety installations, the objective states:

> "IO1 The Objective of this Part is to ensure that people are protected from illness, injury and loss of amenity throughout the life of the building."

On the face of it, this would have implications for the durability (and toxicity, flammability, off-gassing characteristics etc) of certain materials and components. But the deemed-to-satisfy provisions for this clause only cover maintenance of safety installations and of mechanical ventilation and warm water systems, which must of course therefore be accessible for this purpose. Durability of materials is not dealt with in the BCA, though it is under consideration.

From the New Zealand Building Code (1992), the much more precise performance requirement B2.3 states:

> "... building elements shall with only normal maintenance continue to satisfy the performances of this code for the lesser of
> - the specified intended life of the building, if any; or
> - (a) For the structure, including ... floors and walls which provide structural stability: the life of the building being not less than 50 years.
> (b) For services to which access is difficult, and for hidden fixings of the external envelope and attached structures of a building: the life of the building being not less than 50 years.
> (c) For other fixings of the building envelope and attached structures, the building envelope, lining supports and other building elements having moderate ease of access but which are difficult to replace: 15 years.
> (d) For linings, renewable protective coatings, fittings and other building elements to which there is ready access: 5 years."

Green technologies under prescriptive codes
Some building codes do not cover "new" or revived construction technologies such as straw bale or adobe construction. This is a particular problem where the codes are prescriptive and interpretation conservative (i.e. if it isn't expressly permitted, then it is forbidden), as in the USA, rather than where the codes are performance-based, as in the UK, the Netherlands, New Zealand and Australia. In the USA, only some jurisdictions have codes which cover such technologies - for straw bale construction these include Austin (Texas), Boulder (Colorado), New Mexico, California, Cortez (Colorado), Nevada, and Pima County & Tucson (Arizona). For adobe these include San Diego (California), New Mexico and Boulder (Colorado). Elsewhere in the USA, those wishing to use these technologies must seek special consent - a number of associations and web sites assist designers in obtaining such consent e.g. by providing contact details of sympathetic building officials. Before the codes existed, approval was very difficult to obtain - special waivers were required.

By contrast, in Australia, the building code simply states, as a structural performance requirement, that:

> "BP1.1 A building or structure including its materials and components must be capable of sustaining at an acceptable level of safety and serviceability -
> (a) the most adverse combination of loads (including combinations of loads that might result in a potential for progressive collapse); and
> (b) other actions, to which it may reasonably be subjected."

While there is also a (non-mandatory) deemed-to-satisfy prescriptive solution provided for adobe construction (which pre-dates the American examples, by the way), there isn't one for straw bale construction - some demonstration that the performance requirement will be satisfied is required. But at least straw bale construction isn't forbidden.

Legislation: Waste

One key piece of European environmental legislation which affects the building construction industry has been the implementation of landfill tax which requires the classification of waste for disposal and a tax imposed on different waste types. Inactive wastes include rocks and soils, ceramic or concrete materials, minerals, furnace slags, ash, low activity inorganic compounds, calcium sulfate, calcium hydroxide, brine and water. All other wastes are classified as active and the tax on their disposal is at a considerably higher rate. Europe isn't the only region running out of landfill. It is a major problem in Japan and the USA too. Accordingly waste control legislation is common in ICIS-member countries e.g. Sweden, Finland, Australia (NSW), Japan.

Hazardous waste

Some materials are regarded as sufficiently hazardous that their disposal must be controlled in any event. Trading of hazardous (i.e. toxic, explosive, flammable, radioactive) waste internationally is controlled under the Basel Convention, which came into force in 1992, so they can only be shipped if the exporter has the consent of the government of the receiving nation. But many poorer nations do not have the ability to vet these materials, so the treaty's member nations decided that, from 1997, the OECD nations would not be allowed to export any hazardous waste to non-OECD countries for recycling. This simplifies things considerably - and obliges OECD nations to trade hazardous waste among themselves. The dearth of high temperature incinerators (used for example to destroy components containing PCBs) in the world means that there will continue to be trade in such materials (MacKenzie 1995).

Nevertheless many hazardous materials will be disposed of domestically, and are subject to domestic legislation. Under Australian laws CCA treated timber cannot, for example, be burnt. In the USA where it can be burnt, the resulting ash cannot be disposed to landfill because it fails the EPA leaching test. In some jurisdictions the burial of the timber is also problematic - it has to be isolated and the leachate collected, so its disposal is relatively expensive. The timber has an exemption to the USA EPA leaching test, so it can be buried in most states (Wilson 1997). Asbestos is another well-known hazardous waste, the disposal of which is controlled in most ICIS-member jurisdictions.

Legislation also controls disposal of some environmentally deleterious wastes such as CFC refrigerants from decommissioned refrigeration systems - they cannot be released to the atmosphere under the Montreal Protocol. Sulfur hexafluoride (SF_6), a potent greenhouse gas used in medium and high-voltage electrical controlgear and switchgear and sealed acoustic glazing, is also controlled in this way in some jurisdictions (Norway, for example, includes its emissions in national inventories of greenhouse gas emissions) (AS 2791-1996).

PCB disposal is also controlled e.g. under federal legislation (Superfund) in the USA. The chemical, widely known for its use in transformers, is found in some surprising places such as fluorescent lamp magnetic ballasts made before 1979. Use of electronic ballasts is one solution. Mercury is another hazardous waste, found in fluorescent lamps, which contribute maybe 13% of the mercury in solid municipal waste in the USA. No fluorescent lamps can be disposed of in solid municipal waste in Minnesota and Wisconsin, and most other states in the USA ban the disposal of large quantities. This ban may make it into USA federal legislation. Use of lamps made to Philips ALTO technology, or equal, will solve this problem (Wilson 1997a).

Specifiers need to be aware of the known and possible disposal problems of materials when specifying them, and need to be aware of these issues for the specification of demolition/deconstruction e.g. clear identification

of known hazardous materials in the documents, and requests for method statements regarding the handling of these products. The Canadian NMS has work sections for *Hazardous waste materials*, and *Toxic waste*.

2.6 MANDATORY: CONTRACTS

In this section of the Report several contracts are used as examples, mostly from Australia. The Dutch UAV (1989), available in English, is referenced. British contracts referenced are JCT 80 (1980 and amendments to 1998) and ICE (1993). American contracts referred to are EJCDC (1990) and AIA A201 (1997). The Australian contracts referred to are AS 4000 (1997), JCC (1994), SBW-2 (1997), PC-1 (1998), and C21 (1996). Their contents in terms of the environment and health and safety are often similar, but sometimes they are radically different from each other. A comparative study is therefore quite instructive.

Terminology is variable. In discussion the terms "purchaser" and "contractor" and "contract administrator" are used. The contracts themselves often use other terms.

Contracts: Construction site

Some contracts may compel project specifiers to take some responsibility for health and safety on site, even in the absence of the sort of construction site legislation discussed above. For example, AIA A201, at clause 10.4, states "The Owner shall not be responsible under [Hazardous Materials] for materials and substances brought to the site by the Contractor unless such materials or substances were required by the Contract Documents." That is, if they were specified, then the purchaser is responsible for them and the consequences of using them. For example, clause 10.3.1 states "If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance ... the Contractor shall ... immediately stop work in the affected area and report the condition ..." Following this action is the rendering harmless (removal or containment) of the material or substance. If "bodily injury" includes increased risk of cancer, for example, then a raft of materials and substances might become unusable where this contract is used, depending on interpretation of the word "reasonable".

Some forms are silent on the matter e.g. JCC and SBW-2. These rely on legislation to make the position clear. Some contracts explicitly make the contractor 100% responsible, even though the local legislation may not. Others share the responsibility:

- UAV clause 6.16 and 16.1: "The Contractor shall ensure orderly conduct and safety on the Site ..." but "If the Employer considers enclosure of the Works and the Site necessary, the type of enclosure shall be described in the Specification."

- ICE clause 18: "The Contractor acts in accordance with the health and safety requirements stated in the Works Information."

- JCT 80 clause 20.1: "The Contractor shall be liable for ... any expense, liability, loss, claim ... arising under any statute or at common law in respect of personal injury to or the death of any person ... arising out of or in the course of ... the Works, except to the extent that the same is due to any act or neglect of the Employer ..."

- AS 4000 clause 12: : "... the Contractor shall take measures necessary to protect people and property ..."

- PC-1 clauses 8.16 and 8.17: "The Contractor must carry out the Contractor's Activities safely and so as to protect persons and property" and "The Contractor must ensure that in carrying out the Contractor's Activities it complies with all Statutory Requirements and other requirements of the Contract for occupational health, safety and rehabilitation management ..."

- C21 clause 24.3: "The Contractor must do all of the following: comply with all requirements of the Contract for occupational health, safety and rehabilitation management ..."

In the JCT example, responsibility for injury arising from the use of a specified hazardous material may expect to be split - the contractor can mitigate the injury through use of protective clothing, for example, or through a request for substitution (see Gelder 1996 PRO 6, on risk reduction). But the specifier should perhaps have not specified the material in the first place, also the case under the CDM regulations.

The UAV requirement for purchaser-designed security fencing is unusual - this is generally the responsibility of the contractor. In the last three examples it is envisaged that OH&S management may be specified - but this involves the specification of "means and methods". This is generally not recommended (see below), though it is not barred in these particular contracts. They also rely on statutory requirements.

Contracts: Product defaults
Some widely-used standard forms of contract may have some impact on use of recycled materials, by defaulting to new materials in a similar way to the NSW legislation mentioned above. Examples include:

- EJCDC clause 6.5: "All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents."

- AIA A201 clause 3.5.1: "The Contractor warrants ... that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, ..."

- AS 4000 clause 29.1: "Unless otherwise provided the Contractor shall use suitable new materials ..."

- JCC clause 6.08.02: "Any materials not otherwise specified shall be new."

- C21 clause 53.2: "Where the nature of materials is not specified in the Contract, new materials are to be used unless the Principal agrees in writing to the use of recycled materials of equivalent standard."

- PC-1 clause 9.1: "The Contractor must in carrying out the Contractor's Activities ... use materials which ... if not fully described in the Contract, are new ... and of merchantable quality ..."

Under these contracts the specification must state which materials are to be reused and which are second-hand. If these are not so identified, then they must be new (and the contractor cannot reuse materials or use second-hand materials, unless a variation is issued and the local authority is notified). Note that UAV, JCT-80, ICE, and SBW-2 do not appear to have text of this sort, so it is by no means universal.

What does this mean in practice? Must one schedule all possible recycled/second hand items, such as PVC pipe made from recycled PVC, or fibreglass insulation made from recycled glass waste (most is, in part), or second-hand reconditioned floorboards, or retained walls in existing buildings? What about identifying retained paint coats under new paint? How far do we go?

And how do we deal with this? Does one state "The following items are second-hand:" or "The following items may contain components/materials which are recycled: ..."? Or is it easier to state "The following items must not contain any second-hand or recycled material: ..."? Just what does "new" mean in this context? These legislative and contractual defaults are increasingly meaningless and out-of-touch.

Contracts: Waste
Disposition of construction waste is a topic that many project specifiers wish to address, encouraging separation on site, and subsequent recycling. Indeed the Canadian NMS has a work section on the subject. But contracts dictate what can and cannot be said in a specification about waste management, in at least two ways.

Ownership
Construction (versus demolition) waste does not generally belong to the purchaser. It is not one of the products it is purchasing, and it is only disposition of these products which the specification can describe. Waste generally belongs to the contractor, along with other uninstalled materials (unless they've been claimed and paid for - not recommended - see below) and so its disposition is entirely up to the contractor. Some contracts are explicit (or implicit) on this:

- UAV clauses 19.3, 21.1 and 21.2: "Any materials remaining unused after completion of the Works shall be returned to the Contractor and considered as not having been supplied ...", "Any used materials recovered from the Works shall remain the property of the Employer, unless the Employer's Agent states that they are without value to the Employer", and "Used materials that have been declared

to be without value to the Employer shall become the property of the Contractor and must be removed."

- ICE clauses 70.1 and 70.2: "Whatever title the Contractor has to ... Materials which is (sic) outside the Working Areas passes to the Employer if the Employer has made a payment for the ... Materials or the Supervisor has marked it as for this contract" and " Whatever title the Contractor has to ... Materials passes to the Employer if it has been brought within the Working Areas and passes back to the Contractor if it is removed from the Working Areas with the permission of the Project Manager."

In the second example, waste from materials purchased when off-site could become the contractor's property, or not - it seems to be up to the contract administrator (rather than the specifier). What the contractor does with its waste materials is the contractor's affair. While some contracts tell the contractor to remove the waste (e.g. UAV clause 21.2; AIA A201 clause 3.15.1; EJCDC clause 6.17), that's only because the purchaser does not want something which is not its property left cluttering up his site. The market, or the law, might encourage the contractor to recycle or it might not. It's disposal cannot be specified in the contract.

Nevertheless the tender (bid) documents can legitimately include a request for the submission of a waste management plan, for information only, which might be a consideration in tendering/bidding (along with the contractor's financial status, experience, proposed quality control regime, and so on). Disposition could be specified if the waste belonged to the purchaser, which is at odds with normal practice, and would require modifications to the standard forms of contract.

But, the waste does belong to the purchaser if derived from previously uninstalled materials which have been claimed and paid for - a practice commonly permitted in contracts:

- UAV clauses 19.1 and 21.3: "All materials intended for the Works shall become the property of the Employer ... as soon as they have been approved and the Contractor has demonstrated ... that the suppliers have waived all rights and claims to those materials ..." and "The used materials that remain the property of the Employer shall be properly sorted ... and stored ..."

- JCC clause 10.04: "All such materials and/or goods shall become the property of the Proprietor upon payment by him to the Builder ..."

- JCT 80 clause 16: "Where the value of any such [unfixed] materials or goods [whether on-site or off-site] has ... been included in any Interim Certificate under which the amount properly due to the Contractor has been paid by the Employer, such materials and goods shall become the property of the Employer ..."

Generally contractors treat the waste from such materials as their property but, strictly, it isn't. The purchaser is responsible for its legal disposal or use on site, and the specification can therefore deal with this, and indeed should do so. The waste could, for example, be sold to the contractor! Unfortunately few specifiers have any expertise in this matter.

Waste also belongs to the purchaser if it is from demolition and scheduled as belonging to the purchaser e.g. for salvage. The disposition of demolition (versus construction) waste is normally dealt with in schedules in the demolition work section. The purchaser of course owns the entire building before demolition, and so is logically responsible for the legal disposal of demolished materials. The purchaser would also own the waste derived from purchaser-supplied items.

Construction methods
Disposal of waste falls under "means and methods", and some contracts explicitly do not permit specifiers to stipulate these:

- EJCDC clause 8.9: "The OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction."

- JCC clause 6.03: "The Builder is and shall remain responsible for all construction means, methods, techniques, sequences and procedures employed ... in and about the execution of the Works ..."

Further to the JCC clause, the parallel SBW-2 (small works form) goes on to say (clause 6.1) " ... and the Architect shall not be entitled to issue any instructions as to these matters". Under these contracts the environmentally-responsible disposal of waste, and indeed any environmentally-beneficial construction method, cannot be specified. Similarly, the methods of removal and disposal of hazardous waste, such as asbestos (which in any case is adequately covered by legislation), fall into the category of "means and methods", and so are not to be specified. However, one can specify the end result i.e. that the built product at handover must be asbestos-free, but how this is achieved is the contractor's affair.

But some contracts explicitly do permit methods to be specified:

- UAV clause 5.2: "The Employer shall be responsible for the ... construction methods prescribed by him or on his behalf ..."

- AIA A201 clause 3.3.1: "The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures ... unless the Contract Documents give other specific instructions ... If [they do] the Contractor shall evaluate the jobsite safety thereof ..."

- C21 clause 54: "If a particular work method is specified in the Contract, the Contractor must use it. The Contractor warrants that it has [satisfied] itself that all work methods specified ... are appropriate ... The Contractor is solely responsible for all work methods, whether specified in the Contract or not."

The C21 example is rather self-contradictory (a case of having your cake and eating it), and illustrates the problem of specifying methods in the first place. The UAV is fairer. A later clause (6.14) expects the contractor to notify the contract administrator if the contractor considers the methods specified to be defective. Otherwise the contractor becomes responsible after all. Similarly, the AIA contract (which discourages the specification of construction methods) goes on to require the contractor to give notice if it thinks the methods specified are unsafe, but to otherwise take responsibility for their safety. If the contract administrator insists on using the specified methods after all, then the purchaser becomes responsible for loss or damage.

So disposition of waste can be specified under these contracts, but generally at the purchaser's risk. Even so, specification of construction methods is not recommended, for a variety of reasons (e.g. methods expertise is the contractor's, clean boundaries of responsibility must be maintained, the contract administrator does not supervise the process of construction, competitive and innovative responses at tender should not be limited, possible conflict between method and product requirements). For those contracts which make no mention of construction methods at all (e.g. JCT 80), the recommendation is that construction methods, such as disposition of waste, should not be specified.

Miscellany
On a related topic, responsibility for site contaminants may be covered by contracts, making the purchaser responsible for identifying contaminants in the contract documents. That is, they should be scheduled in the specification as far as possible, and a prompt provided in the master specification to this effect:

- UAV clause 5.8: "If the Site, the used materials recovered from the Works, or the materials made available by the Employer shall be contaminated, the nature and the extent of such contamination ... shall be stated in the Specification."

- EJCDC clause 4.5.1: "OWNER shall be responsible for any Asbestos, PCBs, Petroleum, Hazardous Waste or Radioactive Material uncovered or revealed at the site which was not shown or indicated in Drawings or Specifications ... and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the site."

Other contracts tackle this sort of thing under "latent conditions" clauses, and generally do not require the scheduling of known contaminants (though this would still be a good idea).

On the subject of demolition waste, according to *Environmental Building News* (March 1997), some USA forms of contract prohibit the sale of demolished (deconstructed) materials on site. To make deconstruction commercially viable, costs need to be minimised, so selling on site is essential. Accordingly this prohibition would limit the applicability of a deconstruction work section.

Contracts: Environmental protection
Some contracts explicitly tackle protection of the environment:

- UAV clause 5.8: "The Works shall be planned in such a manner as to limit any damage to persons, property or the environment as much as possible."

- PC-1 clause 8.20: " The Contractor must ensure that in carrying out the Contractor's Activities ... it does not pollute, contaminate or otherwise damage the environment; and ... make good any pollution, contamination or damage to the environment arising out of, or in any way in connection with, the Contractor's Activities ..."

- C21 clause 25: "The Contractor must ... comply with all requirements of the Contract for protection of the environment. ... The Contractor is responsible for and must at its own cost make good any damage to the environment caused by the execution of the Works."

The PC-1 example stipulates the requirements and then the remedy for non-conformance - not good specifying practice, but common enough (e.g. under the heading "urgent protection") in contracts. Under C21, the contract can be silent on the subject, or can stipulate environmental protection in a faulty manner, and still leave the contractor responsible for damage. Both are absolute - *any* damage must be rectified. This could be costly.

They raise a number of other questions. For example, does environmental damage include transient damage such as noise or light pollution? How substantial does the damage have to be? The environment is surprisingly robust, and can often recover from low level damage in time. What about damage that cannot be rectified e.g. fire damage to trees, or the destruction of trees and shrubs? Or even loss of a species? Is financial compensation a good enough remedy (there has been an Australian Standard on the amenity value of trees under development for some time)? And just what is "the environment" in these terms?

Most other contracts deal with this subject through general requirements to protect property:

- JCT 80 clause 20.2: "The Contractor shall ... be liable for, and shall indemnify the Employer against, any expense, liability ... in respect of any loss, injury or damage whatsoever to any property real or personal in so far as [it] arises out of or in the course of ... the Works and to the extent that the same is due to any negligence ... of the Contractor ..."

- ICE clauses 80.2 and 81.1: "... the following are the Employer's risks. The risk of claims ... and costs payable for ... loss of or damage to property ... which are due to /use or occupation of the Site by the works ... which is the unavoidable result of the works or /negligence ... by the Employer ..." and "... the risks of ... loss of or damage to property which are not Employer's risks are Contractor's risks."

- EJCDC clause 6.20: "CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to ... other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements ..."

- AIA 201 clause 10.2: "The contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to ... other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements ..."

- AS 4000 clause 12: "... the Contractor shall take measures necessary to protect people and property; ... prevent nuisance and unreasonable noise and disturbance. If the Contractor damages property, the Contractor shall promptly rectify the damage and pay any compensation which the law requires the Contractor to pay."

The two American examples are almost the same - both mention some examples of property which include at least some natural features. The difference is that one is absolute ("all necessary") and the other not ("reasonable"). This would affect pricing. The two UK examples are about financial and legal risk allocation - presumably the contractor under JCT 80 would take steps to mitigate the risk by protecting the environment and other property (but, is the environment at large "property" in this context?), and endeavouring in other ways to avoid damage. Or maybe not - it is up to the contractor to determine how to deal with the risk. To win the project a tenderer (bidder) might decide to ignore it!

Unusually, under the ICE contract at least some of the risk is likely to be the purchaser's, who would have to take steps in the design and documentation to manage the risk. But just what is "unavoidable"? For example, if the building is to have a concrete frame, is cement slurry discharged off (or on) site an unavoidable pollutant? In this case it is over to the specifier.

3 SOURCES OF INFORMATION

3.1 INTRODUCTION

Project specifications may be prepared in several ways:

- National master specification to Office master specification to Project specification.
- National master specification to Project specification.
- Office master specification to Project specification.
- Project specification to Project specification (known as "rolling" specifications).

As we move from National master specification to Office master specification to Project specification, so choice is progressively reduced, and with it the need for advice.

Resources

Just as every office does not have access to a full-time expert specifier, so every office does not have access to a full-time expert environmental specifier. The in-house solar architect, if there is one, may know little about green selection of materials and components, for example. And the in-house specifier, if there is one, may just be one of those old dogs who can't be taught new tricks. Besides, there's a lot to know. The office can engage an expert, of course, as a co-consultant, and this happens often enough. Or the office can look to other sources of advice.

3.2 SOURCES OF TEXT

Master specifications: Choice

Clearly the key feature of a master specification, particularly a national master, is maximum choice. For the text, this would involve providing alternatives, not just for a choice between tile or slate or sheet metal roofs (for example), but also for a choice between tile roofs specified to the national Standard (or Standards, where competing Standards exist as they do for some products in the USA), a full series of proprietary tile roofs (covering all brands available across the country), and a series of performance specifications for tile roofs (covering different climatic conditions across the country, or different project sizes for example). The Dutch STABU system is perhaps the best example, but not many, if any, national masters go this far.

Limiting choices in the master specification might indirectly affect the environmental sustainability of building projects. For instance, whereas one project specifier may decide not to use a particular material on environmental grounds for one project, the same specifier may use it on other projects, and another may be happy to specify it for all projects. Therefore the master specifier should not unilaterally excise any materials or components from the master specification, as this would prejudice some project specifiers, and would in effect involve the master specifier in the design of the project, something he or she is not paid for, not insured for, and not expected to do. All available legal choices should remain in the master specification. This is the view of Norway's NBR, for example. It is only sensible in any case, because there are many factors to consider, other than environmental sustainability, when selecting products.

Master specifications: Defaults and options

Master specifiers must also decide what becomes default text, and what becomes optional text for the project specifier to select or complete. This decision as to whether text is to be a default or an option might have environmental consequences, since project specifiers often leave default text as it is. Non-environmentally sustainable (or controversial) default text should be converted to optional text, unless alternative text which *is* environmentally responsible is provided. So, rather than defaulting to PVC/PVC for power cables (otherwise quite reasonable given its wide usage), let the project specifier decide. Ditto for GP (general purpose portland) cement, rather than GB (general purpose blended) cement - which allows the use of limited amounts of fly ash, slag and silica fume (to AS 3972). Of course the same might apply to green default text, to avoid unilateral forcing of greening by the master specification. So the master specification wouldn't default to halogen-free power cables, or to GB cement, in these examples.

Prompts should also cover attributes which have environmental consequences, but which have been ignored in traditional master specifications. These might include durability, recycled content, embodied energy, thermal

performance, toxics content, and so on. Certification against environmental Standards (e.g. water efficiency, energy efficiency) should also be provided. Of course project specifiers must be realistic when completing such prompts, so advice on market availability is essential. National master specification examples include NATSPEC on energy rating of windows and water efficiency of plumbing products.

Master specifications: Gaps
At worksection scale, few if any master specifications offer default text for the specification of some emerging (or re-emerging) environmentally responsible classes of work, such as photovoltaic power systems, geothermal heat exchange systems, composting toilets, thatching, rammed earth, or straw bale construction. Even quite common environmental technologies may be omitted - such as solar water heating systems, or vegetable fibre flooring (i.e. sisal, coir and the like). Partly this is because master specifications (especially nationals) tend to be geared to commercial and institutional work, whereas some of these classes of work are, at the moment at least, more likely to be used in the small-scale residential sector. Partly it is because take-up of these classes of work is currently slow - they are not often in the mainstream.

So project specifiers, if left to their own devices in these areas, may

- not consider them at all, at least for commercial work, since the master specification doesn't remind them to or help them to;

- not do a very good job of specifying them generically, not having a neutral source to turn to;

- provide domestic-scale specifications for commercial-scale projects; or

- decide to specify them by proprietary item or nominated subcontract (where this is possible) rather than generically, which may have an effect on competitive tendering and innovation.

Most master specifications provide text for landscaping, and most seem to regard this as automatically being environmentally responsible. This is not the case. For example, mowing of lawns has been shown to be a major source of urban air pollution, through increased release of hydrocarbons (Anderson 1998). Also, planting of exotic rather than native species may impact on local native wildlife (e.g. insects, birds, and mammals), and sometimes even on the survival of local (unpopular for landscaping) plant species.

Master specifications: Refurbishment and maintenance
At a broader scale, master-wide, the usual assumption by the master specification is that entirely new construction is being described. Repairs, maintenance, restoration, alterations, fitouts and refurbishment of whole buildings are rarely explicitly dealt with in master specifications (especially nationals). This is a built-in prejudice against environmentally responsible construction (in terms of minimising consumption of finite resources and production of waste) that should addressed. In countries (such as Switzerland) where there is relatively little construction of brand new buildings, this assumption would be unrealistic in any case. And in many other countries it is unhelpful given that a substantial fraction of construction work is in this area (in the UK the percentage for repairs and maintenance was 41.5% of market share by value in 1995). (Bennett *et al*.)

Tackling this topic would have the added benefit of connecting master specifications to the built heritage industry - using sources such as those on repair of woodwork and stone published by the UK's Society for the Protection of Ancient Buildings - and, through fitout, to the growing industry of facilities management, substantially expanding the market for commercial master specifications [?].

Recycling of products, and use of products which are normally rejected at the factory or site (e.g. the 1970s fashion, in Australia at least, for "clinker" bricks), won't often be covered either. Even if these products are supplied by the purchaser there will be specification issues to deal with. Careful demolition (dismantling if you like) for recycling, preparation and cleaning of components to be recycled (e.g. de-nailing and stripping or burning off of timbers, cleaning of old bricks), and repair of components to be recycled (such as faulty door hardware, or partly rotted timbers), are not the sorts of topics that many master specifications deal with at present (the Canadian NMS work section titled *Deconstruction of structures* has been noted). Indeed, new buildings can be designed (and specified) with recycling in mind e.g. using lime mortars for bricks rather than cement mortars, stage-set nails rather than flush nails. These are not the normal defaults in master specifications.

But if the recycled products are to be acquired by the contractor, rather than supplied by the purchaser, how is their quality specified? How defective are such products permitted to be? Even for downcycling (e.g. brick and concrete rubble for hardcore) some minimum level of quality needs to be specified (e.g. free of metals and organic material, and size grading). For visible products this issue is complicated by the general acceptance, even desire, for a certain amount of roughness in the recycled product - it often is expected to look second-hand. Indeed a certain amount of *faux* work may be required. How many master specifications cover that?

The difficulty of specifying at professional level for recycling discourages it - project specifiers tend to go for the safe, and well covered, option of using new buildings, components and materials. Recycling must be brought into the mainstream. Work section examples in national master specifications include the Swiss CSD *Fitting out for commercial purposes*, NBS's *Alterations - spot items*, and *Fungus/beetle eradication*, STABU's *In situ concrete repair*, and *Existing work - floor coverings*, MASTERSPEC's *Masonry restoration and cleaning*, and NATSPEC's *Stone repair* and *Fitout* (proposed)

National master specifications: Progress
Four national master specifications are well underway with large-scale greening programs (NBS, STABU, CRB and NMS) and several others have started to tackle the issue piecemeal. Others have not started the process, and some of these have no intention of doing so in the near future. Several ICIS members did not respond to the survey. Edited responses from ICIS members are included in the Appendix D. Following is a summary of the main points.

Finland
BII's RYL 2000 has some green text sections, and every work section may have text in subsections for repair work and environmental impact.

Germany
GAEB's StLB system is not being greened at present. GAEB feels that government legislation covers the territory adequately.

The Netherlands
The STABU Foundation is implementing the rules in the Dutch government's covenant for sustainable construction of houses and utility buildings. The covenant covers materials, energy, water and internal environment. A series of specifications (mostly modified existing basic specifications) reflecting the requirements of the covenant is being prepared as a special part of the STABU system. Use of these will be facilitated through special help screens, and through a tool box to assist in identification and selection of text. Some new specifications, for emerging environmental technologies e.g. re-use of PVC and for water efficiency, are also being prepared as part of this work.

Norway
The Norwegian standards forming the national master specification are being republished as smaller sections with clauses for health, environment and safety, and for clean building, including performance requirements.

Sweden
SBC is revising existing AMA text and commentary to cover environmental issues, and is adding some new text, with more expected. Separate green guides are not being produced, but a database of environmental data for building products is being prepared.

Switzerland
CRB is involved in a series of joint venture projects attempting to combine energy and mass flow, environmental impact, and cost, notably OGIP. This computer-based approach connects 1000 elements in the standard cost-planning database to data on embodied energy of building materials, construction waste, energy in use and so on. Energy and mass flow for about 200 elements is being done now. This is more to do with selection than specification.

United Kingdom
The RIBA Companies' NBS has commenced a greening program with the aid of funding from the Department of Environment, Transport and Regions' *Partners in Technology* program. The first stage, "The Greening Report", has been prepared by ECD Energy and Environment and is distributed on diskette to subscribers on request.

The report considers general issues (e.g. metals, timber) relevant to many worksections, then specific issues linked to the relevant NBS work section(s) (e.g. flat roof/waterproofing membranes, screeds and toppings), waste management and site issues (e.g. earthmoving), a series of other issues (e.g. rainwater collection), and emerging green solutions (e.g. adobe bricks and rammed earth walls). Each chapter provides background, references, and discussion, and suggests "basic" and "improved" green specifications.

Over the next two years, NBS will add green text and guidance throughout its material, as the sections undergo routine maintenance. Guidance on environmental issues has already been introduced in some sections, on timber preservatives, timber, plastics, and peat.

Canada
The Canadian government Real Property Services' NMS is greening with a vengeance, responding to the Services' sustainable development strategy, developed under a 1995 government mandate. The long term intention is to green all sections, but in the short term a half-dozen priority issues are being tackled:

- Toxic or hazardous substances and waste management.
- Ozone depleting substances.
- Non-hazardous solid waste management.
- Energy and water efficiency in facilities.
- Contaminated sites management.
- Land and marine/freshwater activities management.

To address these issues, nine new sections have been published (dealing with waste, deconstruction, underground storage tank removal, contaminated sites and PCB abatement), and the content of many others has been updated.

United States of America
ARCOM's MASTERSPEC is beginning to address environmental issues through the advice it provides, and is considering co-operating with the large architectural practice HOK on this. It has a prototype project underway for chillers, in which ARCOM is collaborating with Green Seal, and with principal manufacturers. ARCOM has experienced some difficulty with the sort of information available from manufacturers generally, and with the highly variable levels of interest among project specifiers.

CSI is to produce a performance-based green specification, with USGBC, perhaps integrated with its new PerSpective master specification system.

SpecText, which was published by NIBS until recently (not an ICIS member), offers little or no advice, just text and prompts, and it appears that there was no effort being made to bring environmental issues into the text, even though the text was undergoing a major review. Nevertheless the environment and health feature in other NIBS activities (e.g. the Building Product Pre-Approval Program) and it seemed likely that they would have eventually found their way into SpecText. The current state of play is not known.

Australia
CISA published, as part of NATSPEC, a *Monolithic stabilised earth walling* worksection in 1997, and has provided green advice at a number of points e.g. for the *Termite control*, *Timber finishes and treatment* and *Refrigeration* worksections. NATSPEC systematically references, throughout the *Commentary*, the highly-successful notes in the *Environment Design Guide* published by the Royal Australian Institute of Architects.

Interest is high - an RAIA attitudes survey found that 90% of respondents agreed that architects have a responsibility to protect the environment. CISA is seeking funding from the Australian Greenhouse Office for the greening of NATSPEC, which will include generation of new work sections as well as the greening of existing material (Wright 1999).

New Zealand
CIL's MasterSpec is greening incrementally, reflecting market demands (noting that there is little mainstream support for environmental issues), and providing for choice. Reference to published advice on environmental and health matters is included.

Japan
Japan has a national master specification system in the form of the Ministry of Construction's "Common Specification for Building Construction" [title?]. This is not undergoing greening, though the Ministry has developed the "Recycle Plan 21" program. The AIJ (Architectural Institute of Japan) publishes the JASS series of 26 work sections, which also is not being greened.

3.3 SOURCES OF ADVICE

In general, providing choice in the text (including prompts to be completed by the project specifier) means that master specifications should also provide advice to assist in making those choices and completing the prompts. In this section, the presentation of advice, its scope, and its potential reliability are discussed.

Accessing reliable advice on this subject to pass on to project specifiers, either directly or by reference, is difficult at the moment. There is no single authoritative source. Indeed it seems, sometimes, that there aren't any! But few master specifications have the resources to commission their own research (NBS's *Greening the NBS* project is funded through a government grant), and so perhaps it is a case of "beggars can't be choosers".

Many project specifiers look to their master specification for guidance in "best practice" documentation. This may run from page layout and terminology to correct use of Standards, conformance to legislation, and so on. Guidance and text provided by master specifications (especially nationals) is usually regarded as current, unbiased and authoritative. Any "greening" of the master specification text and its commentary must satisfy these expectations.

Master specifications: Extent of advice
The more choices offered, the more advice is needed. Advice will also be needed for project specifiers wishing to write their own text e.g. to cover territory not covered by the master specification, or to vary the default text offered by the master specification. Of course project specifiers should be keeping themselves informed of environmental and other issues without depending on the master specification, and master specifications should be used critically - but the master specification can and should assist. If it doesn't, the project specifier will be obliged to look for advice elsewhere, which rather defeats the object of a master specification as an indispensable one-stop-shop specifications tool.

Most national master specifications, at least, offer advice but some, such as SpecText, do not offer much. Advice on environmental (and health) issues is not widespread among national master specifications at this stage, though a number are working on it systematically e.g. NBS and STABU.

Master specifications: Form of advice
Master specifications may provide advice on several topics:

- Master specification text, alternatives and prompts. This may be editorial, technical or both and , for prompts, may include suggested or example text. It may also include background material.

- Documents referenced from the master specification text, such as Standards.

- Identification of sources of further information for project specifiers, referenced from master specification commentary.

The advice may be

- integrated with the text (e.g. on the same page, as in SpecText);
- located in a separate helpscreen (as provided in the STABU system);
- interactive e.g. using decision trees to help resolve complex choices;
- in a parallel (i.e. clause-by-clause) document (as in NATSPEC *Commentary*);
- in separate non-parallel essays or guides (such as the now-defunct *CSI Monograph Series*); or
- some combination of these.

Provision of advice is an opportunity for the *integration* of guidance on the various issues (e.g. cost, availability, fitness-for-purpose, conformance) which inform specification practice. This would ensure that, for example, environmental issues will be considered by all project specifiers rather than just those who have an interest in these matters. It also ensures that they will be placed in their proper context, so that enthusiastic green project specifiers are encouraged to consider other issues, such as conformance to Standards, and vice versa.

That is, through integration, environmental considerations could become mainstream rather than remaining at the fringe. Providing completely separate advice on green issues does not encourage mainstreaming of these issues since this may well be seen only by those with an interest in the subject.

Nevertheless most national master specifications are addressing the environment quite separately from other issues. Integration of advice is not happening. There may be good reasons for this. For example, the Australian Council of Building Design Professions (BDP) *GreenSelect* project is intended to be made available to all architects and contractors, not just to NATSPEC subscribers, so it must be published as a separate document. The best that NATSPEC can do is to reference the *GreenSelect* material, when it becomes available, from its *Commentary*. Flagging of green text and advice is used by some funding agencies to show just what it is they have paid for - if it was anonymous, this would not be possible.

Objective advice

This is a particular problem when considering environmental issues, because so much of the available information is not objective, not fact-based. Misinformation proliferates, partly courtesy of green groups on the one hand, and manufacturing industry on the other. It can be very difficult to get to the bottom of this - green groups are out to make a point and will often ignore inconvenient facts (so it is now suggested that burning of paper waste may be more environmentally responsible than recycling it, in spite of green group rhetoric), and industrial groups will often suppress internal reports which are critical of products and processes in which they have a vested interest (as we have seen in the case of the tobacco industry). Useful information may also be suppressed by manufacturers claiming commercial-in-confidence protection (e.g. in MSDSs (material safety data sheets) for formulas and mixes for plastics-based products such as vinyl floor tiles, or in government statistics for Australia's overseas sources of vinyl chloride monomer), or may simply be not released by the manufacturers for the same reason, as in life cycle analyses of proprietary products.

Even apparently reliable sources, such as the "learned society" Indoor Air International, need to be treated with caution. Papers from this society suggested that factors other than tobacco smoke might be behind lung disease. The society was reportedly established by the tobacco company, Philip Morris (Hawkes 1998).

When factual information is available, its interpretation and application is not necessarily simple. This means that very often master specifications cannot give definitive recommendations regarding products - the best that can be done is to provide both sides of the story and let the project specifier decide. The US AIA *Environment Resource Guide* does this, for example, with a manufacturer "right of reply".

Changing advice
In any case, the facts vary - for example, across time and place. And there may be mitigating circumstances. As the facts change, so the advice must change.

Time
Well known examples of variation across *time* include lead, cadmium, chromates, VOCs (volatile organic compounds), asbestos, organochlorines, CFCs (chlorofluorocarbons), halons and vinyl chloride - which all shifted from being regarded as (at least relatively) safe to health and/or the environment in the first half of this century, to being considered unsafe in the third quarter (hence the OECD's Existing Chemicals Programme, which involves environmental and health review of suspect industrial chemicals which have been in use for some time). A recent controversial example is the withdrawal of a pitch-polymer damp proof course by its manufacturer in the UK, because of the claimed risk of skin cancer associated with pitch and tar (*RIBA Journal*, June 1998, p53) (however, it appears that the manufacturer was using scare tactics to expand its market share, such that both designers and trade unions would abandon its own and its competitors' pitch-polymer products in favour of its own "safe" alternatives - see Richardson 1998). Other examples will be the use of steel slag as fill (arising from the UK *Rotherham v Haslam* case of 1996), and the use of a "coal combustion by-product" as fill (arising from structural damage to dozens of buildings in Richmond, Virginia, USA, leading to five lawsuits in 1999). Even humble fill has standards - any old waste product won't do!

The time factor can be seen in the application of the Precautionary Principle, which may be considered in hindsight as either unduly conservative or as being timely. For example, something of an over-reaction to asbestos occurred in the ACT (Australia), with a costly program to remove asbestos-cement roofing from houses where it was posing no hazard at all (whereas the process of removal and disposal does pose hazards). On the other hand, acting early on CFCs (described by the chief USA negotiator on the Montreal Protocol as a "leap of faith") has since been vindicated.

Again on time, the perception of environmental and health issues is evolving, forcing change in specification practice:

- Scientifically, as knowledge and understanding increase (so we now understand that catalytic converters probably do as much harm as good, for example).

- Legally, through enactment of national, regional and local regulations.

- Politically e.g. through treaties such as the Montreal Protocol and its subsequent amendments, and the recent Clinton administration orders for energy-efficient USA federal purchasing.

- Socially e.g. as community interest and passion waxes and wanes, and as risk perception evolves - acceptable risks today may be unacceptable risks tomorrow, and vice versa. For example, the debate about whether endangered species are best served by bans (forcing trade to go underground) or by controlled exploitation, continues (e.g. for elephant ivory, for mahogany).

Place
For variation by *place* we have well understood environmental variables such as daylighting levels, temperature regime, wind speed, snow loads, bushfire vulnerability, proximity to the sea, earthquake risk, humidity and rainfall, all affecting the selection of materials and design of components. For small countries these can be easily dealt with by a national master specification - the variation across the country is not very great. For large countries (e.g. Canada, USA, Australia) these sort of variations can be much harder to deal with, but if national building regulations can do it, then so can a national master. At international level, a good example of variation by place is the level of hazard posed by radon - the official view in the USA and UK is that this gas is a hazard, responsible for many thousands of deaths a year (though there are dissenting opinions). But in Australia the official view is that it is a non-hazard, since it does not occur to any great extent in built-up areas.

Legal, political and social forces affecting specification vary from place to place, too. There are international variations, of course. France only banned asbestos in 1996, for example, whereas Australia did it in the 1980s. The greenhouse mitigation commitments following the Kyoto summit are a well-known example of variation from country to country, arising from political pressure and tactics. On the social front, German green groups are far more influential than those of many other countries, with the result that German environmental controls

are well in advance of those in, for example, most of the rest of Europe, Australia, and the USA. But state-by-state variations are also quite common, and are harder for a national master specification to deal with. Especially when there are 50 states with widely varying attitudes to these issues! The national master specification(s) may reasonably opt out, relying on the specifier's local knowledge. Or, the master specification could become regional rather than national e.g. compare SpecText and MASTERSPEC in the USA in terms of citation of east-coast or west-coast Standards (e.g. for fire doors), and building code alignment.

While greenhouse forcing and ozone depletion are global, not local, issues, there are many local environmental and health issues to consider, ranging from the nature of the construction site itself, to its locale, to its hinterland (e.g. for materials sourcing and waste disposal). Some of these variations (e.g. at hinterland level) can be addressed in a national master specification system, but others cannot. Again, the project specifier is expected to have the requisite local knowledge.

Complicating the issue, other varying considerations involve

- the source of power and the processes used in manufacturing - some are environmentally cleaner than others e.g. hydroelectricity versus burning sulphur-rich coal, use of waste versus virgin materials;

- whether the product is to be sourced or processed locally, or not - transport can impose a heavy environmental cost (in Australia stone may even be sourced locally but shipped overseas for processing and reimported), as for precast concrete (Rush 1999);

- the quantity of the material present (aluminium in reflective foil versus aluminium in window frames);

- the availability of the material - chemicals hazardous to the environment or health may be locked away in building products e.g. asbestos cement, or they may be free e.g. VOCs in paints;

- the function of the product, which may be environmentally beneficial, offsetting some non-green content (as for thermal insulation or termiticides); and

- the availability and cost of alternatives.

So just because a product contains a chemical or material which everyone agrees is not environmentally sustainable, this does not necessarily mean that the product should not be used, and vice versa. There may be mitigating factors. The difficulty is that some of these may be brand-specific, whereas most national master specifications deal with products generically - only a few offer proprietary specification text (e.g. NBS's NBS Plus, STABU, CSI's ManuSpec series, and NZ MasterSpec). Proprietary specification is generally left to the project specifier to resolve.

Government advice

Government agencies might be expected to serve as reliable sources of information, particularly in environmental and health assessment of chemicals. And they probably are in most cases, but it can be hard to tell which advice is reliable and which isn't. Even hard data like statistics can be used to misrepresent the case.

International authorities can disagree on fundamental issues. An example is the IARC (International Agency for Research in Cancer) system of carcinogenicity labelling, and the European system, which has resulted in some apparent conflict regarding the classification of DEHP (di[2-ethylhexyl] phthalate), used in PVC. IARC classifies it as a "probable human carcinogen" on the grounds that it is carcinogenic to rodents, but the EC has decreed that it is not a human carcinogen at all, because the mechanism by which it induces cancer in rodents is not found in humans.

Other examples (largely politically and economically driven) include the Australian government's well known position on greenhouse gases, at odds with most other countries', and the European approach to methyl bromide (an ozone-destroying pesticide). Scientific advice from governments is quite often coloured by the hue of the government of the day.

Government scientific agencies sometimes do a less-than-excellent job in providing independent advice. One example is the Australian CSIRO's report on PVC, of which the conclusions have been widely quoted (it was

even recently cited in a British architectural journal) in spite of the report's obvious flaws (aired in the journal *Chemistry in Australia*, and covered in an article by this author). A second edition of this report, purporting to take on board some of these criticisms, has now been published.

Another example is the American BEES (Building for Environment and Economic Sustainability) program, which is produced by the NIST (National Institute of Standards and Technology) (outlined below). In spite of this pedigree, it has been roundly criticised in a recent issue of *Environmental Building News*:

> "But given the gaps in the data and lack of documentation as to its sources, we certainly wouldn't suggest that anyone try to make material selection choices based on this model. A little knowledge is a dangerous thing." (EBN, May 1998, p15)

You will also find government departments disagreeing with each other - a good example is the case of motorways in Britain, heavily promoted as a good thing by the Department of Transport while being slammed by the Department for the Environment (DoT eventually conceded the point - more roads simply generate more traffic - now the departments are merged). Departments have their own turf to defend and their own cases to make, just like manufacturer and green groups.

Professional association advice
An increasing number of organisations around the world publish guidance on environmentally responsible specifying and design. Institutes of architects are quite active in this area, for example. Some of this is local, some can be used more widely (use of metric units helps - BEES [discussed elsewhere] is partly in imperial units, which is surprising given USA federal requirements for metric documentation). Examples include the AIA's *Environment Resource Guide* (unlikely to be developed further or maintained as of March 1999), CSI's magazine *The Construction Specifier*, the RAIA/BDP *Environment Design Guide*, the NZIA *Environment Position Papers*, and the Japanese BCS *Guidance for Environmentally Conscious Design* and JIA *Sustainable Design Guide* (see Appendix A).

This material can be used to assist specifiers in text preparation, and can be referred to from master specification commentary. This is much more efficient than specification organisations carrying out such research themselves. On the other hand, specifiers will probably have no control over the content, and some good and relevant material may not be readily available. Perhaps the (national) master specification organisations can carry such material on the CD-ROMs that they are increasingly using to publish their own material. Australia's CIS BuilDIR CD is to carry BMAS, an assessment system for building materials, for example. Direct (hyper) links between the (national) master specification and the environmental advice then become possible.

Increasingly, universities are offering courses in sustainable design (e.g. in the UK: University of Cambridge short course on Design for Sustainability, University of Nottingham course on Renewable Energy and Architecture, for architects and engineers), indicative of the interest in the subject. It would be nice to think that materials and components, and specification, feature in such courses. Specifiers (through their master and national master specifications) could attempt to influence the content of such courses to ensure that this is the case, and could inform other specifiers about relevant courses through their newsletters and web pages.

3.4 MATERIALS AND COMPONENTS

Product environmental assessment schemes
A number of material selection schemes are now available assessing materials against environmental impacts (see Appendix A). The schemes mostly use life cycle analysis concepts although rigorous analysis is not possible due to lack of detailed and accurate life cycle data. Each material is given a score by weighting the various impacts on the environment. The method of weighting varies between schemes.

They include the Czech "register of limits", Nordic *Building Product Declarations*, the Dutch *Environmental Preference Method*, the Swiss *Declaration Grid*, the UK's *Green Guide to Specification*, US NIBS *BPPAP* (not yet green), and Australia's *WERS* and *BES Index*. Some are outlined below.

Environmental Declarations (Finland)
The Finnish Building Information Institute is developing an environmental database of building material products drawing on life cycle analysis results from manufacturers. This database will form part of a large building material catalogue. The Institute will be developing 'Ecological criteria for building design'. These criteria are to be used as a basis for the revision of building design guidelines and for the creation of ecological profiles for building products based on life cycle analyses.

The intention is to use the profiles to develop environmentally improved building products and building concepts, rather than to compare materials as this would require a very high standard of data quality. Each product will have a declaration format. The declaration format is expected to include the environmental profiles (energy use and emissions) and consider the whole life cycle of the product. The service life of building products should be seen as an important part of ecological design.

By the end of 1998 there will be 'environmental declarations' for about 50 products for use in both Finland and Sweden. See the entry for Sweden in Appendix A.1 (translations of scheme titles are a bit inconsistent).

Environmental Preference Method (The Netherlands)
Developed in the Netherlands in 1991, the Environmental Preference Method was published in English in the UK in 1996.

The method compares building materials and building components and ranks them according to their environmental impact. It gives ‘best practical solutions’, stating a main environmental preference with a justification statement. The justification explains which issues have determined the choices made between the various alternatives. It considers environmental impact throughout the whole life cycle of a material or product, during the extraction phase (raw material), production phase, building phase, occupational phase and decomposition phase. Environmental issues considered include: damage to ecosystems, scarcity of resources, emissions, energy use, waste, reuse, life span and reparability of components.

The Green Guide to Specification (UK)
The Green Guide to Specification is an environmental profiling system for building materials and components. The system was developed by the UK's Post Office Property Group together with Davis Langdon and Everest Consultancy and Oxford Brookes University. The system assesses the likely impact of materials in seven categories:

- Use of primary energy to extract, produce and transport the material.
- Resource use.
- Reduction of natural reserves.
- Toxic pollutants resulting from manufacture.
- Emissions.
- Waste.
- Recyclability.

Under each of these categories the scheme uses a simple scoring system of A, B, or C, with A having a less adverse effect on the environment than B and C. A summary rating is given to the building component based on the individual scores of A, B, C in each category. The guide also contains information on the relative costs, maintenance requirements and replacement intervals of the different types of material. Materials and components covered are external walls, wall insulation, roof construction, upper floor construction, partitioning, paint systems, floor finishes and coverings and floor surfacing.

Building Material Ecological Sustainability Index (Australia)
The Building Material Ecological Sustainability (BES) Index is designed to assist architects, engineers, other building designers and their clients to make practical and more objective assessments of the relative environmental impacts of building materials at the design stage, before construction begins. The method considers issues over the whole of a building's life but is not a formal life cycle assessment. The BES Index scores materials on a scale of 1 (best practice) to 5 (worst practice) for a number of issues. Many of the judgements are qualitative but the scheme can be updated to incorporate an increasingly quantitative scoring methodology. The system is based on sixteen environmental parameters. These assess a building material or product in terms of

- resource depletion;
- inherent pollution; and
- embodied energy.

Parameters are assigned weightings set by a panel of experts. This provides relative values for the resource depletion and inherent pollution of a particular material or product. The embodied energy is a measure of the energy used to produce the material. The index has been used to give scores to a range of alternative building assemblies.

Life cycle analysis programs
LCA (life cycle analysis) methodology, devised in 1990 by SETAC (Society of Environmental Toxicology and Chemistry), examines the environmental impact of a product or process during production, use and disposal, tackling transportation/distribution separately. LCA generally involves four steps:

- Goal and scope definition: Purpose, breadth and depth of study.
- Inventory analysis: Identification and quantification of environmental inputs (e.g. resources consumed) and outputs (e.g. pollutants produced) for product's life cycle.
- Impact assessment: Inputs and outputs characterised in terms of a set of environmental impacts e.g. global warming, ozone depletion.
- Interpretation: Environmental impacts combined in accordance with goals.

Over the recent years many material LCA schemes have been developed and are still under development. An unpublished study by Environment Canada identified 37 LCA software tools (Hazardous Waste Branch, Environment Canada, *Evaluation of Life-cycle Assessment Tools*). Fuad-Luke (1998) reckons there were 25 software applications for LCA worldwide. Examples include the Nordic *Environmental data for building products*, the Swiss *OGIP*, Canada's *ATHENA* and *Optimise*, US *BEES*, and Australia's CSIRO *EEM*. Some are discussed below (and see Appendix A).

It is very much an evolving area with no agreed methodology or definition of the scope of any analysis. The quantity and quality of data on building materials is also likely to vary considerably from one database to another. Building components are usually compared with those with an equivalent function, for example different external wall construction assemblies. Athena, Optimise and BEES are tools which have specific building material data. Life cycle data is also likely to be country specific.

Environmental life cycle analysis is most likely to impact on building specification through material selection schemes which apply life cycle analysis methodology to the use of materials for buildings. The subject is still in its infancy and care is needed to ensure the accuracy of the data. Material selection schemes currently tend to use a simplified form of life cycle analysis. They usually produce environmental profiles rather than a single score as there is no agreed methodology for weighting environmental impacts and it is unlikely that this will be possible in the immediate future.

Pollutant release information
LCAs may be internal to a company, using information only it has access to, and released only if favourable. Independent and publicly available LCAs can be hard to do unless manufacturers are compelled to release data on environmental impacts, particularly pollutant releases. Several countries operate pollutant release and transfer inventories, including Canada, England and Wales (Chemical Release Inventory), the Netherlands (Pollutant Emission Register), the USA (Toxic Releases Inventory), and the USA states of Massachusetts and New Jersey. In these jurisdictions the data is collected and publicly released, and so the schemes are important tools for independently determining environmental impacts during manufacture. Australia (National Pollutant Inventory), South Africa, Sweden (Polluting Emission Register) and Switzerland have new systems being developed. The Czech Republic, Egypt and Mexico are designing and testing systems with UN assistance.

Following the EC Integrated Pollution Prevention Control Directive in 1996, Sweden's Environmental Protection Agency was asked to develop an outline for a European Polluting Emission Register. Their 1998 proposal is that this be implemented in three phases:

- First: known greenhouse gases, sulfur dioxide and ammonia.

- Second: CFCs, benzene, VOCs, asbestos, ethylene, heavy metals including lead, mercury, cadmium and arsenic.

- Third: long-lived organic compounds and metals due for phase out within 25 years under the Esbjerg Declaration.

Sweden reported that, in the EC, the Dutch and UK schemes were currently the best. Where schemes such as these are not available, one must often rely on information released by the manufacturers, or through prosecutions.

Netherlands
Three abridged LCA applications from the Netherlands are EcoScan 2.0, ECO-it, and IDEMAT. Each uses a common methodology called Eco-indicators, developed by the Dutch government. Ozone layer depletion, heavy metals, carcinogens, smog, pesticides, greenhouse effect, eutrophication and acidification are all considered. Depletion of raw materials, use of renewables, production of waste, landscape degredation and toxic emissions in use are not considered (Fuad-Luke 1998).

OGIP (Switzerland)
OGIP is based on the BEW research project, CRB tools, the pricing tools of the trade associations and construction plant schedules produced by SBV (Swiss Contractors' Association), and has the following aims:

- Development of a method for the combined calculation of construction costs (production, maintenance, renovation), embodied energy requirement (production, renovation), environmental impact (air, soil, water, construction waste) and energy in use (heating, warm water, electricity).

- Definition of a data model, based on the specification system and cost information at element level data provided by CRB, for materials and processes that are the subject of energy and mass flow analyses.

- Transformation of the method into a design instrument for analysing and predicting the total environmental impact of the production and use of buildings. This instrument must be able to provide calculations and assessments at every stage of design and use.

- Production of a design instrument prototype (data and applications programs) for implementation by software houses. The project is limited to the development of the instruments, testing and any necessary preparation for implementation.

- Use of the instrument as a communication aid between the parties involved in the construction process and as a design aid supporting Integral Design

ATHENA (Canada)
ATHENA is a program that focuses on common assemblies for buildings of up to 5 stories rather than individual materials. Data is taken from the analysis of individual processes and the makeup of each assembly. Different material processing practices have been taken into account on a regional and a product basis. One report (Caneta Research Inc 1997, *Environmental Assessment Tool for Multifamily Buildings*, Canada Mortgage and Housing Corporation, October) considered it to be an imprecise method which requires more validation.

Optimise (Canada)
Optimise is a program that calculates embodied energy, air emissions and other impacts associated with the materials used in construction. It uses Input/Output analysis with Statistics Canada data looking at the entire economy energy use broken down by sector and commodity. Data is therefore specific to Canada. It tracks all transfers of energy and dollars between industries and commodities, and assigns mega-joules per dollar to each commodity. This is then converted to weight and energy per unit weight.

BEES (USA)
Building for Environmental and Economic Sustainability (BEES) is a material selection tool based on life cycle analysis data, it has been developed in the USA and uses predominately USA data. Instead of requiring the user to input a full building design, it provides choices of substitutable materials. These can be compared side by side in terms of: embodied energy, global warming potential, acidification, nitrification potential, natural resource depletion, solid waste and indoor air quality for interior elements. Criticism in *Environmental Building News* has already been mentioned

4 SPECIFICATION METHODS

4.1 INTRODUCTION

There are four basic ways of specifying - by performance, by description, by brand (proprietary), or by construction method. In each case the specification text can be contained within the specification, or external i.e. in a standard or in manufacturer's literature. And in each case, verification methods should also be specified.

Performance specifying

Performance specifying will permit contractors to use innovative new, but conforming, environmentally responsible products in lieu of the standard items that might otherwise have been specified, especially if the criteria include environmental considerations such as recycled content, source certification, durability and so on. In this respect, this method of specifying is to be recommended.

The appropriate verification method is testing, which may be either by type, or project-specific. However, testing may be problematic against some green performance criteria, such as durability.

Proprietary specifying

If the specifier has gone to some trouble to research environmentally-responsible (and functional and cost-effective) products, then specifying by brand is one way to ensure that this research will bear fruit. However the contractor will almost certainly be tempted to substitute a conventional product (familiarity, cost, availability), and this should be resisted. Sound text on the management of substitutions is essential. A short list of several "equivalent" products would also assist but, for many products, green choice is limited.

Specifying construction methods

There may be environmentally friendly and environmentally damaging methods for manufacturing, fabricating and/or constructing the same item. Should specifiers dictate methods of construction in their specifications? The answer is "no", as we have seen above (under Contracts). The solution, if one is interested in this sort of thing, is to request a method statement at tender/bid, and to advise tenderers/bidders that environmental aspects of the proposed methods will be taken into consideration at the time of tender. It is quite possible that simple economic considerations will push contractors towards greener processes, if damage to the environment is dealt with under the contracts (see above) or through legislation e.g. for hazardous waste disposal.

4.2 BANS

Specifications should not rely on the simplistic solution of inserting "banning clauses" up-front e.g. "Do not use rainforest species". This unilateral excision may impress the harassed environmentally-aware project specifier (or the green client) but has some disadvantages:

- It undermines the recommendations to provide maximum choice, and to leave that choice to the project specifier.

- It may be contradicted by detailed text in the master or project specification.

- It could be overlooked in any case if not located with, in this case, text dealing directly with timber species (likely to be scattered all through the specification).

- It is too simplistic - a point acknowledged in the recent SOCOG decision to treat PVC on its merits for Sydney Olympics projects, with the result that PVC may be used in one project worksection, where there is no better alternative, but not in another, where there is one.

- It could lead to legal action by manufacturers, which is why calcium silicate bricks were taken off the blacklists (published by the British Council for Offices, for example) often incorporated in British contracts (not specifications) and why use of these blacklists in general has been reviewed (other materials banned in this way included man-made mineral fibres, lead, vermiculite, asbestos products and wood preservatives).

- It may, in a project specification, unduly limit a competitive response by the tenderers.

- It is more positive, more helpful, and more usual in a specification to state what is wanted rather than what is not.

With this in mind, "bans" in Australia's NATSPEC - regarding use of spray applied termiticide under slabs-on-ground, for example - are being removed. Nevertheless, lawyer-generated blacklists were common in British contracts (not specifications) over the 1980s. For the first time, in 1994, the British Council for Offices (BCO) "Specification for Urban Offices" placed in the public domain a list of "deleterious" materials which were not to be used in the construction of buildings. The list was suspended after complaints from manufacturers. BCO represents major developers such as British Land, Greycoat and Helical Bar.

In 1995 a calcium silicate brick manufacturer challenged a blacklisting by West Lothian District Council in court, but the ban was withdrawn before court action. Blacklists may lead to libel claims, and claims of unfair barriers to trade. Indeed the Calcium Silicate Brick Association has threatened court action if blacklists were not removed. The lawyers who write the blacklists into their contracts claim not to understand the technical reasons why the materials are listed.

To deal with this, the BCO (with Ove Arup & Partners and the British Property Federation) published "Good Practice in the Selection of Construction Materials" in 1997, which addresses 12 of the 67 materials identified by Ove Arup & Partners and the Construction Industry Research and Information Association (CIRIA) as commonly excluded in UK contracts. This guide does not ban the materials, but explains in what circumstances they might fail, and gives points of caution. BCO plans to incorporate the guide into the second edition of "Specification for Urban Offices", due 1997 [status?]. The 12 materials are as follows:

- Wood wool cement slabs.
- Vermiculite.
- Urea formaldehyde foam.
- Man-made mineral fibres.
- Lead & materials containing lead.
- Brick slips.
- Asbestos products.
- Calcium silicate bricks.
- Admixtures in concrete products.
- Wood preservatives.
- High alumina cement.
- Aggregates in reinforced concrete.

The National Council of Building Materials Producers (BMP) and the BRE (Building Research Establishment) are also tackling the problem, funded by the DOE and BMP, with the aim of scrapping blacklists altogether. BRE hasn't ruled out a guide document similar to the BCO's.

Nevertheless, the BRE has recently suggested that "a general clause prohibiting the use of materials not conforming with British Standards and other codes of practice could be included in contracts" (Cook 1997). This approach is particularly foolish because, on top of the previous arguments, there are many (new and not so new) materials for which there are no British Standards. Also, this sort of clause would stifle innovation, and could lead to further conflict, as when non-conforming (e.g. imported) proprietary items are specified. Putting it into the contract rather than the specification also takes the decision out of the hands of the project specifier, which is surely wrong. It also reinforces the argument that specifiers (master and project) and other designers do have something to contribute in the writing of contracts - lawyers are not omniscient. [Since writing this, *BRE Digest 425: Lists of excluded materials: a change in practice*, has been published and reportedly recommends inclusion in contracts of a general clause relating to materials specifications.] [more detail?]

In general, the contracts themselves should say nothing at all about construction materials and workmanship. This is the role of the specification and other contractual descriptions. Requirements in contracts on these matters tend to be simplistic, and even contradictory, and may well do more harm than good.

4.3 STANDARDS

Standards need to be used critically in specifications, not least because they are not always fully up-to-date in terms of legislative control of materials which may be detrimental to the environment or health. Examples from

Australia have included the membrane roofing Standard, which specifies asbestos-based materials, the refrigeration Standard, which specified CFCs, and the timber preservative treatment Standard, which specifies PCP, tributyl tin and organochlorines. The Standards Australia policies of adopting ISO and IEC Standards where possible, and of dropping Standards older than 15 years, will help. See Appendix A for lists of some standards used in green design and specifying.

Recycled materials
Like building regulations and contracts, most Standards assume that the products they describe will be made new. This is especially true of old-style prescriptive product Standards such as AS 1535-1975 *Moulded plastics household garbage cans*, which precludes the use of recycled resins, other than those generated by the manufacturer, in household garbage bins (there may be good reasons for this, of course). The current generation of performance Standards do not in themselves care whether materials and components are new or recycled. Even so, there are some significant problem areas, being tackled by some Standards-producing agencies.

For example, Standards are being developed for recycling e.g. of aggregates - but progress is slow (see Collins "Reuse of demolition materials in relation to specifications in the UK" and Henrichsen "Report on unified specifications for recycled coarse aggregates for concrete", both in Lauritzen 1993). There are a few standards on recycled-content materials, including plastics, asphalt and bitumen, paint, rubber and metals. A sample follows:

- BS (UK) EN 2955:1993 Recycling of titanium and titanium alloy scrap (did Gehry use this at Bilbao?).

- CSA (Canada) B182.7-97 Multilayer PVC Sewer Pipe (PSM Type) Having Reprocessed Recycled Content.

- ASTM F1760-97 Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-pressure Plastic Pipe Having Reprocessed-Recycled Content.

- ASTM D4887-89 Standard Test Method for Preparation of Viscosity Blends for Hot Recycled Bituminous Materials.

- CED (USA) TR GL-84-2 Evaluation of Properties of Recycled Asphalt Concrete Hot Mix.

- DoD (USA) TT-P-2846 Paint, Latex (Recycled with Post-consumer Waste).

- ASTM D5603-96 Standard Classification for Rubber Compounding Materials - Recycled Vulcanizate Particulate Rubber.

4.4 CONFORMANCE (ECO-LABELLING)

Third-party certification to standards is the preferred method of verification where standards are specified. An understanding of standards and conformance is vital to specifiers. In the environmental arena, conformance is increasingly demonstrated through "eco-labelling". Example of general-purpose eco-labelling schemes include the EU's *Ecolabel*, Nordic *Svanen* (Swan), Germany's *Blue Angel*, Swiss *ŠLV*, UK BRE *Ecoprofile*, Canada's *Environmental Choice* and *ETV* programs, the US *Green Seal* and *Scientific Certification Systems* scheme, and Japan's *Eco-Mark*. Some are outlined below (and see Appendix A). Single purpose schemes include the Forest Stewardship Council scheme for timber.

The international standards ISO 14020 - 25, for which Australia has the secretariat (some still at the draft stage), define three types of environmental label. Type I or third-party "environmentally preferred" labelling uses criteria set by an independent body with a simplified form of life cycle assessment. Others include Type II or first-party labelling (not discussed here), featuring claims such as ‘recyclable’ and ‘water efficient’. Type III or third-party environmental performance labelling provides a declaration of the environmental effects of a product with no fixed criteria: consumers are presented with environmental information about the product. The preference is for third-party labelling.

In Type I schemes an accredited independent third party (i.e. neither the manufacturer nor the purchaser) would assess the product in a scientific way, and judge it environmentally preferred. Only the "better" products

would be labelled. Type I schemes are multi-criteria and life-cycle based (though "full" life-cycle assessments (LCAs) aren't usually used).

Most such schemes are parochial. They include at least 10 European schemes run by the European Commission (through Directorate XI) - including Germany's *Blue Angel* scheme - and Australia's not very successful "Environmental Choice - Australia" (closed in 1994). Others include Canada's *Environmental Choice* scheme, Japan's *Eco-Mark* program, the EU *Ecolabel*, and the Nordic *Swan*. The main problem with these schemes is their lack of compatibility with each other - one cannot compare a product assessment under one scheme with a product assessment under another. The ISO standard for these schemes, ISO 14024, should ensure better inter-compatibility.

Type III labelling, of the sort offered by the USA company Scientific Certification Services (SCS), can be applied to all products, and the decision as to which product is environmentally "best" will be made by the purchaser. The label will inform the purchaser through a set of environmental scores, not unlike the approach used for nutrition labelling. SCS uses standardised criteria, objective assessment methods, and a bar chart format in its labelling.

There are some international environmental assessment schemes for products, such as those operated by the Forest Stewardship Council, currently focussed on tropical timber species. In this case the full product life cycle is not considered, so this scheme would not be an ISO Type I or Type III.

In many countries there are a number of single-attribute non-LCA environmental assessment schemes for building components. These might include energy efficiency of electrical appliances, water efficiency of appliances, energy efficiency of residential windows, and product certification for paints (taking into account VOC and heavy metal content). All might involve certification against Standards, and labelling. Much of this may be helped along through government purchasing policy. In the USA, for example, federal purchasers are required to buy products such as chillers which are in the top 25% of energy efficiency, making use of *Green Seal* certification of chillers, for example. In Australia, government purchasers support the APAS paint certification scheme, which incorporates a VOC and toxics reduction program. Some of these single-attribute schemes are quite longstanding, unlike the ISO Type schemes, which tend to be fairly recent.

The Global Ecolabeling Network
The Global Ecolabeling Network is a non-profit making association of eco-labelling organisations which aims to improve, promote and develop the eco-labelling of products and services and harmonise eco-labelling schemes. The network operates world-wide with offices in Sweden and Japan. Members of GEN currently include 14 eco-labelling organisations from Europe, Asia, North and South America.

It was founded in 1994 and participates in eco-labelling activities for the United Nations Environment Program, ISO, the World Trade Organisations and others.

Timber labelling (international)
For designers to determine whether timber has originated from a sustainable source they need reliable and independent information on the source of supply. To be sure of the source of supply certification schemes must cover every link in the supply chain, including felling, shipping, production and supply to the consumer. This has been termed the "chain of custody".

There is currently no single internationally accepted and widely adopted system of identifying whether timber comes from a sustainable source. Of the schemes that do exist, the number of suppliers that have been certified is small. However, the situation is likely to improve.

One of the most promising initiatives is the Forest Stewardship Council (FSC). The FSC has established principles for good forest management and provides independent evaluation, accreditation and monitoring of certification organisations around the world. The FSC was set up by environmentalists, foresters, timber traders, indigenous peoples' organisations and certification organisations from 25 countries. It is independent and has been strongly supported by the World Wide Fund for Nature (WWF).

There are currently four timber certification schemes that are accredited by the FSC. In the UK these include the Soil Association's WOODMARK and a scheme run by SGS Forestry. In the United States these include the

Rainforest Alliance's Smart Wood Program and the Scientific Certification System's (SCS) Forest Conservation Program. Timber or timber products which have been certified under these schemes can be considered to have originated from well managed sources. The North American Certified Forest Products Council (CFPC) supports the FSC.

The FSC has recently launched a trademark logo which appears on certified products. The directory of FSC endorsed Certified Forests World-wide lists those forests which have been certified. In some countries the number of FSC approved companies supplying timber to the building industry is small, but this will grow as more timber producers complete the certification process.

European Union Ecolabel
This is an official European Commission scheme (launched 1994) whereby an 'eco-label' is awarded to those products which have the best environmental performance within their particular product categories. The scheme is voluntary and aims to

- promote products which have a reduced environmental impact during their entire life cycle; and
- provide consumers with better information on the environmental impact of those products.

The life cycle stages of a product and the types of environmental impact for each stage are identified. From data gathered from manufacturers and others, the key environmental impacts can be identified. Criteria are then developed so that products gaining the eco-label have the lowest impact in the key areas.

Progress agreeing criteria has been slow and the only building products which currently have an eco-label are paints and light bulbs (insulation, varnishes and ceramic tiles were due for assessment). One of the disadvantages of the eco-label which is likely to affect its uptake is that it is a pass/fail system.

Nordic eco-labelling - The Swan (Svanen)
In 1989, the Nordic Council of Ministers adopted a measure to implement a voluntary, positive eco-labelling scheme in the Nordic countries. Criteria are set by a coordinating body. The award of the eco-label is assessed on the basis of

- the product's composition, energy consumption;
- waste minimisation during the production phase;
- measures to recycle the main constituent materials; and
- properties of use.

Building products which have achieved the Swan label include adhesives, chipboard, fibreboard, gypsum board, light sources, wall coverings, floor materials, wooden furniture and fitments and closed toilet systems. The label has a validity of three years.

Blue Angel (Germany)
The Federal Republic of Germany was the first country to introduce an official eco-labelling scheme. It was launched in 1978 as a single criterion scheme. It is now multi-criterion and cradle-to-grave. The scheme involves an overall assessment of a product's environmental quality relative to other products in its specified category, and highlights one or two of the product's greenest characteristics on the label. Building products covered include:

- Materials from waste paper.
- Materials made from recycled glass.
- Materials made from recycled gypsum.

- Low pollutant varnishes.
- Asbestos-free floor coverings.
- Paints low in lead and chromates.
- Low formaldehyde wooden products.
- Low-emission oil-fired boilers.
- Electrical coolants.

Building Research Establishment Ecoprofile Scheme (UK)
The Building Research Establishment is at the end of a three year project to develop reliable information on the environmental impact of construction materials. The aim of the project is to create an agreed methodology for identifying and assessing the effects of building materials over their entire life cycle. A UK National Database for the construction industry will be created. The information will be presented as an 'environmental profile', a display of the environmental parameters associated with a construction material, component or building. One parameter will be the embodied energy of the material.

The scheme is seen as an alternative to the EC Ecolabelling Scheme which operates on a pass/fail basis. The work has been funded by the Government and 24 trade organisations representing a range of manufacturers of construction materials and products including aggregates, clay pipes, PVC, timber, cement and metals.

Environmental Choice program (Canada)
Environmental Choice program (ECP) - is an eco-labelling scheme developed by Environment Canada in 1988 and now managed by an environmental consultancy firm. EcoLogo is the label awarded by the Environmental Choice program for products verified as more environmentally responsible. The EcoLogo and the Environmental Choice Program are both owned by the Federal Department of the Environment.

Products are assessed against a set of criteria which they have to achieve in order to receive the EcoLogo. The Environmental Choice uses research on the environmental impact of the product during production, transportation, use and disposal to develop the criteria. The criteria are then established in consultation with industry, environmental groups, and independent experts. The process of approving criteria also includes a public review period.

Criteria exist for the following building-related products:

- Products made from recycled plastic.
- Water-borne surface coatings.
- Solvent-borne paints.
- Composting systems for residential waste.
- Energy efficient lamps.
- Water-conserving products.
- Domestic water heaters.
- Acoustical products.
- Thermal insulation made from cellulose.
- Adhesives, sealants and caulking compounds.
- Gypsum wall boards.
- Demountable partitions.

The Green Seal (USA)
Green Seal is a national independent non-profit environmental labelling organisation that awards a Green Seal of approval to products that meet certain environmental standards (e.g. GS-11 - 1993 *Environmental Standard for Paints*). The standards are developed through a public (involving industry, government, universities, manufacturers, environmental groups, and the public) review process, use LCA, and have a performance requirement that the product work at least as well as others in its class. Over 300 products have been awarded the Green Seal. Building related products covered include windows, compact fluorescent lamps, air

conditioners, heat pumps, paints, plastics, chillers and water efficient fixtures. The organisation also publishes Choose Green Reports (e.g. for windows).

Green Seal has board members from business, public figures and leaders of major national environmental, consumer and other public interest organisations.

Scientific Certification Systems (USA)
Scientific Certifications Systems (SCS) runs a program (launched 1993) to independently evaluate and certify using LCA. The product and its packaging are included in the assessment. SCS is an independent scientific organisation based in California working in food and environmental testing and certification. To maintain independence in the certification work SCS has a policy of no ownership interest in any of the products or companies it certifies.

Products which perform in the top 20% for all significant environmental performance indicators can earn a 'certified environmental state-of-the-art' designation. Under the Environmental Claims Certification Program, a detailed investigation is conducted to determine whether first-party claims can be verified. SCS certification is issued when the claim has been shown to be valid and clearly stated, for example:

- VOC content ('no smog producing').
- Recycled content.
- Water efficiency (e.g. '10% more efficient than required by law').

The (separate) SCS Environmental Report Card is a graphical multi-attribute eco-label, and includes

- resource depletion (e.g. the amount of wood and minerals used);
- total energy use;
- air and water pollutants (include ozone depleters); and
- solid wastes (including hazardous wastes).

Building products covered include spray paints, preservative treated timber, recycled polyester fibre, wood studs and steel studs.

Eco-Mark labelling scheme (Japan)
This program (introduced 1989) is designed to promote conservation by awarding labels to products which use recycled materials, can themselves be recycled, or promote energy efficiency. It takes a cradle-to-grave approach. Building products covered include thermal insulation, and cement containing 50% blast furnace slag.

5 OTHER ISSUES

5.1 MISCELLANY

It is likely that the no-build option should become more widespread as we pursue sustainable development. This means that repair, maintenance, alterations, fitout and the like will become much more common as we stretch the life of the existing building stock, even where its aesthetic and technical quality is poor (as is so often the case). This resuscitation of existing buildings will be quite a challenge in many cases, and will pose a different class of problems (and solutions) to the reuse of heritage buildings. All of this will challenge the future specifier.

It also means that we will take more care when we do build - after all, new-build opportunities will be rarer, and the community will be saddled with the building for a very long time (if it has been properly designed for adaption and reuse, as a green building should be). This has the interesting consequence of a pursuit of high design quality, and high specification quality - no longer can we assume that a building will be demolished after only 20 to 30 years. The aesthetic *and* the technical quality of new buildings will, in the future, be higher than today. Something to look forward to.

Over specifying

Over specifying, and under specifying, is generally not desirable from an environmental point of view. Either too many resources have gone into the building to start with - the components will be far more durable than they need to be, for example - or not enough have, with the result that enormous amounts of resources will be needed later to repair or replace under-specified components. Quality levels become more critical.

Structure of the specification

A green specification looks no different to an ordinary specification. There is no need for a section titled "Environmental considerations" for example, just as there's no need for one on economic considerations or aesthetics. These matters should be dealt with throughout the document at the appropriate spot in the appropriate way. The difference will be in what is or isn't specified. This may result in the presence of some work sections not normally provided, such as Waste management or Environmental management.

Within work sections, environmental considerations can be readily fitted into the standard work section structure. Again, some subsections or clauses not normally encountered may be needed.

Design

One would hope that an environmentally responsible specification is matched by environmentally responsible design. For example, dimensioning of board-faced partitions should be based on standard board dimensions as far as possible, thereby dictating the height of suspended ceilings. This will reduce waste, time taken cutting boards down, and cost. It may be that the drawings will need to be annotated to draw these features to the attention of the contractor.

5.2 PRODUCTION AND DISTRIBUTION

Master specifications

Having helped project specifiers to design and build green buildings, it behoves master specifers to look to their own activities. General green office practices are well-known, with advice available from many sources on equipment selection and use, paper selection and use (though it now seems that recycling waste paper is not as environmentally-sound as simply burning it), and other matters. Environmentally responsible publishing is a slightly different matter.

Publishing on the Internet would enormously reduce paper consumption and fossil fuel usage (by post and courier services), though security remains an issue. Publishing on CD-ROM or diskette (or Zip disk), perhaps piggy-backing on another publication (e.g. the national architecture and engineering magazines) rather than going out in its own mailout, also saves paper and fossil fuel.

This is preferred to sending all subscribers paper versions of work sections (and their updates) they may never, or rarely, use. Instead, project specifiers will only print what they need, so lesser used work sections such as wallpapering may never be printed at all. Indeed they may not print the master specification version of any work section, working on them on-screen to produce project specific drafts before printing.

Another step that would assist in reducing paper consumption would be a switch to smaller work sections. Printing a vast concrete work section - covering in situ work, post-tensioning, precasting and so on - when all one wants to specify is precast panels is both annoying and wasteful. Small work sections make sense, at least in this respect.

Project specifications
Parallel to the exhortation to master specifiers, having designed and built green buildings, it behoves project specifiers to look to their own activities. General green office practices are well-known. Environmentally responsible development and publishing of contract documentation is a slightly different matter to publication of master specifications.

Documenting and publishing using the Internet would enormously reduce paper consumption and fossil fuel usage (by post and courier services), though security remains an issue. Increasingly project teams are interacting over the Internet, using modems, servers, extranets and intranets, and even satellites for communication. This enables offices to be remote from each other, across the continent, or overseas. So as well as being green, its more exciting!

Publishing contract documents on CD-ROM or diskette (or Zip disk) also saves paper and fossil fuel. One would have to determine whether one wants the recipient to be able to alter the text, or not.

Avoiding paper production of contract documents has some environmental benefit, though given the nature of the material most users will print their own paper copies - producing the material only in digital form merely shifts the printing from producer to user. But the users will be able to print only what they want, which may lead to some paper savings. Preparing smaller work sections would assist, as printing could be more focused e.g. for subcontracting.

5.3 USE

Verifying that what has been described in the drawings and the specification is an important part of on-site activities, and is carried out for the purchaser by the contract administrator. The specification should make clear how this verification is to be achieved. This depends on the specification method used. For performance specifying, for example, testing is required. This may be either type testing, or project-specific testing on or off-site.

Where reference has been made to standards in the specification, then third-party certification (which generally involves type-testing) is easiest. Otherwise project-specific evidence will have to be provided, which can be costly to generate and time consuming to review.

Compliance
The compliance specification - the specification submitted to the building control authorities for approval - should address environmental considerations in a number of ways. Code requirements for insulation should be covered, for a start (where applicable). As should any local authority requirements over and above the code e.g. for solar water heating, for erosion control (e.g. in national parks), noise control and so on. But perhaps most difficult, given the stage that compliance specifications are submitted, is the business of second-hand materials (a requirement at least in NSW, Australia).

Cost planning
Waste-minimising use of products and components may not be immediately obvious to the cost planner, who will otherwise allow for the usual amount of waste. Design incorporating safer construction e.g. avoidance of toxic or contentious materials, should also be brought to the cost planner's attention. The pre-tender estimates should be that much more realistic.

Tendering
Waste-minimising use of products and components may not be immediately obvious to the tenderers, either. Nor will non-traditional materials and components, which may (or may not) make the contractor's life on site much easier e.g. zero VOC paints, no synthetic mineral fibres. Drawing these aspects to the attention of the tenderers as well as cost-planners should result in a more realistic price and program. Asking for submission of

a waste-management program is also something that should be done at tender - if it is one of those aspects that will be considered.

Facility management
Just as waste-minimising use of products and components may not be immediately obvious, so environmental aspects of the finished building may not be obvious to the facilities manager. Products may have been chosen because they can be easily repaired or recycled; windows may need to be manually opened, closed, screened or shuttered under specific circumstances; floor finishes may be able to be cleaned with water rather than noxious cleaning chemicals; the toilets may have specific maintenance requirements. All of this will need to be spelt out in operation and maintenance manuals, which should be specified to the extent that they are not provided by the designers.

6 CONCLUSION

6.1 CONCLUSION

Environmental considerations will be just one of the matters routinely considered by specifiers in selecting and describing products and components. Already this is the case for many projects, and it will become easier as manufacturers and researchers provide more information on these issues e.g. recycled content, durability. One can expect the coverage of environmental standards and legislation (e.g. via building codes) to increase too. The natural environment is no longer something which can be ignored.

Specification context

The current state of affairs is a mixed bag. Increasingly, policies are forcing purchasers, specifiers and contractors to "go green and healthy". Use of environmental management systems is on the rise internationally, though there is a good chance that these will be misapplied by purchasers and suppliers, just as quality management systems have been. There is a plethora of building environmental management schemes available, but these are often national in focus, incompatible with each other, and even competing in some cases (e.g. BREEAM v LEED in the US). It is likely that the BREEAM approach - different schemes for different building types - will prevail. Evolution tends to specialisation, not generalisation. These may well be developed by different interest groups (as was the case for SEAM for UK schools).

Legislation, like policies, is forcing purchasers and so on to "go green and healthy", but it tends to be too little too late. Legislation virtually never happens proactively. There are also barriers to green specifying in some codes, particularly prescriptive codes. We are also likely to see conflict between (free) trade legislation and green legislation, which tends to be restrictive. Contracts are more of a muddle, and perhaps constitute the main barrier, even where well-intentioned. They should not say anything at all about materials, for example. There is a lot of work required to sort them out.

Sources of information

There are lots of good resources available and being developed for green design and specifying. However, advice in this area is notoriously unreliable and unstable. Many players providing advice are mainly out to protect their interests, which may be commercial or political. Ideas about what's good and what's not are changing all the time. Advice, where thorough, can also be hard to follow for harassed specifiers.

Advice is increasingly available from governments and professional associations, and through product environmental assessment schemes. Some of this is rooted in life cycle assessment programs, some of which are available for use by designers, but most of which are used by researchers. The outcome of this work is inconsistent, because the LCA tools are inconsistent. It is expected that this will soon change, to enable cross-comparison of results from different schemes and countries.

National master specifications

Many national master specification systems have greening programs in place. Some are very advanced, but none are complete at the moment. Some are waiting for funding. It is the nature of national master specifications that choices are provided, including non-green but legal alternatives. Office masters can be more thorough, excising non-green alternatives. Few masters tackle repair and maintenance very thoroughly - this must change.

National master specifications are in an unusual position of influence, representing as they do the needs of the nation's principal construction project specifiers. They should represent these needs externally, through lobbying, to influence relevant matters outside their direct control. For example, legislators, governments, purchasers, and Standards producing agencies could all be lobbied by national master specification organisations on environmental (and other) issues linked to specifying.

ICIS, too, as a coalition of national master specification organisations, could represent the needs of construction project specifiers to corresponding international agencies, such as ISO and IEC, the EC, and the OECD, and could lend its support to individual national master specification organisations tackling local entities. Consistency of approach is one thing that could usefully be argued for. ICIS could certainly be more conspicuous, as the Copenhagen Communique quoted earlier indicates, under the topic heading Standard Specification and Sustainable Building:

> "Most countries did not react to this issue directly. A number of local authorities in certain countries, including for instance Italy, have standard specifications of which sustainable building forms a part."

ICIS was evidently keeping a low profile! To counter this, copies of the previous ICIS papers were made available to the OECD programme, with a view to future co-operation.

Specification methods

Bans in specifications (and contracts) are out - tempting but problematic. Standards reflecting green and healthy requirements are on the increase, but are still in the minority. Even performance-based standards rarely address environmental issues in the criteria and tests given, but at least they don't discriminate against green solutions. Prescriptive standards, on the other hand, often do. They are sometimes trapped in a time warp. mandating the use of materials and processes long since banned for environmental reasons. Manufacturers information is muddled in this area - some have seen that recycled content is now something to be proud of, others would rather not mention it because of the implication that the product must be second-rate. Some manufacturers are out of step (one in the UK has just released a series of heavy concrete blocks, contravening H&SE manual handling requirements, for example) and some are just a little too in step (as in the pitch-polymer dpc example).

Eco-labelling is widespread, but tends to have a consumer focus. The various schemes are incompatible, anyway - some are multi-attribute, some are single-attribute, for example. It is hoped that the release of the ISO 14000 series for eco-labelling will sort this problem soon.

7. REFERENCES & FURTHER READING

7.1 LITERATURE

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7.2 ORGANISATIONS

Following is a very incomplete list of organisations mentioned in this Report.

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VTT Building Technology
Environmental Declaration
Strategic Technology Development
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www.vtt.fi

Building Information Institute
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Gemeinsamer Ausschuss Elektronik im Bauwesen (GAEB)
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STABU Foundation
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www.sis.se

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cig.bre.co.uk/waste

Building Research Establishment
Environmental profiles for building materials & Green Guide
Garston
Watford WD2 7JR
UK
www.bre.co.uk

UK Department of the Environment Transport and the Regions
Opportunities for change
www.environment.detr.gov.uk/sustainable/consult1/index.htm

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Green Building Information Council
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greenbuilding.ca/GBIC.htm

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Phone: 1 800 363 3732
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Scientific Certification Systems
1939 Harrison Street, Suite 400
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Fax + 510 832 0359
www.scsl.com

Green Seal
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US Green Building Council
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Department of Primary Industries and Energy
National House Energy Rating Scheme (NatHERS)
Energy Division
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Construction Information Systems Australia (CISA)
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www.ozemail.com.au/NATSPEC

CSIRO
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www.dbce.csiro.au

Sydney Olympics 2000 Bid Ltd
Environmental Guidelines
www.sydney.olympic.org/games_info/environment/environment.fs

Royal Australian Institute of Architects
BDP Environment Design Guide
Practice Services
Level 2, 41Exhibition Street
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VIC 3000
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www.branz.org.nz

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Asia
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The Building Centre of Japan
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iibh@mbd.sphere.ne.jp
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APPENDIX A: NATIONAL CONTEXTS

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INTRODUCTION

This Appendix comprises responses to a questionnaire prepared by Marian Kempson, then of ECD Energy & Environment, UK, and sent to ICIS members. Response was uneven, and this is reflected in the contents, which have been supplemented in some instances with other material. Survey headings are given below. Under the national responses, only those headings for which a response was given are included.

ENVIRONMENTAL ISSUES
For more on this, see Appendix E.

POLICIES

ENVIRONMENTAL MANAGEMENT SYSTEMS

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

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CONTRACTS

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PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES

LIFE CYCLE ANALYSIS PROGRAMS

STANDARDS

ECO-LABELLING

A.1 EUROPE

Czech Republic

Response from URS Praha.

ENVIRONMENTAL ISSUES
Water use.
Protection of agricultural and forestry land.

LEGISLATION
Adaptation of EU code to Czech legislation, including ISO 14001, is a continuing process which must be finished before entry to the EU. The process is continuously and systematically checked by the Czech government.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
A "register of limits" (Seznam Limitu) - a system of obligatory or voluntary environmental limits for design and construction. The classification system... [missing]

LIFE CYCLE ANALYSIS PROGRAMS
Only for mainly industrial buildings, calculated by the design firms involved in individual designs of buildings.

Finland
Response from BII.

ENVIRONMENTAL ISSUES
Energy use and associated pollution (CO_2 and SO_2).
Indoor climate (VOCs etc).
Moisture risks.
Building waste.

ENVIRONMENTAL MANAGEMENT SYSTEMS
For brick: Optiroc Oy has an EMS [ISO 14001?].
For metal: Rantaruulder Oy has an EMS [ISO 14001?].

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
Ecological criteria in buildings, ready March 1998 (see Appendix B).
Classification of indoor climate, construction works and finishing materials.

LEGISLATION
Separation of building waste into at least
- concrete, brick, ceramics etc.;
- wood;
- metals;
- soil; and
- hazardous waste.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
Environmental declarations for building products (see Sweden).

LIFE CYCLE ANALYSIS PROGRAMS
Environmental profiles of building products and the principles for assessment (see Norway).
Material and Energy Flow Estimation from building elements in the context of LCA (research report only).

ECO-LABELLING
Svanen (see Norway)

Germany
Response from Hartwig Lang, GAEB.

LEGISLATION
Everything in GREEN is handled by German Federal Law.

ECO-LABELLING
Blue Angel
See main body of Report, section 4.4.

The Netherlands
Response generally from Tom van Lieshout, STABU, and Jan-Oege Ziljstra (CROW).

POLICIES
National Environmental Plan (NMP) and explanatory note on Sustainable Building, published early 1990s.

ENVIRONMENTAL MANAGEMENT SYSTEMS
Civil engineering (CROW):
Some road building contractors are certified to ISO 14001.
Increasing use of ISO 14001.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

DUBO

The Dutch Building Industry Association (NVOB), in an effort to overcome confusion about measures required for sustainable building, commissioned the building research organisation SBR (Stichting Bouwresearch) to identify the various packages used around the Netherlands and create one national package. A wide range of building sector organisations assisted in the production of this package, the National Package for Sustainable Building (Duurzaam Bouwen Nationaal pakket Woningbouw, Nieuwbouw - DUBO for short) (it is only available in Dutch).

DUBO has been available since 1996, and was welcomed by the State Secretary for Housing, Planning and the Environment. DUBO consists of some 160 voluntary measures, and is widely accepted. It forms the basis of a voluntary covenant between industry and government (and of the greening of the STABU System - see Appendix D.1), but it is set to be incorporated in the Housing Act in due course.

DUBO focuses on the construction of new housing. There is however another document specifically for the renovation and refurbishment of housing. A separate document for utilities is being developed. All phases of the building process are covered.

SBR has also worked out the costs involved with the measures in DUBO. On the basis of these costs, the State Secretary has recommended that

- all fixed measures be applied (costing between US$750 and 1000);

- all further no-cost or cost-beneficial measures be applied; and

- other selected measures must be applied to bring the extra cost up to US$1500.

Future activities supporting DUBO include education and apprenticeship schemes in the building industry, development of a long-term vision, and an environmental rating system.

Example of the way information is presented by SBR (in NPW):

- S039 Make use of central heating or water heating with low emission of NOx.
- Type of rule Solid. [i.e. fixed, mandatory?]

SBR received a budget from the government for the development of the first edition. All further work will have to be financed from the income from DUBO subscriptions.

The measures in DUBO, each of which has a sheet of specifications, are based on the following four interests:

Materials:
- Prudent use of materials (e.g. extend the lifespan of the materials, reduce the necessity to renew materials throughout the lifecycle, use materials which are suitable for recycling).

- Environmentally conscious choice of materials (reduction of toxic emission and stimulation of the use of renewable/recyclable and secondary materials).

- Reduce the quantity of waste products during the building process and ensure safe and sensible transport of the waste products from the working site to the waste depot.

Energy:
- Reduce the demand and use.

- Promote the use of renewable sources.

Water:
- Reduce the demand and use.

- Prevent dehydration by using water-saving measures.

- Guard/protect the quality of water.

Inner environment/milieu:
- Improve air quality and thermal comfort and at the same time minimise the level of noise production.

Measures are divided into
- Part 1 - design and layout, for example energy performance, daylighting design; and

- Part 2 - technical measures and measures to be taken during implementation such as separation of site waste, specification of sustainably sourced timber, and use of recycled or guaranteed recyclable PVC.

LEGISLATION
There is legislation for a large number of health and safety issues.

Building Material Decree (Bouwstoffenbesluit)
This is a decree under the Soil Protection Act. It is designed to ensure a balance between protection of the soil (and ground water) and re-use of building materials. The most important aspects of the decree are

- leaching limits and concentration limits for inorganic compounds;

- materials used must be reported to the authority;

- testing for leaching, sampling and analysis (against cited standards);

- return of demolished materials to the owner; and

- two categories of material:
  - Category 1 materials i.e. below the first leaching limit, are free to be used.
  - Category 2 materials i.e. below the second leaching limit, must be isolated (from the soil).

This affects use of materials in substructures and roads etc., and the disposal of waste materials. [?]

Civil engineering (CROW):
Prohibition on dumping re-usable building materials.
Decree on use of building materials (above).
Agreement on use of secondary building materials (voluntary agreement between national, regional and local authorities).
Law on protection of surface water and ground water.
In development: "National Package for sustainable building in civil engineering".
Contact:
Rob Henneveld [CROW?]
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CONTRACTS
See main body of Report.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
Environmental Preference Method
For selection of materials for use in construction and refurbishment. Developed in 1991 by Woon/Energie within the framework of the SEV (Steering Committee on Experiments in Housing) program on sustainable living (Schoner Wonen). Quoting from the Introduction to the English-language edition of the book (1996):

"The Environmental Preference Method compares materials and products currently on the market and ranks them according to their environmental impact. A preference ranking has been developed for each of the construction elements in a building, ranging from wall construction through to waterproof membranes used in a roof, through to kitchen units. ... Considerations such as cost or aesthetics are not involved in this assessment.

The result is not an absolute assessment but a relative ranking based on environmental impact: an environmental preference. ...

In brief, the Environmental Preference Method considers environmental impact throughout the whole life cycle of a material or product, during the extraction phase (raw material), production phase, building phase, occupational phase, and decomposition phase ... The main issues considered in this assessment are:

- shortage of raw materials
- ecological damage caused by extraction of raw materials
- energy consumption at all stages (including transport)
- water consumption
- noise and odour pollution
- harmful emissions, such as those leading to ozone depletion
- global warming and acid rain
- health aspects
- risk of disasters
  reparability
- reusability
- waste

So far, the Environmental Preference Method has proved to be a very successful tool. Over 50% of the local authorities in the Netherlands use the original Dutch version of this handbook to draw up building guidelines. EPM is also being used as an evaluation tool in seven EU member states, for example in Thermie Building targeted projects, such as Energy Comfort 2000 projects. In the Netherlands, a large building products retailer has its line of products screened yearly using this method. In Poland an adaptation to the Polish construction market has been developed."
(Anink *et al*, 1996)

LIFE CYCLE ANALYSIS PROGRAMS
See *Environmental Preference Method*, above.

Civil engineering (CROW):
Embodied energy schemes : not yet developed.
Lifecycle analysis: will be developed.

Norway
Response from Kjell-Ivar Bakkmoen, NBR

POLICIES
Norway has special responsibility for pursuing Agenda 21, Chapter 4: Changing Consumption Patterns [Item 4.1: "This chapter contains the following programme areas: (a) Focusing on unsustainable patterns of production and consumption; (b) Developing national policies and strategies to encourage changes in unsustainable consumption patterns."] from the Rio Conference.

The GRIP Centre is one of several means towards this end (see below).

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
EcoProfile for Buildings
In 1994 the government established a branch EcoProfile Committee for the development of a national standard environmental assessment method for commercial buildings. The method developed, EcoProfile for Buildings (• koprofil for bygg), is administered by the GRIP Centre, established in 1995, and charged with following up the earlier Green Management Program and implementing Agenda 21 - particularly Chapter 4.

The method is simpler than the UK BREEAM (for example, it doesn't need to be tailored for different building types), although BREEAM can be used in Norway, by NBI (Norwegian Building Research Institute) through a joint operation directed by the European Network of Building Research Institutes.

Categories covered are as follows:

- Energy (41 variables).
  - Energy consumption.
  - Building factors (e.g. airtightness).
  - Heating (e.g. pipe insulation).
  - Ventilation system (e.g. humidifier).
  - Hot water (e.g. heater temperature).
  - Lighting (e.g. demand control).
  - Cooling (e.g. regulation).
  - Outdoor facilities (e.g. operating instructions).

- Internal climate (55 variables).
  - Materials (e.g. wall surface).
  - Ventilation (e.g. capacity).
  - Heating/cooling (e.g. sun shade).
  - Lighting (e.g. daylight).
  - Acoustics and noise (e.g. sound insulation between rooms).
  - Cleaning (e.g. easy-clean surfaces).
  - Other factors (e.g. sanitary equipment).

- Pollution (55 variables).
  - Air pollution (e.g. CO_2 g/m^2/year).
  - Water pollution (e.g. surface water).
  - Solid waste (e.g. canteen waste).
  - Noise (e.g. noise from alarms).
  - Potential pollution (e.g. control of eco-hazardous substances in building)

.
- External environment (21 variables).
  - Outdoor conditions (e.g. nature values, biological diversity).
  - Local factors (e.g. risk of flood).
  - Traffic (e.g. bike parking).

Buildings are classified in three quality levels, depending on points achieved. From this point of view the "Materials" category is interesting. For walls, for example, bottom scores are for unplaned wood plank, wood wool cement, untreated hessian/coarse textile covering, or untreated concrete. Top scores are for vinyl wall cover & laminates, glass, marble tiles, glazed tiles/bricks, wood plank - sanded with paint/stain, and painted concrete, render or plasterboard.

The EcoProfile scheme is intended to receive official recognition, to be aligned to the Svanen scheme (see below), and in time to become a Nordic rather than Norwegian scheme. The GRIP Centre issued a guide to eco-efficient management, operating, maintenance and development of buildings (GRIP Bygg-fdvu), in 1996, and a new edition of the EcoProfile guide (GRIP Bygg-prosjekt).
("EcoProfile for Buildings - Final Report EcoProfile Committee" April 1996)

LEGISLATION
Questions like energy efficiency and things like that are handled in the building codes. The use of materials like asbestos is illegal.

Disposal Act
Relates to the disposal (i.e. sale) of real property. Requires condition reports to be prepared - an EcoProfile assessment is seen as a likely component of these.

Area and Building Planning Act
With Building Regulations (Bf-97) and Internal Control Regulations.
("EcoProfile for Buildings - Final Report EcoProfile Committee" April 1996)

LIFE CYCLE ANALYSIS PROGRAMS
Environmental data for building materials in the Nordic countries
A project funded by the Nordic Council of Ministers, and involving NBI, the Norwegian University of Science and Technology, the National Building Research Institute of Denmark, Chalmers Technical College in Sweden, and the Finnish VTT (National Technical Research Centre).
("EcoProfile for Buildings - Final Report EcoProfile Committee" April 1996)

STANDARDS
NS 3424 Condition Analysis of Buildings and Plant.

Norway will ... at the forthcoming [1997] meeting of ISO TC 59 in London propose to start work upon standards which take care of environmental issues connected to building. This might for example be

- international standards for eco-profiles or environmental classes (this is much the same thinking as within BREEAM);
- environmental assessment methods; and
- eco-profile on building products: declaration of energy use, resource use, and handling when demolished.

Durability and other questions concerning products will (hopefully) be handled within the product standards.

ECO-LABELLING
Svanen
In 1996 wall boards and floor coverings were the only building materials which had been licensed under the Svanen (Swan) voluntary Nordic (i.e. Scandinavian) environmental mark. The responsible agency, SMN (Stiftelsen Milj**Ý**merking i Norge - Environmental Marking Foundation in Norway) is developing product-specific criteria documents based on scientific data. See also Report, section 4.4.
("EcoProfile for Buildings - Final Report EcoProfile Committee" April 1996)

Sweden
Response from SBC.

ENVIRONMENTAL ISSUES
Transport and energy use.
Ozone depletion.
Energy production - long term effects.
Air pollution (SOx).
Land pollution (NOx).
Sea pollution (from farming).

ENVIRONMENTAL MANAGEMENT SYSTEMS
There are a few building material manufacturers with ISO 14001 and EMAS certification. The larger construction companies will be using ISO 14001 as the management systems. NCC [who?] will be certified in 1999-2000.

Approximately 10% of industry is currently certified to ISO 14001 and this is increasing rapidly.
EMAS and various quality/management schemes are also used.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
Contact Jerker Lorssan, HWL Arkitekt AB, Stockholm.

On-going research to achieve a broad system, several attempts by various commercially based ‘interests’ i.e. concrete, wood, steel etc.
Contact Mauritz Glauman.

LEGISLATION
Yes, both legislative and voluntary codes.
Contact Danielle Freilich, Byggentieprenererna, Stockholm.

Several exist in PBL (Building Laws) and RL (Waste Laws) specifically to exclude dangerous and hazardous materials.

Ecology Bill (1992/93: 180)
"What is taken from nature must be capable of being sustainably used, re-used, re-cycled or disposed of with the minimal use of resources and without damage to nature."

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
Building Products Declarations
Responding to a 1994 government-appointed ecology delegation decision to make producers responsible for building products, the Swedish building sector groups (developers & owners, designers, contractors and manufacturers & suppliers) formed the Ecocycle Council for the Building Sector. The Council decided on an action plan which included a number of specific measures, in particular Building Product Declarations.

These are environmental versions of MSDSs (Material Safety Data Sheets). These are intended to make known the composition of materials and components, and their (external and internal) environmental impact over their life cycle, in a standard format. In terms of the ISO 14000 series ecolabelling standards, the Declarations are first-party claims of Type II (i.e. to ISO 14021). Because it is felt that full life-cycle analysis is not yet possible, information in the Declarations will initially be qualitative. Eventually this information will be replaced with quantitative data. Through Nordic cooperation, 4000 Building Products Declarations were due to be ready by December 1998.

Main headings are as follows:

1 Constituent materials
1.1 Raw materials/input goods
1.2 Additives
1.3 Recovered materials
1.4 Origin of raw materials/input goods

2 Production
2.1 The production process

3 Distribution of the completed building product
3.1 Production area/country
3.2 Transport method
3.3 Methods of distribution
3.4 Packing

4 The building phase
4.1 Building production
4.2 Adaptation of building products

5 Usage phase
5.1 Operation
5.2 Maintenance
5.3 Length of life

6 Demolition
6.1 Dismantling

7 Waste products
7.1 Re-use
7.2 Material recycling
7.3 Energy extraction

8 Products to tip
8.1 Tipping

9 Indoor environment
9.1 Allergenic substances
9.2 The building process
9.3 Self emissions
9.4 Surrounding materials
9.5 Basic data for stipulations as per 9.4 for surrounding materials
9.6 Operation & maintenance
9.7 Sound level
9.8 Electrical and magnetic fields
(Ecocycle Council for the Building Sector 1997)

LIFE CYCLE ANALYSIS PROGRAMS
Contact Chelmers [Chalmers?] Institute of Technology (and see Norway).
Plus several schemes at similar institutions with more limited goals and scopes e.g. concrete, wood, steel etc.

ECO-LABELLING
Svanen
(see Norway)

Switzerland

LEGISLATION
Until now, energy efficient design has been based on Standard SIA 380/1 "Energy in Building Construction" and the related statutory requirements concerning heating energy requirements.

Environmental legislation has also induced public sector clients to address the environmental issue, leading e.g. to the launch of the ÖLV project (February 1993).

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
The Swiss Society for Engineers and Architects has a standard "declaration grid". [for materials and components?]

LIFE CYCLE ANALYSIS PROGRAMS
OGIP '98: Life cycle impact assessment and building specification
Sandro Heitz , t.h.e. Software GmbH, Karlsruhe

The decision to take the building as built as the pivot of product modelling means that the description of a building has to be process based (building process, operation process) and object based (construction elements). The link to existing catalogues of building specifications as a basis for process description and to existing cost and simple energy calculations is presented and discussed.

Introduction:
One of the major areas of interest in our work is the life-cycle analysis of buildings "as built" and "as being planned" and especially the impact on the environment during the lifecycle of the building such as production of construction products, construction, use, renewal and demolition.

The model we develop is based on predefined components which are described by materials, processes and information about their structure. These components are represented in a uniform way but in different scales such as systems, parts and details. The scope of the model extends from buildings as one unit, parts like walls and ceilings, to details like connections or cables.

The second goal is to provide the architect or engineer with an easy to use software which enables him to compute the energy and mass flow of an given building project by describing the building in predefined building elements and their quantities (walls, ceilings, windows). This software is called "OGIP`98".

Catalogue:
The CRB is providing catalogues of building specifications (NPK) and derived from this a catalogue of building elements (BEK, Berechnungselemente-Katalog). The main goal of these catalogues is to support cost-targeting. These catalogues are widely used in the Swiss building industry and are the base of standardization in the Swiss market.

- CRB building specifications

The catalogue of building specifications holds approximately 50,000 different entries. Each of these entries describes one of these 'atomic' units which are referenced during calculation and accounting. The goal of the catalogue is to give support for cost calculation and cost targeting, the description of these building specifications and the materials and work is in a way which is useful not only in respect to costs, but also in support for energy- and mass flow (E+M) analysis.

Examples: The catalogue from CRB holds one entry which is giving the costs for delivery and mounting of a window. The costs given are related to the size of the window but there is no information about the mounting materials (mounting foam, screws,etc.). However this missing information is necessary for doing energy and mass flow (E+M) analysis of buildings.

- BEK elements

Since using these atomic units is getting quite complex and difficult to handle if many of these building specifications are involved, CRB is also providing a catalogue of pre-configured building elements with approximately 18,000 entries.

Each of these entries describes a complete and more complex element (e.g. one square-meter of concrete wall, thickness 11.5 cm, including concrete form, coating etc.) by assembling these elements out of building specifications and their relative quantities per element.

The level of building elements is the appropriate level of detail in order to describe complete buildings for doing energy- and mass flow analysis. Once a building is given by a list of building elements and their quantities, it's possible to generate a list of all building specifications and their quantities by using the catalogue.

- Transformation

Since the building elements as given by the CRB catalogue are holding information necessary for cost calculation but not all the information necessary for E+M analysis (not enough data about materials, machines, waste etc.), the missing data have to be added. Some of these additional [data] are: machines (which type of machine, duration of use), exact details about materials or additional things like nails, screws, glue, foam (exact quantities) and information about transports, the waste being generated and average life expectancy.

Some of these [data] are implicitly given by the description of the building elements, some are hidden in the description of the building specifications. In any case there must be a person to extract the hidden information from the given description and to transform the description of building specifications given by the CRB into a more detailed machine-readable form. This transformation can be stored in a database management system.

OGIP Research Project
The OGIP project "Electronic Instruments for the Integral Design of Buildings" started in 1994.

Funding: Federal Coordination Group For Energy and Ecological Assessment (see above).

Project management: University of Karlsruhe (ifib).

Other project partners: Aarprojekt AG (building data), ETHZ - Institute for Energy Technology, Zürich (ecological inventories and materials data), CRB (system tools and construction-specific data)

Aims:
OGIP is based on the BEW research project (see below), CRB tools, the pricing tools of the trade associations and construction plant schedules produced by SBV (Swiss Contractors' Association), and has the following aims:

- Development of a method for the combined calculation of construction costs (production, maintenance, renovation), embodied energy requirement (production, renovation), environmental impact (air, soil, water, construction waste) and energy in use (heating, warm water, electricity).

- Definition of a data model, based on the specification system and cost information at element level data provided by CRB, for materials and processes that are the subject of energy and mass flow analyses.

- Transformation of the method into a design instrument for analysing and predicting the total environmental impact of the production and use of buildings. This instrument must be able to provide calculations and assessments at every stage of design and use.

- Production of a design instrument prototype (data and applications programs) for implementation by software houses. The project is limited to the development of the instruments, testing and any necessary preparation for implementation.

- Use of the instrument as a communication aid between the parties involved in the construction process and as a design aid supporting Integral Design

Product outline:
E+M (energy and mass flow) data are supplied to users together with CRB element cost data (BEK); apart from cost indicators, every "calculation element" also has E+M parameters and additional data for assessing energy in use.

The E+M interpretation program is an independent program for use only in connection with the cost calculation software. The cost calculation prepared for the building or building part (using CRB cost data) is imported into the E+M interpretation program and, using the breakdown of this cost calculation, the relevant E+M data are accessed to produce an analysis of resources consumed, resulting emissions (in the context of certain effects, e.g. greenhouse effect, ozone depletion) and resulting waste. Historical E+M data from completed projects are also integrated to provide reference values.

The energy in use assessment program is an independent program using data on energy in use and the breakdown of cost calculations to produce an energy assessment based on Recommendation SIA 380/1.

The energy and mass flow data are divided into three packages:

- E+M Base package for new construction (aggregated data for manufacture and transport of materials and waste).

- E+M Additional Package 1 for renovation (aggregated data for manufacture and transport of materials, use of machines and waste).

- E+M Additional Package 2 for demolition (aggregated data for use of demolition machines, transport and waste).

For each package, small, medium and large data collections will be available to allow varying degrees of adjustment from standard calculation elements to project-specific features.

Applications:

- Using the BEK data the project is described and a cost calculation prepared.

- Using the E+M data and the project description items, the environmental impact and energy in use assessments are prepared.

- The results are compared with threshold or target values; BEK items may be substituted to allow experimentation with various scenarios

- The BEK and E+M values may also be used as input for other programs (e.g. for assessment of the operating costs of building services)

- Historical cost data (CRB's Catalogue of Historical Rates) are also supplemented by E+M and energy in use data for completed projects for use in the early design phases of new projects.

E+M building model database:
The database model (or product model) is separated in three parts: construction elements, construction products and machines. The DBMS applications are: transforming catalogue elements to DBMS entities; transforming building specifications to related DBMS entities; aggregation and analysis; writing output files of results and exchange files, which will be used in the software "OGIP`98" and delivered to engineers and architects by an CD-ROM.

The following input files exist in the E+M building model database:

- The E+M transformation file is produced by analysis of CSD items, which are sorted into E+M-relevant and non-E+M-relevant; E+M relevant CSD items are transformed into E+M items by breaking them down into "item parts" ("things") and finally into material units; supplementary information (lifespan, direct waste etc.) may be added.

- The construction product file facilitates transformation of CSD items into E+M items by direct referencing to construction products (semi-products, components, connectors) which are also transformed into E+M items.

- The inventories (of ETHZ and HAB) show all the resources and emissions of a construction material from the extraction of the raw material to its incorporation into the building (approx. 900 values); they are to be supplemented by information on waste category, density and thermal conductivity.

- Interface files: material designations from CSD items are referenced to the material designations of the inventories; there are two interface files, one for manufacture and one for disposal.

The following application modules exist for the E+M building model database:

- Aggregation: at the level of "item parts", for E+M analyses of components or building elements. The following aggregations are possible at present:

    - New construction: covering all materials necessary for the production of a construction element, including reusable and non-reusable ancillaries.

    - Site waste during new construction: direct waste such as offcut.

    - Use of machines on site: machine times can be converted into litres of fuel or kWh of electricity; machine materials cannot as yet be integrated into the calculation due to lack of relevant data.

    - Renovation and replacement: by allocation of typical lifespans to building elements, CSD items etc. continuous wear and ageing can be allowed for. Energy and mass flows for each renovation cycle for the whole lifespan of the facility are calculated taking account of the manufacture of the replacement parts, direct waste, machine use etc.

- Decomposition, as the second step, involves breaking down the aggregations for the item parts (e.g. the sum of all screws in a building part) into constituent material(s) and inventories; this involves the implementation of the interfaces. The results are passed on to the compressor.

- By means of compression the results can be summarised in various ways (e.g. to show total materials quantities or total resource consumption and emissions), but only for one aggregation type (i.e. new construction or site waste etc.) at a time.

- Formatting may take place after compression to allow assessment of the results in the light of a particular method (e.g. CML method, Eco-Indicator '95).

Further potential:

- The OGIP method may be integrated into diagnostic methods for building renovation, i.e. extended to building surveying and facility management. We are now in the stage of proposing a new project on European level (EUREKA perhaps) with one major goal: integration of OGIP and DUEGA (diagnostic method for building renovation) to enable the user on a strategic level to decide on more information than only cost targeting.

- Since it allows environmental impact assessments at the level of building parts, components and materials, the OGIP method may be implemented as a service to provide environmental impact assessments for manufacturers and suppliers of building components.

- Production of special data for research purposes.

- Implementation by other users than architects and engineers (e.g. facility managers, quantity surveyors, environmental experts).

- Use in other European countries.

BEW Research Project
Funding: Federal Coordination Group For Energy and Ecological Assessment comprising EMPA (Swiss Federal Laboratory for Materials Testing and Research), BEW (Federal Energy Office) and AFB (Office for Federal Construction Facilities).

Project management: EPF Lausanne (LESO) and University of Karlsruhe (ifib).

Other project partner: University for Architecture and Construction (HAB), Weimar.

Energy and mass flow (E+M) analyses for construction materials, components and buildings are the basis for developing design aids to ascertain and minimise the environmental impact made by construction activity and building use. In 1993, the BEW Research Project "Energy and Mass Flow Analyses for Buildings over their whole Lifespan" was completed. The various stages analysed were: preliminary stage (energy provision and construction materials manufacture), construction process, use, renovation and waste disposal; the data for buildings comprise base process data (energy provision and transformation, transport, disposal) and construction process data (production, renovation and disposal of construction elements).

KOBEK
Method for combined calculation of energy requirement, environmental impact and construction costs in early project stages, managed by ifib (University of Karlsruhe).

REGENER
Regional planning for the development of renewable energies, managed by ifib (University of Karlsruhe).

STANDARDS
SIA 380/1 "Energy in Building Construction".

United Kingdom

POLICIES
Opportunities for Change
Refer to main body of Report, section 2.2.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
BREEAM
Refer to Report, section 2.4.
About a third of all office designs are assessed using BREEAM, according to John Doggart of ECD Energy and Environment Ltd (1996). BREEAM and its derivatives are applied to other building types. Assessment issues are given below for some of them.

BREEAM 98 for Offices: Pre Assessment Checklist
Management:
- Client commitment to commissioning.
- Client environment policy.
- Client environmental purchasing policy.
- Client environmental management system.
- Operating manuals on site.

Health & wellbeing:
- Cooling towers: None, or maintainable.
- Minimise risk of Legionella in hw system.
- 30% plus windows openable.
- No steam humidification.
- Air intakes avoid external pollution, and spaced 10 m plus.
- Trickle vents, or 30% plus fresh air in HVAC.
- Daylighting to 80% plus offices.
- Controllable blinds.
- High frequency ballasts to office luminaires.
- Lighting levels to BCO Specification.
- Modular lighting control.
- Views from workstations.
- Local temperature control.
- Cooling towers: None, or to HSG 70 & TM 13.
- Thermal comfort levels used in services design.
- Ambient noise levels below 40/45 dB.
- Maintenance to HVCA Standard for HVAC, lighting and hw systems.
- Hot water system: To TM 13, or safety survey and risk minimisation.
- Smoking ban.
- High performance cleaning of carpets & soft furnishings.
- Collection and evaluation of feedback.
- Improvement targets for user satisfaction.

Energy:
- Total CO_2 emissions between 0 and 160 kg/m^2/year (points scored vary with level).
- Sub-metering for lighting, computer room, catering facilities, humidification and cooling plant, fans.
- Check-metering for tenancy areas.
- Client energy policy to GPG 186.
- Energy audits every 3 years.
- Quarterly release of information on energy use.
- Energy/CO_2 monitoring.
- Energy/CO_2 targeting..
- Movement towards energy/CO_2 targets.
- Energy consumption better than good practice in DETR ECON 19.
- Maintenance schedules and records, for heating/cooling.

- Maintenance schedules and records, for lighting.

Transport:
- Location: National transport node best, rural worst (points scored vary).
- Good public transport connections, car parking 20% below local authority requirement.
- Bicycle sheds, showers and changing.
- Use of private cars discouraged for commuting.
- Use of private cars discouraged for business.
- Good public transport access, and 15 min service to town centre.
- Good public transport access, and 30 min service to major transport node.

Water consumption:
- Water consumption up to 20 m^3/person/year (points scored vary with quantity).
- Water meters.
- Leak detection system.
- Proximity detection shut-off in toilets.
- Maintenance schedule and records for water systems.
- Quarterly water consumption monitoring.

Materials:
- Asbestos: None, or surveyed & removed/contained/identified.
- Storage for materials with access, between 2 and 10m^2/1000m^2.
- Upper floor slabs, external walls, roof, windows: 80% plus of area achieves an A rating to Green Guide to Materials Specification.
- Main timber from sustainably managed sources.
- Timber for panel products from sustainably managed sources.
- Reuse of facades 50% plus.
- Reuse of structure 80% plus.
- Crushed aggregate or masonry in structure, roads etc.
- Client policy for collection and recycling of office consumables.
- Information on hazardous materials.

Land use:
- Site was built on or industrial in last 50 years.
- Site contaminated and contained/cleaned pre-construction.

Ecology:
- Site of low ecological value.
- Change in ecological value (points scored vary with change).
- Enhancement advice followed, from Wildlife Trusts or IEA member.
- Existing trees, hedges, ponds, streams etc maintained and protected during construction.

Pollution:
- Refrigerants: None, or zero ozone depletion potential.
- Refrigerant leak detection system, or no refrigerant.
- Automatic refrigerant pump and isolation valves, or no refrigerants.
- Fire fighting systems halon free.
- NOx emissions from boilers in burner plant up to 200 mg/kWh (points scored vary with level).
- Runoff to watercourses reduced 50%, and site treatment provided.
- Insulants: No ozone depleting substances used or contained.
- Maintenance schedule and records for boiler/burner systems, to HVCA Standard.

Environmental Standard: Homes for a greener world
Carbon dioxide production due to energy consumption.
Low-energy lighting.
Gas cooking.
CFC and HCFC emissions, from insulants.
Timber, reused or from well-managed, regulated sources.
Renewable, non-renewable and recycled resources:
- Over 50% use of products containing over 50% waste or by-product material, in walls, flooring, roof covering.
- Re-use of bricks or stone in walls.
- Use of demolition materials in hardcore etc., and crushed concrete aggregate in foundations etc..
- Timber frame construction.

Storage of recyclable materials.
Ecological value of the site - using brownfield sites, minimising ecological damage, enhancing site ecology.
Water economy - 6L WCs, rainwater collection.
Hazardous materials:
- Formaldehyde emissions, from insulation, particleboard, fibreboard.
- Wood preservatives, minimised, and factory-applied.
- Asbestos free.
- No paints with added lead.
- Daylighting to kitchen and habitable rooms.
- Containment of thermal insulation material in lofts.
- House log book and operating manual.

Schools' Environmental Assessment Method (SEAM)
Site selection for new buildings
Sources of hardwoods and softwoods
Low NOx combustion equipment
Use of recycled materials in new buildings
Ozone-depleting chemicals
Volatile organic compounds
Lead-free paint
Lead pipework in existing schools
School grounds
Recycling facilities and waste disposal
Ventilation
Lighting
Water economy
Water quality
Legionellosis
Asbestos in existing buildings
Health and safety
Maintenance
Energy (CO_2) rating
Energy management
Home-to-school transport policy
School environmental policy

LEGISLATION
See Report, section 2.5

CONTRACTS
See Report, section 2.6.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
The Green Guide to Specification
See Report, section 3.3.

STANDARDS
Standards cited in BREEAM (various) include the following:

Mechanical services
HVCA Standard Maintenance Specification for Mechanical Services in Buildings

Lighting
BCO Specification for Offices
BS 8206: Part 2: 1992 *Lighting for buildings - Code of practice for daylighting*

Sanitary
BS 6465: Part 1:1994 *Sanitary installations - Code of practice for scale of provision, selection and installation of sanitary appliances*

Cooling towers
HSG 70 (cooling towers)
TM 13 (cooling towers, hot water system - Legionella)

Energy
GPG 186 (energy policy)
DETR ECON 19 (energy consumption)
BRECSU 1994, *The Government's Standard Assessment Procedure for energy rating of dwellings (SAP)*, BRE

Materials
Green Guide to Materials Specification
BS 882 - 1983 *Specification for aggregates from natural sources for concrete*
BS 1142: 1989 *Specification for fibre building boards*
BS 5250 *Code of Practice for control of condensation in buildings*
BS 5268 *Structural use of timber* (various Parts)
BS 5617: 1985 *Specification for UFFI systems suitable for thermal insulation of cavity walls with masonry or concrete inner and outer leaves*
BS 5618: 1985 *Code of practice for thermal insulation of cavity walls by filling with UFFI systems*
BS 5669: 1989 *Particleboard* (various Parts)
BS 6543:1985 *Guide to use of industrial by-products and waste materials in building and civil engineering*
BS 8208: Part 1: 1985 *Guide to suitability of external cavity walls for filling with thermal insulants*
Forest Stewardship Council: timber certification
BRE 1983, *BRE Digest 276: Hardcore*
BRE 1991, *BRE Digest 363: Sulphate and acid resistance of concrete in the ground*
BRE 1994, *BRE Report: Thermal insulation: avoiding risks*

ECO-LABELLING
BRE Ecoprofile Scheme
See Report, section 4.4.
The UK Ecolabelling Board, under DETR, was to be wound up in 1998, and a new advisory panel was to look at how to take the EU eco-labelling scheme forward.

A.2 NORTH AMERICA

Canada

Response prepared by Ian Z. Bartlett.

ENVIRONMENTAL ISSUES

At this time we do not have a comprehensive answer for this question.

ENVIRONMENTAL MANAGEMENT SYSTEMS

ISO 14000

The application and use of ISO 14000 is currently in the education and promotion stages. Much of this work is being done by the Canadian Standards Association (CSA).

To our best knowledge, the construction industry is not actively pursuing ISO 14001. The more predominant trend is for construction companies to integrate elements of environmental management into their occupational health and safety practices and programs. For example, a number of companies are combining specific environmental management roles, such as waste diversion and training on waste diversion systems, with occupational health and safety systems.

While certain sub-sectors of the building material industry are likely implementing environmental management systems, this trend is largely in response to requests from other customers outside of the construction industry (e.g. clients in the automotive sector). Those building material companies that are implementing an EMS consistent with the requirements of ISO 14001 are, generally speaking, the leading edge companies who see a competitive advantage from marketing their products as environmentally preferable products; many of these companies would be participants in the Environmental Choice program.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

BEPAC and The BEPAC Foundation

BEPAC - Building Environmental Performance Assessment Criteria.

The Building Environmental Performance Assessment Criteria (BEPAC) is the first comprehensive method for evaluating the environmental performance of both new and existing office buildings in Canada. BEPAC evaluates the environmental merits of office buildings and is incentive oriented to guide and encourage the market to value more environmentally responsible practices and higher performance standards. It is voluntary in its application and offers a certificate of design and management performance for office buildings and their tenancies. The initial version, designed for new and existing office buildings in British Columbia, was released in December, 1993. Regional variants have subsequently been developed for Ontario and Atlantic Canada to take account of regional diversities.

Background

Building Environmental Performance Assessment Criteria (BEPAC) is a comprehensive, standardized approach to evaluating the environmental performance of office buildings. Dr. Raymond Cole developed BEPAC at the Environmental Research Group, School of Architecture, University of British Columbia (UBC), modeled on the British Research Establishment Environmental Assessment Method (BREEAM). The BEPAC program distinguishes between design and management criteria for both the base building and the tenancies. The criteria of BEPAC are covered in four modules:

- Base Building Design;
- Base Building Management;
- Tenancy Design; and
- Tenancy Management.

BEPAC evaluates buildings spanning the global, local and interior environment in the following topic areas:

- Ozone layer protection;
- Environmental impact of energy use;
- Indoor environmental quality;
- Resource conservation; and
- Site and transportation.

BEPAC have developed a series of linked spreadsheets for the five topic areas to standardize the assessment procedure and facilitate subsequent monitoring. These spreadsheets record the information, make the calculation involving the credits, and report the results in numeric and graphic form.

The goal of BEPAC is to provide a holistic method of evaluating buildings with respect to their impact on the global, local and indoor environments. The objective of BEPAC is to guide and encourage the buildings market to take major steps in introducing more environmentally responsive practices. The program is voluntary in its application, and offers a certificate of design and management performance for buildings and their tenancies. BEPAC is owned and governed by the BEPAC Foundation, a not-for-profit, national corporation responsible for the care and control of BEPAC. The BEPAC Foundation is headquartered in Vancouver, with regional offices in Halifax, Montreal, Ottawa, and Toronto.

BEPAC is not currently active as a commercial real estate marketing tool. BEPAC's executive director Peter Horvatis reports that the BEPAC Foundation has been struggling to raise the needed funds to develop and promote its materials. Using volunteer time, the Foundation is currently developing assessment tools for internal use by building owners and managers. Horvatis welcomes the BREEAM initiative (see below) as another forum that will help promote the value of environmental assessments to real estate executives and building owners.

BREEAM Canada
The Building Research Establishment Environmental Assessment Method (BREEAM) developed in the U.K. is now available in Canada. BREEAM is a voluntary rating system that assesses the energy and environmental performance of commercial buildings. The program has been available since 1993 in the U.K. and since then has become available in several countries in the Asian Pacific.

Building owners and managers use the ratings to help their buildings stand out in the marketplace. BREEAM was officially adopted by the Canadian Standards Association on December 6, 1996 as CSA Publication Plus #3211 and is administered in Canada by the environmental consulting firm ECD Energy and Environment Canada.

The first BREEAM Canada certificates were awarded to Enterprise Property Group for three properties, and to Oxford Development Group and Nexacor Realty Management Inc. for one property each.

In addition, CANMET and Ian Cook Construction received the certificate for Green on the Grand, the first building produced to Canada's C-2000 specifications.

Green Building Challenge '98
The Green building Information Challenge ‘98 ... is now necessarily a scheme used to assess all buildings in Canada [and] it is an important initiative.

Green Building Challenge '98 is a two-year program of international building performance assessments which aims to inform on advances in green building performance and to test and demonstrate an improved method for measuring building performance. The project has been initiated by Canada, but is being carried out in partnership with representatives from eleven other countries, who form an International Framework Committee. These countries include Austria, Denmark, Finland, France, Germany, Netherlands, Norway, Poland, Sweden, the UK, the USA, and Japan.

An assessment framework is being developed

- for the assessment of case study projects presented as part of Green Building Challenge;
- as the basis for a second-generation 'green design guideline'; and
- to provide the basis of a second-generation tool for building ecolabelling for further development.

Buildings covered are: offices, schools and multi-unit residential buildings.

There are six performance categories:

- Resource consumption i.e. energy, land, water and materials.
- Environmental loadings i.e. airborne emissions, solid waste, liquid waste.
- Indoor environment i.e. air, thermal, visual and acoustic quality and controllability of systems.
- Longevity i.e. adaptability and maintenance.
- Process i.e. design and construction and building operations planning.
- Contextual factors i.e. building location and its immediate context.

Each category has a set of performance criteria and sub criteria which tend to be building and region specific. All performance is assessed against a benchmark set by national teams. Criteria are weighted by country-based panels of experts.

A performance profile is produced in graphical form, which illustrates the relative performance in each of the major categories. There is no single overall score.

LEGISLATION
Our impression of the questionnaire is that you are more concerned with legislation affecting the design and construction of buildings, as opposed to their operation. For this reason, we have not included legislation relating to wastewater discharges, hazardous waste transportation and disposal requirements, air emissions, etc.

The use and application of the environmental legislation and voluntary codes which affect building specifications in Canada is growing as the environmental awareness of building owners, designers and builders increases. Some examples of the building legislation and voluntary codes available in Canada are as follows:

National
Canadian Environmental Protection Act

Canadian Environmental Assessment Act

Canadian Labor Code
There are proposed amendments to the Canadian Labor Code Part II (occupational health and safety) that addressed the issues of proper operation, maintenance and documentation of the building ventilation system and a requirement for the employer to deal with IAQ complaints, no date for when amendments will be passed.

Indoor air quality:
There are no regulations on buildings except, of course, that it should not be worse than an industrial environment which then falls under occupational health and safety regulations

Auditor General Act:
Federal Government Departments must report annually to the House of commons on their progress in advancing sustainable development. The first report was due by December 31, 1997.

Regional
Ontario
- Environmental Protection Act, Ontario Regulation 101/94: Recycling and Composting of Municipal Waste
- Ontario Regulation 102/94: Waste Audits and Waste Reduction Workplans
- Ontario Regulation 103/94: Industrial, commercial and Institutional Source Separation Programs
- Ontario Regulation 104/94: Packing Audits and Packaging
- Ontario Regulation 105/94: Definitions (Amendments to Regulation 347) Municipality of [?]

Municipal
Waterloo, Ontario
Engineer Environmental Procurement Pilot Study, prepared by the Engineering Department Waste Management Division, Industrial commercial & Industrial Waste Reduction Unit. Developed to examine the purchasing behaviors of the Region so that an effective model could be designed to promote environmental procurement.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
Environmental Technology Verification (ETV) Program
The Environmental Technology Verification (ETV) program is an initiative designed to accelerate the growth and marketability of the Canadian environment industry. The Program builds on Canada's reputation by emphasizing our capabilities and credibility in the environmental market and is an important step in reversing Canada's negative trade balance for environmental technologies.

The ETV Program provides validation and independent verification of environmental technology performance claims. A voluntary program, the ETV initiative has been developed to promote the commercialization of new environmental technologies into the market place and thus provide industry with the tools to address environmental challenges efficiently, effectively and economically.

The Program was developed by Environment Canada (the lead department) in cooperation with Industry Canada and in consultation with the Canadian environmental industry. The Program was one of the key initiatives of the Canadian Environmental Industry Strategy.

Environmental technology vendors apply to the program for verification of the claims they make concerning the performance of their environmental technologies. If the claim is verified, the company is issued three documents:

- Verification Certificate.
- Technology Fact Sheet.
- Final Verification Report.

It is also entitled to use the ETV logo (subject to guidelines issued by ETV Canada) to market their technology in Canada and abroad. Besides suppliers of technologies, suppliers of equipment-based environmental services (where performance of equipment can be verified) are eligible to apply for verification.

What is verification? The assessment and validation by an independent third party of a supplier's technology performance claim.

Participation in the Program is voluntary.

ETV Canada Inc. delivers and administer the ETV Program under license from Environment Canada. Specifically, it is accountable for:

- day-to-day responsibility for ETV Program delivery;
- overall management and leadership functions;
- financial management on a cost recovery basis;
- marketing and promotion;
- coordination of technical expertise to complete verification;
- awarding verification certificates
- monitoring use of verification certificates;
- addressing conflict of interest and confidentiality issues; and
- general administration of the Program.

The ETV Program does not deal with "green" consumer products which are addressed by Canada's Environmental Choice Program™.

LIFE CYCLE ANALYSIS PROGRAMS
CSA Z760-94 Life Cycle Assessment.

ATHENA and Optimise
See Report, section 3.3.

STANDARDS
CSA Z762-95 Design for the Environment.

Indoor air quality
Canadian Standards Association: CSA Z204-94 Guideline for Managing Indoor Air Quality in Office Buildings.
The guideline defines acceptable indoor air and provides methods to help achieve acceptable IAQ in office buildings, throughout the conception, design, construction, commissioning, operation, and maintenance stage.

Canadian Carpet Institute: They have a voluntary labeling scheme going on for carpets that addresses only the indoor air quality issue and none of the others such as waste disposal, etc.

ECO-LABELLING
Environmental Choice™ Program
The EcoLogo™ is the recognized seal of approval of the Environmental Choice™ Program (ECP), Canada's only national and comprehensive eco-labeling program. The Environmental Choice Program was established in 1988 to encourage the demand for and supply of products and services that are more environmentally responsible, and to help consumers make informed choices in favour of the environment. Today, the EcoLogo can be found on a broad range of household, commercial and industrial products and services. All consumer products and services have varying degrees of environmental impact, but those certified by the Environmental Choice Program help reduce the burden on the environment. Generally this means using less energy than conventional products, reducing harmful emissions and by-products, using recycled materials or reusability.

The Environmental Choice Program establishes stringent environmental criteria against which products, goods, services and technologies are assessed. The development of criteria for any given product begins with research on the environmental impact during production, transportation, use and disposal. Certification criteria are established in consultation with industry, environmental groups, and independent experts. This process of approving criteria also includes a public review period.

Criteria are based on the latest scientific, technical and market information available, and allow only environmentally preferable products and services to be certified. Today, the Program counts over 100 product certification criteria.

If criteria have yet to be developed for a particular category, a panel of independent experts relies on criteria for comparable products, up-to-date research and life-cycle review to establish appropriate certification criteria. Alternatively, for those products which do not have a set of guidelines, an independent panel of experts recommends applicants to the Environmental Choice Program on the basis of submitted documentation. This way, unique products and leading-edge technologies can also be evaluated to determine if they are indeed environmental leaders in their fields.

Third-part Certification: In order to have a product certified, companies must demonstrate that their product meets the relevant certification criteria. Generally, they must be made or offered in a way that uses less energy, reduces harmful emissions and by-products, uses recycled materials, or can be re-used.

Testing and verification against specific environmental criteria is conducted on a cost-recovery basis by qualified auditors to ensure that products comply with the stringent environmental, performance and quality control requirements.

Company Licensing: Companies whose product successfully passes the testing and verification stage are licensed to use the EcoLogo. Once licensed, companies can use the EcoLogo on packaging and in conjunction with promotional and marketing activities. They can also participate in the Environmental Choice Program's

marketing media and advertising campaigns, or can partner their own efforts with those of the Program. Annual license fees are charged to participating companies on the basis of their certified product sales.

The advantages of ECP Certification are:

- The EcoLogo is the Government Seal of Approval for products verified as being more environmentally responsible. The EcoLogo and the Environmental Choice Program are owned by the Federal Department of the Environment, which provides considerable marketplace credibility.

- All EcoLogo labeled products offer guaranteed performance and value. They must meet established industry standards for safety, performance and must stand up to any products in their class in order to bear the EcoLogo.

- Major retailers and specialty shops throughout Canada carry a variety of EcoLogo products and services, which can meet consumer needs in such areas as the following:

    - Building, grounds and construction.
    - Cleaning products.
    - Paints and surface coatings.
    - Appliances.
    - Automotive products and lubricants.
    - Marine products.
    - Non-commercial and consumer products.
    - Office products.
    - Paper products and printing services.
    - Plastic products and plastic film.
    - Systems and technologies.

EcoLogo labeled products are gaining in preference of institutional buyers and consumers because they display a credible mark of environmental leadership. They can trust the EcoLogo because the criteria that stand behind the logo are developed using a transparent, science-based process relying on the latest technical and market information available.

The ECP program is managed and delivered by TerraChoice Environmental Services Inc., through an exclusive licensing arrangement with the Federal Department of the Environment.

United States of America

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

US Green Building Council: LEED (Leadership in Energy and Environmental Design)

LEED is a whole building assessment scheme managed by the USGBC. It is designed for new and existing commercial office buildings and hi-rise residential. Other buildings will be covered under a separate rating system. Following is the summary of the rating system:

Tally Sheet:
Applicants must meet all of the Prerequisites as well as score the requisite number of points in the desired LEED Building™ category.

A total of 44 credits, plus 4 bonus credits is available. Bonus credits may be counted toward certification.

0. LEED Building Platinum™: for buildings that earn 81% (35) or more of the available credits.
1. LEED Building Gold™: for buildings that earn 71-80% (31-34) of the available credits.
2. LEED Building Silver™: for buildings that earn 61-70% (27-30) of the available credits.
3. LEED Building Bronze™: for buildings that earn 50-60% (22-26) of the available credits.

In addition, the USGBC will present an award for the "Green Building of the Year" for the LEED Building™ with the highest score of the year.

Prerequisites (11):

- Asbestos Avoidance or Management.
- Building Commissioning.
- Elimination of CFCs.
- Energy Efficiency.
- Erosion Control.
- Indoor Air Quality.
- Smoking Ban.
- Storage & Collection of Occupant Recyclables.
- Thermal Comfort.
- Water Conservation.
- Water Quality - Lead.

Building Materials (7 Credits):

- 1 or 2 Credits for low VOC materials:
  (1 credit for 1 or 2 measures; 2 credits for 3)
  (a) Limit VOC content in adhesives.
  (b) Limit the VOC content in architectural sealants.
  (c) Limit the VOC content in paints and coatings.
- 1 Credit for use of local materials.
- 1 Credit for resource use.
- 1 Credit for advanced resource reuse.
- 1 Credit for recycled content.
- 1 Credit for advanced recycled content.

Construction Waste Management (2 Credits):

- 1 Credit for management plan.
- 1 Credit for advanced management plan.

Energy Efficiency (7 Credits):

(Note: points are NOT additive, except for Heat Recovery, Natural Ventilation and Bonus Credit)
- 1 Credit for
  - EPA Green Lights Partnership; or
  - California Title 24 Lighting.
- 2 Credits for
  - EPA Energy Star Building Certification; or
  - Exceeding ASHRAE 90.1 by 20%.
- 3 Credits for exceeding ASHRAE 90.1 by 30%.
- 4 Credits for exceeding ASHRAE 90.1 by 40%.
- 5 Credits for exceeding ASHRAE 90.1 by 50%.
- 1 additional Credit for Natural Ventilation, Heating and Cooling.
- 1 additional Credit for Waste-Heat Recovery System.

Renewable Energy (3 Credits):

- 1 Credit for 10% of building energy from on-site renewable sources.
- 2 Credits for 20% of building energy from on-site renewable sources.
- 3 Credits for 30% of building energy from on-site renewable sources.

Existing Building Rehabilitation (2 Credits):

- 1 Credit for maintaining 75% of the structural shell when renovating and existing building.
- 2 Credits for maintaining 100% of the structural shell when renovating an existing building.

Indoor Air Quality (3 Credits):

- 1 Credit for construction IAQ management plan.
- 1 Credit for advanced construction IAQ management plan.
- 1 Credit for permanent air monitoring system.

Landscaping (3 Credits):

- 1 Credit for erosion control
- 1 or 2 Credits for reducing heat islands: (1 Credit for 1 or 2 measures; 2 Credits for 3)
  (a) Shade cover.
  (b) Reflective roofing materials.
  (c) Reflective surface.

Occupant Recycling Equipment (1 Credit):

- 1 Credit for occupant recycling systems and equipment.

Ozone Depletion/CFCs (2 Credits):

- 1 Credit for eliminating CFC, HCFC and Halon use in mechanical and fire suppression.
- 1 Credit for eliminating CFCs and HCFCs in building materials.

Siting (3 Credits, plus 1 Bonus Credit):

- 1 Credit for reduced habitat disturbance or building rehabilitation.
- 1 Credit for site restoration.
- 1 Credit for infill development or building rehabilitation.
- 1 Bonus Credit for brownfield development

Transportation (3 Credits, plus 1 Bonus Credit):

- 1 or 2 Credits for alternative transportation facilities:
  (1 Credit for 1 or 2 measures, 2 Credits for 3 measures)
  (a) Bicycle racks.
  (b) Shower and changing facilities.
  (c) Transit and pedestrian-facility physical linkages or carpool parking.
- 1 Credit for efficient building location.
- 1 Credit for alternative fueling facilities.

Water Conservation (4 Credits):

- 1 Credit for water-conserving fixtures.
- 1 Credit for gray water recovery system.
- 1 Credit for water-conserving cooling towers.
- 1 Credit for water efficient landscaping.

Water Quality (2 Credits, plus 1 Bonus Credit):

- 1 Credit for surface runoff filtration.
- 1 Credit for surface runoff reduction.
- 1 Bonus Credit for biological waste treatment.

LEGISLATION
See Report, section 2.5.

Federal regulations
The U.S. Environmental Protection Agency (EPA) Environmentally Preferable Purchasing (EPP) Program is charged with carrying out Executive Order 12873 (10/93), "Federal Acquisition, Recycling, and Waste Prevention," which directs Executive agencies to reduce the environmental burdens associated with the $200 billion in products and services they purchase each year, including building products.

"... an Executive Order [#12902] [was] signed by President Clinton to have the Federal Government procure products that are in the top 25% of energy efficiency. Lawrence Berkeley National Laboratories is making a study to determine what that means. ... Attached are copies of materials from a program ... for the US Federal Government agencies "Buying Energy Efficient Products" guide. Included in the materials is a copy of a description of the program and some sample product guidelines."

"... a new Federal Acquisition Regulation ... mandates post-consumer reuse materials for Federal projects ... contractors and architects/engineers must certify to using a certain percentage of this kind of recycled material for all projects after a prescribed date."
(Mike King, ARCOM)

"In the U.S. federal agencies are mandated, again by Executive Order, to procure "environmentally preferable products (EPP)", when available; but there is great ambiguity and confusion as to what this precisely means." (Alexander Shaw, NIBS BPPAP)

CONTRACTS
See Report, section 2.6.

PROFESSIONAL ASSOCIATION ADVICE
AIA ERG
"The American Institute of Architects has published and updates a document titled "Environmental Resource Guide". This document IS a major project focussed on the subject. ... It is my opinion that this is the kind of effort ICIS could support. It appears to be a very labor intensive project, requiring lots of research and documentation. This [ERG] is a worthwhile project. ICIS must begin by deciding how to approach it. I hope the first intermediate objective is to decide how ICIS members can help fulfil the need. Maybe ICIS can contribute to AIA's ERG. ICIS may also be able to identify additional needs not addressed by the ERG. And then decide how International Construction Information Society can fulfil them." (Mike King, ARCOM)

Construction Specifications Institute
" ... CSI has been a member [of the U.S. Green Building Council] for the last two years. During that time I have served as CSI's representative to the Council. In November 1997 I was elected to the Board of the U.S. Green Building Council. The CSI *Monograph Series* and *SpecGuides* [some of which dealt with environmental and OHS issues] were discontinued by CSI's Board of Directors due to lack of sales and interest. We were experiencing great difficulty in finding members who wanted to volunteer the large amount of time necessary to create one of these documents. At the same time that the Board discontinued these series of documents they also authorized establishment of a Task Team to study possible replacements for them recognizing that these were truly member-driven programs. The task team is expected to deliver a report to the Board sometime during the coming year.

The goal you noted for fiscal year 1996 [to "have programs, products or services which encourage the use of construction materials that protect the environment and conserve resources"] was superceded by a new set of goals with an achievement date of FY 2000. Generally these goals do not include a specific environmental reference but several of the goals are general enough to have environmental considerations plugged into them." (Ross Spiegel, CSI)

The CSI's journal *The Construction Specifier* regularly carries articles on environmental and health issues. A good recent examples were the April 1998 issue, which had a special focus on the environment, with articles on BEES, BREEAM, life-cycle assessment, environmentally responsible lighting, site cleanup, and renovation safety planning, and the March 1999 issues (articles on adaptive reuse, contaminated sites, indoor air quality and an LCA for precast concrete panels). CSI also organises conferences and seminars on environmental and health issues, the *A Green World* symposium being a good example.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES

NIBS Building Product Pre-Approval Program (BPPAP)

"... NIBS [National Institute of Building Sciences] is getting new incentives to include environmental considerations in their BPPAP. ... [which] ... will eventually include guidelines and criteria for product recommendations relating to environmental issues. " (Mike King , ARCOM)

"I understand [that] environmental issues ... have begun to drive the NIBS-managed federal BPPAP, more than the purely technical, at least as far as the Feds are concerned." (Thomas Young, SmithGroup architects)

"BPPAP is a program using technical committees composed of federal agency specification writers to identify and document construction products meeting the performance requirements of federal specs. Once product requirements are identified and manufacturer's test reports documenting performance are obtained the pre-approved product lists will be published. ... We are attempting to create a pilot project to use the BPPAP process and committee structure to further the general understanding of environmental preferability and to advance the state-of-art in defining EPP ("environmentally preferable products") in various product categories. Greening of BPPAP is an opportunity which we are trying to take advantage of, but it is most definitely a secondary priority to address "performance requirements"." (Alexander Shaw, NIBS BPPAP)

LIFE CYCLE ANALYSIS PROGRAMS

BEES

The National Institute of Standards and Technology (NIST) Green Buildings Program began the Building for Environmental and Economic Sustainability (BEES) project in 1995 to facilitate the process of identifying environmentally and economically balanced building products. BEES is a systematic methodology implemented in decision support software for selecting building products that achieve the most appropriate balance between environmental and economic performance.

The BEES model is implemented in publicly available decision-support software, the first version of which is available and contains environmental and economic performance data for 24 building products. The goal is lowered building-related contributions to environmental problems at minimum cost.

The BEES methodology is claimed to be practical, flexible, consistent, and transparent. It measures environmental performance using an LCA approach, following guidance in the ISO 14040 series of draft standards for LCA. Economic performance is separately measured using the ASTM standard life-cycle costing (LCC) approach (ASTM E 917). These two performance measures are then synthesized into an overall performance measure using the ASTM standard for Multi-Attribute Decision Analysis (MADA) (ASTM E 1765). For the entire BEES analysis, building products are defined and classified according to UNIFORMAT II, the ASTM standard classification for building elements (ASTM E 1557). (Lippiatt 1998)

STANDARDS

Standards

"... about environmental legislation and standards affecting materials selection and building specifications. My intuition from a mechanical engineering point of view is to look into ASHRAE activities relating to Standard 90.1 "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings," Standard 90.2 "Energy Efficient Design of New Low-Rise Residential Buildings," and "Standard 62 "Ventilation for Acceptable Indoor Air Quality." These ASHRAE standards are American National Standards (ANSI) and have been written in "code-compliance language" to make them easy to incorporate and enforce by building codes and building officials (at least, that is the theory)." (Mike King, ARCOM)

USGBC is also involved in the preparation of the ASTM (American Society for the Testing of Materials) Standard Practice for Green Buildings.

Standards or Regulations Referenced in LEED:
Asbestos
OSHA Asbestos Regulations, in 29 CFR Part 1926 Safety and Health Regulations for Construction

Building Materials
South Coast Rule #1168-South Coast Air Quality Management District
Regulation 8, Rule 51, Bay Area Air Quality Management District
Title 7, Chapter 27, Subchapter 23 -- New Jersey State Department of Environmental Protection

Brownfield Development
EPA OSWER Dir. 9610.17
ASTM Standard Practice E1739: Site Remediation

Building Commissioning
GSA "Model Commissioning Plan and Guide Specification"
Bonneville Power Administration "Building Commissioning Guidelines-2nd edition" PECI

Energy Efficiency
ASHRAE/IES 90.1-1989 "Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings"
DOE's "International Performance Measurement and Verification Protocol" (IPMVP)
California Energy Commission "California Title 24 Lighting" Sacramento
US EPA "EPA Green Lights Requirements" Washington DC
US EPA "EPA Energy Star Buildings Requirements" Washington DC

Erosion Control
Maryland Model Erosion and Sediment Control Ordinance - Sections 4.2 e & f
Maryland Model Stormwater Management Ordinance-Section 6 (Group 2)
Maryland Department of the Environment, Water Management Administration-Nonpoint Source Program

Indoor Air Quality
ANSI/ASHRAE 62-1989 "Ventilation for Acceptable Indoor Air Quality"
Sheet Metal and Air Conditioning Contractors National Association (SMACNA) "IAQ Guidelines for Occupied Buildings Under Construction" Chantilly
ANSI/ASHRAE 52.1-1992 "Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter" (filters providing 85% filtration)

Thermal Comfort
ANSI/ASHRAE 55-1992 "Thermal Environmental Conditions for Human Occupancy"

Water Conservation
Energy Policy Act of 1992-Plumbing Fixture requirements (42 USC Section 6295 (j))

Water Quality
EPA Publication # 812-B-94-002: "Lead in Drinking Water in Schools and Non-Residential Buildings," April 1994

ECO-LABELLING
Green Seal
Refer to main body of Report, section 4.4.
"Apparently, the Feds (DOE, EPA) are presently trying to decide between the Green Seal certification program and a program out of California."
(Thomas Young, SmithGroup architects)

Scientific Certification Systems (SCS)
Refer to main body of Report, section 4.4.

A.3 AUSTRALASIA

Australia

Response provided by Deborah Singerman of CIS Australia.

ENVIRONMENTAL ISSUES

These points generally reflect the areas the federal government aimed to address with its major initiatives announced in last November's "climate change" package (see "$180 million climate change package").

The ACT identified water resources, air quality, greenhouse gases and urban amenity (e.g. noise and overall quality of design).

Architect David Oppenheim identified water pollution, blue green algae, uranium mining and forests.

Architect John Gelder identified soil erosion (from excessive land clearing for agriculture), contamination of river systems (from agricultural runoff), salinity of river systems (from irrigation), loss of old-growth native forest and biodiversity (clearing for development and agriculture, and silviculture), reliance on coal for electrical energy generation (renewables are scarcely used though they are plentiful), and excessive low-density development (i.e. sprawling suburbia).

These reflect general comments about environmental concerns in Australia such as the need for more environmentally benign sources of energy than coal burning, the need for better transport planning and land use, improved water and air quality, water and waste management and disposal, and problem of contaminated sites.

POLICIES

Federal government

The Prime Minister, John Howard, announced an A$180 million package November 1997. The relevant departments are the Department of the Environment, Department of Primary Industries and Energy, and the Department of Industry, Science and Tourism. "Implementing national energy efficiency codes and standards for buildings, appliances and industrial equipment" is the only initiative with direct implications for the building and construction industry.

Response to this initiative has been mixed. The following report is from *the construction newsletter*, 8 December 1997:

> "Proposals to expand the Nationwide House Energy Rating System (NatHERS), to develop energy efficiency codes and standards for commercial buildings, and the implementation of the international Cities for Climate Protection program through local councils are the key changes affecting the industry.
>
> Responses vary mainly on whether the first two should be voluntary or compulsory. The expanded NatHERS will include a minimum energy performance requirement for new housing and major extensions, integrated with relevant approval processes.
>
> But both NatHERS and the proposed energy efficiency codes and standards for new and substantially refurbished commercial buildings will remain unregulated for the next 12 months. If this approach is not effective by the end of that period, the Federal Government promises to work with state and territory governments and industry to implement mandatory standards through the Building Code of Australia."

State or territory appendices override the Building Code of Australia, so implementation of "mandatory standards through the Building Code of Australia" is by no means a foregone conclusion. For more on this, see the information and contacts for NatHERS and Tony Isaacs, the contact for VicHERS and ACTHERS.

Another useful contact at policy level is the environment protection group, Environment Australia.

Energy Victoria
Energy Victoria runs a program currently called Energy Smart Companies, which is soon to be renamed, Energy Smart Business. Please see attached brochures and information. Phase 2 of the program, due to be introduced in March, will mean that for a fee Energy Victoria representatives will assist companies wishing to set up an energy efficient program.

The Electricity Supply Association of Australia
ESAA has just released revised environmental policies and new guidelines covering 29 environmental issues. The code, policies and guidelines are supposed to be accessible via the association's website, www.esaa.com.au but they were not up on 26 February. Also see a recent report on NSW EnergyAustralia's Pure Energy program, which only operates in NSW (as far as we know).

Sydney Olympics
Sydney Olympics 2000 Bid Ltd - Environment Guidelines for the Summer Olympic Games, 1993.
Mandatory for this project. The 1997 annual report from Green Games Watch 2000 includes a review of Olympic Projects against the Environmental Guidelines.

- Conservation of species: flora & fauna, people.
- Pollution control: air, noise, light, water, soil, waste management.
- Conservation of resources: water, energy, construction materials, open space, topsoil.
  e.g. construction material: "That OCA developments minimise the use of materials which deplete natural resources or create toxic pollution in their manufacture, use or disposal."

Waste management
We have heard of two waste management schemes - the RECON Environmental Program, and the WasteWise Construction Program established by the Australian and New Zealand environment and Conservation Council (ANZECC).

Department of Public Works and Services (NSW)
The Department has policies governing biodiversity, materials, pesticides, timber and waste. On pesticides, for example, the policy states:

> " New buildings: No chemical pesticides and termiticides are to be used on any project managed by the Department. Preventative treatment is to be by physical means and by careful design to minimise the risk of pest infestations."

On materials, Department policy says:

> " In line with the above it is DPWS policy to direct and encourage the use of materials and products which
>
> • adequately and economically perform their intended functions, and also have lower adverse environmental impacts throughout their life cycle (e.g. manufactured with lower pollution and waste emissions and less energy);
>
> • contain reduced or nil hazardous substances;
>
> • reduce the demand for rare and non-renewable resources (e.g. rainforest timbers); and/or
>
> • are made from or contain recycled materials or can be recycled at the end of their useful life."

Royal Australian Institute of Architects
Published 1995, the policy is based on five principles:

- Maintain and, where it has been disturbed, restore biodiversity.
- Minimise the consumption of resources, especially non-renewable resources.
  - Resources.
  - Built form.

  - Designing for durability.
- Minimise pollution of soil, air and water.
  - Greenhouse gas emissions.
  - Ozone depletion.
  - Generally.
- Maximise the health, safety and comfort of building users.
  - Construction.
  - Built form.
- Increase awareness of environmental issues.

The policy is non-mandatory, and is supported by an increasing number of notes in the EDG subscription system (currently around 80). The RAIA also operates a built environment education program for primary and secondary schools, which tackles sustainable design as well as other design issues.
(RAIA 1995 "Environment Design Guide Gen 1: RAIA Environment Policy" RAIA, February)

National Greenhouse Response Strategy, 1992

National Pollutant Inventory

DIST Housing Construction Waste Report

MBA Solar Heating & Cooling Program

ANZECC Wastewise Construction Program

Building Energy Council of Australia

Queensland
1995 $35 million promoting sustainable energy use.
1996 Waste Management Strategy.
Register of Contaminated Sites.
1997 Built Environment Protocol.
Brisbane River Management Group on phasing out of sand & gravel dredging.

Victoria
1995 Renewable Energy Assistance program.
1995 Energy Smart Companies Program.

ACT
1995 Environment Policy e.g. water action strategy.

NSW
SEDA/Greenlight Energy Smart Homes Program.
DUAP Model Code for urban structures.
Waste Reduction Program.
1995 Sydney Electricity/Pacific Power Commercial Building Energy Efficiency Program.
1995 Armidale City Council, loans for home insulation.
1995 New England Electricity, loans for purchase of energy efficient equipment.

ENVIRONMENTAL MANAGEMENT SYSTEMS
AS/NZS ISO 14001:1996 *Environmental management systems - Specification with guidance for use*

This has been trialled in Australia, though it is not yet widely used. A search on the March 1997 CD-ROM version of the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) Register of Accredited and Certified Organizations revealed that only one company in the building/materials sector was certified to ISO 14001. The company is:

Wesfi Pty Ltd - Wesboard Division
Dandanup
West Australia

It is a manufacturer of particleboard (reconstituted wood panel) and low pressure melamine panels. The certification was from Bureau Veritas Quality International.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
ESDAM - ESD Assessment Model
Set up by architect David Baggs.

Royal Melbourne Institute of Technology
RMIT Department of Building and Construction Economics is working on an energy-related environmental assessment of buildings. We understand that the Department's Peter Graham is a member (Australian representative) on the International Energy Agency Annex 31, which was set up in 1995 to consider energy - related environmental impact of buildings.

National House Energy Rating Scheme (NatHERS)
Developed by Unisearch, University of New South Wales, and available from the Energy Division, Department of Primary Industries and Energy. It is endorsed by the Sustainable Energy Development Authority, NSW. It is aimed at residential building designers, and local councils. Only the initial stage has been launched.

Scoring methodology:
Performance simulation software (NatHERS) uses a bandwidth rating (5-star rating), giving overall performance.

Effort and training:
Software training and code of practice

Certification:
SOLARCH informs us this is from the HERS Management Body, though according to Energy Victoria, there is not an 'official' HERS Management Body as such. SOLARCH is still probably the best contact for this.

ISSUES COVERED BY THE SCHEME	COMMENTS
Building in use issues Energy of building in use/carbon dioxide emissions	Heating-Cooling load (no CO_2)
Ventilation	Part of overall performance

This scheme should become a national compliance scheme during 1998 (see information from *the construction newsletter* under 'Environmental legislation, standards or voluntary codes').

ACT House Energy Rating Scheme (ACTHERS)
A joint development to achieve results under the National Greenhouse Response Strategy initially by the Department of Primary Industries and Energy on behalf of COG which commissioned ANZMEC (Australian/New Zealand Minerals and Energy Council) to produce a national system. The ACT worked with the Victorian Government to develop a software package, ACTHERS, which in effect is a customised version of the House Energy Rating (HER) Software Package.

Available from Energy Victoria (Tony Isaacs), and accepted by NBEECC (the National Building Energy Efficiency Coordinating Committee) as satisfying the requirements of NatHERS. It is now legislated under The Land (Planning and Environment) Act 1991 of the ACT (Tony Isaacs is on the NBEECC).

Aimed at new residential, town houses, waste management plans, and all larger developments. All larger developments must achieve a minimum energy rating in all new constructions (according to Tony Isaacs, this minimum in the ACT is 4 stars, though certain exemptions are accepted for 3 star buildings).

Scoring methodology:
Yes, on the software, ACTHERS, giving an overall score.

Effort and training:
Must attend a user training course. Must become an accredited user of the ACTHERS software.

ISSUES COVERED BY THE SCHEME	COMMENTS
Building in use issues Energy of building in use/carbon dioxide emissions	ACTHERS
Lighting	ACTHERS
Ventilation	ACTHERS
S*ite issues* Waste disposal	Normal condition of approval for other than single/dual occupancy/residential

House Energy Rating (HER) Software Package
Developed by and available from Energy Victoria (since about 1994). Because ACTHERS has been accepted by the NBEECC (the National Building Energy Efficiency Coordinating Committee) as satisfying the requirements of NatHERS, we imagine HER has.

Aimed at residential builders, designers, architects and planners. Recent change to the BCA allowing four star rated home to be traded off against the Insulation Regulations in Victoria may increase HER's use.

Scoring methodology:
Yes, on the software, HER giving an overall score, with 5 stars being the most energy efficient.

Effort and training:
Advanced user training is available and highly recommended.

LEGISLATION
Building Code of Australia
See Report, section 2.5.
The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board on behalf of the Commonwealth government and each state and territory government. The BCA is a uniform set of technical provisions for the design and construction of building and other structures throughout Australia. It allows for variations in climate and geological or geographic conditions.

Each state and territory's legislation adopts the BCA subject to variations or deletion of some of its provisions, or the addition of extra provisions. These variations, deletions and additions are in Appendices to the BCA.

The Victoria Appendix mandates thermal insulation in certain classes of building, and the ACT Appendix mandates energy conservation e.g. through thermal insulation, in certain classes of building.

ACT Part F6 Energy efficiency:
"A building, including carpets and internal fittings, must achieve an annual energy consumption rate for heating and cooling not greater than 255 MJ/m^2 based on the ACT climate zone."

Vic Part F6 Thermal insulation:
"A residential building must have a reasonable level of thermal insulation to conserve energy used for internal heating and cooling."

CFCs and halons
Controlled through national legislation, the Ozone Protection Act 1989, which was enacted after the signing of the Montreal Protocol. The Act has been modified since 1989. Commonwealth legislation controls the import, export and manufacture of ozone-depleting substances, and each state and territory has its own legislation to control the sale, purchase and use of ozone-depleting substances. Contact AFCAM (Association of Fluorocarbon Consumers and Manufacturers) and AIRAH (Australian Institute of Refrigeration, Air Conditioning and Heating).

Termiticides
Controlled through registration/deregistration with the National Registration Authority for Agricultural and Veterinary Chemicals (the NRA). Organocholorines have been deregistered.

Asbestos and SMFs
Use of asbestos is banned via occupational health and safety legislation in each state and territory. Removal of asbestos is controlled via a Worksafe Australia document, Asbestos - Code of Practice and Guidance Notes, Handling and disposal of asbestos (1988). Handling of synthetic mineral fibres is also controlled - see Worksafe Australia document, Synthetic Mineral Fibres - National Standard and National Code of Practice.

Paints: solvents and heavy metals
National Drugs and Poisons Schedule Committee "Uniform Scheduling of Drugs and Poisons No 10 ; Appendix P: Uniform paint standard ". NDPSC is a committee of a national umbrella organisation, the Health and Community Services Ministerial Council (HCSMC). The standard is updated four times a year, and issued every September.

Australian Capital Territory (ACT)
Runs the ACT House Energy Rating Scheme (ACTHERS) - see above.

No legislation but the ACT Government supports material recycling of demolition waste and larger developments often require an Environmental Impact Assessment to address the issue of waste recycling, energy efficiency and waste management once the building is constructed.

New South Wales
The Environment Protection Authority (EPA) administers a range of legislation and provides information on the industry waste reduction provisions of the NSW Waste Minimisation and Management Act 1995.

The University of NSW's Building Research Centre and the Housing Industry Association have a A$100,000 grant from the EPA to help the NSW government implement its waste reduction targets by the year 2000. The 12-month project will quantify waste generated from selected housing sites. The waste audit will establish the type of waste and the value of its constituents generated during various stages of housing construction. As well as identifying the causes of waste generation, the researchers will devise strategies, test them in special trials, and initiate a waste management strategy for the building sector.

The NSW Government Agency, SEDA (Sustainable Energy Development Authority) has a number of schemes. The main ones for the building sector are:

- Energy Smart Homes.
- Energy Smart Buildings.
- Energy Smart Allies.

Queensland
We have been advised that there is no specific environmental legislation relating to the building and construction industry.

South Australia
Limited, if any, legislation. The Environmental Protection Agency only mentioned a Machine Noise Policy e.g. no construction machinery before 7 am Monday-Friday, and 9 am weekends, and all machines must stop by 6 pm every day of the week.

There are laws on illegal waste going into stormwater drains, and local monitor such measures as the hosing down of buildings to avoid excessive dust.

Tasmania
Disposal of demolition wastes have to conform to the Environmental Management and Pollution Control Act 1994.

CONTRACTS
See Report, section 2.6.

PROFESSIONAL ASSOCIATION ADVICE
RAIA (Royal Australian Institute of Architects) Environment Design Guide
Soon to become the BDP (Australian Council of Building Design Professions) EDG, recent releases include the following:

- Life-Cycle Energy Analysis.
- Using School Buildings to Teach Environmentally Sustainable Design.
- Light pollution.
- The National House Energy Rating Software (NatHERS).
- Domestic wastewater.
- An Introduction to Ground Source Heat Pump Systems.
- An Overview of Operational Energy Minimisation Technologies from Green Building Challenge '98.
- Lead Hazards in Construction.
- Homebush Newington Village.
- RAS Horse and Cattle Pavilions.
- WWW: Some Energy/Environment/Products Sites.

PRODUCT ENVIRONMENTAL ASSESSMENT SCHEMES
Window Energy Rating Scheme (WERS)
Developed by the Australasian Window Council (AWC), SOLARCH, CSIRO Division of Building, Construction and Engineering, and BRANZ, the Building Research Association of New Zealand. It is available from the AWC (Ian Frame, Executive Director). AWC has a list of members (window manufacturers) which are participating in WERS. Aimed at manufacturers of residential windows.

Scoring methodology:
Computer simulation, giving an overall score, with 5 stars being the most energy efficient.

Certification:
WERS certificate and sticker.

TimberSure (termite control)

Woodmark (timber preservative treatment)

LIFE CYCLE ANALYSIS PROGRAMS
Building Material Ecological Sustainability (BES) Index
Developed by and available from Harry Partridge, Partridge Partners, or Dr Bill Lawson, SOLARCH, University of New South Wales. The scheme is aimed at architects, engineers, building designers, and clients. Harry Partridge told us that they had sold 60 copies of the BES Index but he has had no feedback.

Embodied Energy Module
Developed by and available from Dr Selwyn N Tucker, CSIRO Division of Building, Construction and Engineering. The scheme is aimed at architects and other designers; only at prototype stage at the moment.

Embodied energy is calculated from all objects in a CAD drawing using embodied energy values from Input-Output tables and process analysis. The total is both comprehensive and uniform in approach. The method

includes embodied energy calculations/lifecycle analysis for components, whole buildings (derived from components), materials (linked to components), and elements.

The calculation method is based on aggregation of embodied energy intensity by amount of material for every item in a building. No weightings. Also calculated CO_2 emissions based on energy source. A CAD drawing of a house takes at least a day to do but the embodied energy relationships are automatically included (but can be changed).

Australian Sustainable Materials Group
ASMG has about 110 individuals and organisations on its mailing list, including university academics and researchers, the CSIRO (Commonwealth Scientific & Industrial Research Organisation), architects in small and large practices, engineers, manufacturers and environment groups. Recent focus is on embodied energy of materials. ASMG is part of the School of Architecture and Building, Faculty of Science and Technology, Deakin University.

Roger Fay is completing a PhD (at Deakin) which broadly focuses on life cycle energy analysis of Australian suburban low- and medium-density housing. The aim is to determine the critical factors influencing the energy attributable to dwellings over their lifetime.

Graham Treloar is completing a PhD (at Deakin) on Embodied Energy of Residential Building Construction.

STANDARDS
Appliances
AS 2575.1-1989 Energy labelling of appliances - Refrigerators, refrigerator/freezers and freezers - Specification for appliance energy rating level
AS 2575.2-1989 Energy labelling of appliances - Refrigerators, refrigerator/freezers and freezers - Determination of energy consumption and efficiency rating
SAA MP64-1995 Manual of assessment procedure for water efficient appliances
(MP64 is at least partially mandatory)

CFCs and HCFCs
SAA HB40 The Australian Refrigeration and Air Conditioning Code of Good Practice
SAA HB40.1-1997 Reduction of emissions of controlled ozone-depleting refrigerants in commercial and industrial refrigeration and airconditioning applications
SAA HB40.2-1997 Reduction of emissions of fluorocarbons in residential airconditioning applications
SAA HB40.3-1997 Reduction of emissions of fluorocarbons in domestic refrigeration applications
AS/NZS 1677.2 Refrigerating systems – Safety requirements for fixed applications

Indoor air quality
1668.2 - 1991 The use of mechanical ventilation and air-conditioning in buildings - Mechanical ventilation for acceptable indoor-air quality (cited in the BCA)

Paints: solvents and heavy metals
APAS GPC-D-181 Volatile organic compounds (VOC) limits for approved paints
(Voluntary phase-in of tighter limits, published by the Australian Paint Approval Scheme (APAS) and supported by state and federal government purchasers)

Occupational exposure to radon (e.g. in show caves)
Worksafe Australia/NHMRC 1995, " Radiation Health Series No 39: Recommendations for limiting exposure to ionizing radiation (Guidance note) and National standard for limiting occupational exposure to ionizing radiation" National Health and Medical Research Council

Lead remediation
AS 4361.1 Guide to lead paint management – Industrial applications

Insulation
AS 2627.1 Thermal insulation of roof/ceilings and walls in dwellings
AS 3999 Thermal insulation of dwellings – Bulk insulation – Installation requirements

Noise
AS 2021 Acoustics – Aircraft noise intrusion – Building siting & construction
AS 2436 Guide to noise control on construction, maintenance and demolition sites

Legionella
SAA/SNZ HB32 Control of microbial growth in air handling & water systems of buildings
AS/NZS 3666.1: 1995 Air handling and water systems of buildings - Microbial control - Design, installation and commissioning (cited in the BCA)
AS/NZS 3666.2: 1995 Air handling and water systems of buildings - Microbial control - Operation and maintenance (cited in the BCA)

Other
AS 4282 Control of the obtrusive effects of outdoor lighting
AS 2791 Use and handling of sulfur hexafluoride in high-voltage switchgear and controlgear
AS 3660 Protection of buildings from subterranean termites – Prevention, detection and treatment of infestation
SAA HB98 Guidance on environmental aspects in specifications & design briefs for electrotechnical products

New Zealand
Response prepared by Rolf Huber, CIL.

ENVIRONMENTAL ISSUES
Water quality.
Transport.
Climate change.
Hazardous substances and contaminated sites.
Waste management.

POLICIES
Promoting sustainable human development - Agenda 21
Adopted by the New Zealand government as a non-mandatory policy document.

NZIA (New Zealand Institute of Architects) Environmental Policy
Published in 1992, this policy covers air quality (CO_2 production, ozone depletion), material selection (e.g. rain forest destruction, resource depletion), planning, education and advocacy. The policy was one of the first such policies, and was circulated by the International Union of Architects to its 90 plus members for possible adoption.

ENVIRONMENTAL MANAGEMENT SYSTEMS
So far only one paint manufacturer is ISO 14001 accredited.

BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES
BRANZ Green Home Scheme
The BRANZ Green Home scheme assesses new homes at the design stage. It is a credit based scheme where credits are assessed against a set of criteria. As with BREEAM an overall environmental rating of Fair, Good, Very Good or Excellent is given depending on the number of credits gained. The credits are grouped into three areas: global, local and indoor issues. Assessors audit the initial credit rating, with the opportunity to improve the design before a final audit is carried out after which the certificate is issued. Global issues include energy conservation measures such as insulation, compact fluorescent lamps, solar design and other energy efficient features. Local issues include natural resources and recycled material, storage of recyclable materials, water economy, site selection and composting organic waste systems. Indoor issues cover ventilation, wood preservatives, energy efficient lighting, smoke alarms, storage for hazardous materials, non-gaseous indoor pollutants and reducing levels of volatile organic compounds.

Waitakere City Council’s "Eco-design Guide".

LEGISLATION

Building Code

See Report, section 2.5.

The New Zealand Building Code has requirements for environmental issues such as daylighting and indoor pollutants. Sections touching on environment and health include:

B2 Durability
F1 Hazardous agents on site
F2 Hazardous building materials
F3 Hazardous substances and processes
F5 Construction and demolition hazards
H1 Energy efficiency

Department of Labour

Much of the initiative for environmental issues, particularly those affecting safety and the workplace, come from the Department of Labour's network of OSH (Occupational Safety and Health) offices. Publications include "Management of lead-based paints", "Safety and Health guidelines in working with precast concrete", "What every homeowner should know about asbestos".

In New Zealand there is comprehensive legislation dealing with Health and Safety issues. A separate body with wide ranging powers has been set up to uphold these standards.

Resource Management Act 1991

This radical law is intended to promote the sustainable management of physical resources, and places many obligations on architects. They are required to

- meet the reasonably foreseeable needs of future generations;
- safeguard the life supporting capacity of air, water, soil and ecosystems;
- avoid, remedy or mitigate any adverse effects of activities on the environment;
- preserve the natural character of the coastal environment;
- protect outstanding natural features and landscapes from inappropriate subdivision, use and development;
- maintain and enhance public access to and along the coastal marine area, lakes and rivers;
- provide for the relationship of Maori and their culture and traditions with their ancestral lands, waters, sites, waahi tapu and other taonga;
- have particular regard to Kaitiakitanga (stewardship based on nature);
- have particular regard to the efficient use of physical resources;
- have particular regard to the maintenance and enhancement of amenity values;
- have particular regard to the intrinsic value of ecosystems;
- recognise and protect the heritage values of sites, buildings, places or areas; and
- maintain and enhance the quality of the environment.

(Watkins, Tony 1992 "NZIA Environmental Policy Position Paper 5: The Resource Management Act" NZIA)

Ozone Protection Act 1990

This controls the import, use and manufacture of ozone depleting substances such as CFCs, halons, HCFCs and so on.

PROFESSIONAL ASSOCIATION ADVICE

New Zealand Institute of Architects

The NZIA has promoted its Environmental Policy to its membership since 1992. This [promotion] consisted of 21 position papers ... [and] 20 wall charts ... While this provided designers with a valuable resource, there is little mainstream support for environmental issues as a significant design factor. For example, one of New Zealand's largest timber producers is currently promoting the use of "chemical-free" timber, and is finding little if any support from designers or builders. Most locally-grown softwoods are treated with either boron salts (for borer protection) or CCA (for durability in damp and/or subgrade locations).

LIFE CYCLE ANALYSIS PROGRAMS

No working schemes at present, a data-base is currently being constructed.

A.4 ASIA

Japan

Response prepared by Yasuo Omi, I^2BH.

ENVIRONMENTAL ISSUES

Energy saving.
Treatment of waste.
Global warming effect and CO_2 (influenced by Kyoto Conference).

POLICIES

Recycle Plan 21

Under the 1991 Recycling Law (Law for Promotion and Using Recyclable Resources), the contractor must make practical use of reprocessing plants, site waste must be separated and ground [?], and recycled materials must be used where compatible with quality requirements. The employer must specify the use of recycled materials, and that construction waste be taken to reprocessing plants.

Responding to this the Ministry of Construction (MOC) devised *Recycle Plan 21,* to minimise construction waste. It was published in 1994. The objectives are

- strict elimination of waste through design and planning;
- maximum recycling through communication among construction sites/workers [?];
- appropriate disposal of waste which cannot be reused; and
- active research and development.

For waste, the goal is to reduce the amount of waste by 10% by 2000, and raise the recycle ratio from 42% (1990 level) to 80%. In 1995, waste had increased about 30%, but the recycle ratio was up to 58%.

For soil the goal is to reduce use of mountain sand, and raise the recycle ratio from 36% (1990 level) to 70% in public works by 2000. In 1993, the recycle ratio was up to 47%.

Similar goals have been set for mixed waste, wood, asphalt, concrete and sludge. Good progress has been made for concrete and asphalt. The others have gone backwards!

BCS is supporting the Plan, for example through development of signage for on-site separation of waste collected e.g. wood, metal, gypsum board, PVC pipe, concrete and so on.

Under the Plan, the contractor must confirm the contents of the drawings and specifications, and question the employer "in the site orientation" [i.e. regarding site policy?]. The employer must clearly show in the drawings and specifications

- construction methods and/or materials;
- standards and location of waste materials used in the project; and
- processing method and disposal location of site waste.

The Architectural Institute of Japan

Action Plan for the Global Environment:

1. Architecture and the Global Environment

Attention has focused recently on worldwide deterioration of the environment, including problems such as global warming, depletion of the ozone layer, and waste pollution. Architecture has always been a fundamental factor in the human living environment and it strongly reflects regional history and culture. Since ancient times, mankind has striven to create comfortable and safe surroundings in which to live. However, as our living spheres on the earth have expanded and economies have become dynamic, we gradually realized that everyday

acts which from a narrow perspective were thought to improve our living conditions have actually been aggravating environmental quality on a global scale. It is time to review the interactive relationship between architecture and the global environment from the perspective of Earth as the dwelling place for mankind.

2. Our Measures

Since 1990, the Architectural Institute of Japan has conducted a special research program to study preservation of the global environment because we recognized that both architects and their patrons were partly responsible for ecological deterioration. In 1995, we established the Global Environmental Committee and initiated broader, in-depth research in the fields of science, technology, and art. Based on the outcomes, we summarized priority issues to be addressed by the Institute and developed our action policy for each effort presented herein, with the attendant goal to actively advance its implementation in order to realize sustainable living spheres while conserving the global environment.

3. Deployment of our Action Plan

The Institute conducts fundamental research for the specific issues under the policy, and promotes activities for timely disbursement of the research benefits to society. We must examine the progress of such activities when necessary; periodically incorporate the findings into the policy of the Institute as a whole; and transfer the Action Plan to subsequent generations.

4. Member Awareness and Action

We encourage our members to be aware that their professional knowledge can contribute toward relieving environmental problems, and to make the utmost effort to resolve the issues in each field while vigorously participating in relevant activities.

The Action Policy:

1. Lifestyle

As the current global environmental issues have arisen as a result of the entire chronicle of human endeavors, we must reevaluate the roles and significance of economics and ethics in a broader sense, while also pursuing the traditional architectural discipline that has emphasized studies of human living environs related to architecture itself. We take initiatives in establishing an entirely new architectural paradigm, and in proposing and promoting alternative lifestyles suitable to the era of global environmental awareness, without being confined to the concepts of architectural production and consumption alone.

2. Analysis and Assessment of the Environmental Load

Toward the goal of proposing means to curtail environmental load, we undertake comprehensive research and development to establish databases and methodologies for load assessment, exemplified by the CO_2 issue that is said to be the major contributor to global warming, in the field of architectural life cycle; namely, the series of architectural stages from planning, design, and construction, practical use, and modification, to eventual dismantlement and removal.

3. Use of Resources

Architectural production has traditionally been responsible for the mass consumption of our natural resources; toward the goal of curtailing depletion of our resources, we examine and propose ways to enhance architectural longevity and durability; appropriate use of architectural resources reflecting regional characteristics; methods to reduce resource consumption and promote recycling; and development of materials to reduce architectural waste and improve structural planning and construction design.

4. Use of Energy

The quantity of energy and water consumed in the process of architectural construction and operation has been a profound load factor to the global environment. We conduct further research toward reducing the amount of these wasted resources, and improving utilization efficiency and recyclability. We also work to discover and implement innovative design techniques such as the use of natural energy to foster our symbiotic coexistence with the natural environment.

5. Use of Land

On reflection that our previous development activities in pursuit of economic efficiency often resulted in devastation of our ecosystems, we strive to provide prime living environments for all people through the better use of land and superior design techniques while also embracing ecological conservation. Furthermore, we promote new research and design activities to create buildings and cities that are hospitable, pleasant, and safe from disaster.

6. Health

Based on our experience that inadequacies in pre-development assessment of environmental impact have led to the change and degradation of our environs, we endeavor to undertake research on the desirable status and methodologies for environmental conservation in relation to human living conditions. In addition, in order to protect our health and the earth's ecology from contamination and deterioration, we propose and disseminate architectural measures, regional planning, and design techniques that enable us to alleviate damage caused by water, air, and soil contamination.

7. International Cooperation

As global environmental issues exactly involve the entire human endeavors on global scale, worldwide collaboration is essential. Through the exchange of information with other nations and organizations, we encourage reciprocal utilization of all experiences and achievements and promote further international cooperation toward our goal.
[from AIJ web site]

ENVIRONMENTAL MANAGEMENT SYSTEMS

In the building and building material industry, many companies have great interest in ISO 14001 (and also ISO 9000 series) and they are now studying to achieve certification (very few companies have achieved certification to ISO 14001 in the field of construction in Japan).

LEGISLATION

Japanese Environmental Trend

1967 Enactment of "Anti-pollution Measures Standard Law".
1970 Enactment of "Waste Disposal Law".
1971 Foundation of Environment Agency.
1972 Enactment of "Nature Conservation Law".
1973 Environment Committees were founded by Japan Federation of Construction Contractors (JFCC) and Japan Civil Engineering Contractors' Association.
1979 Enactment of "Energy-saving Law".
1990 Cabinet decision of "Action Program on Global Warming Effect Prevention".
1991 Federation of Economic Organisations (FEO) constituted the "Charter of Global Environment".
Building Contractors Society (BCS) founded Technical Committee for Global Environmental Issues.
Amendment of "Waste Disposal Law".
Enactment of "Recycling Law".
"The Clean Japan Center" established, to promote recycling.
1992 Ministry of International Trade and Industry (MITI) issued "Volunteer Plan".
JFCC issued the "Guide to Making Action Program on Environmental Protection".
1993 Amendment of "Energy-saving Law".
Promulgation of "Energy-saving and Recycling Promotion Law".
Promulgation of "Basic Law for Environmental Pollution Control".
1994 Ministry of Construction (MOC) issued "General Principles on Construction Policies" and "Recycle Plan 21".
Cabinet decision of "Basic Plan for Environmental Issues".
1995 Re-examination of "Volunteer Plan" by MITI.
1996 FEO published the "Environment Appeal".
JFCC published the "Vision".
BCS issued the "Action Program".
1997 Enactment of "Environmental Assessment Law".

[Footnotes omitted]

PROFESSIONAL ASSOCIATION ADVICE

Guidance for Environmentally Conscious Design

Part of the BCS (Building Contractors Society - which consists of 85 large contractors in Japan) "Action Program". This document tabulates a series of 43 environmentally conscious design items (in 8 sections) against 33 stages in the project life-cycle, from schematic design (e.g. basic zoning), to design development (e.g. ratio of open space), detailed design (e.g. energy planning), construction (e.g. construction by products), maintenance (e.g. use of energy), inspection (e.g. drainage of stormwater), to renewal (e.g. recycle). The points achieved are weighted and aggregated, leading to a score for each section, which in turn are plotted on a radial graph. The sections and items are as follows:

A Attitude toward environmental issues
- Confirm client's demand for environmental issue
- Client's understanding of explanation of total environmental cost
- Assessment and analysis of historical, social, geographic and biologic environment of surrounding area
- Prediction of environmental effects of the design
- Proposal for improvement of environment e.g. new way of life

B Preservation of atmosphere
- Control of oxide [SOx, NOx ?] production in use
- Use of clean energy
- Control of CFCs
- Control of CO_2
- Control of other greenhouse gases

C Preservation of resources
- Use of natural or alternative energy (incl. waste heat recovery)
- Adoption of the Energy Saving Law
- Optimisation planning in life-cycle cost [?]
- Extension of building life span
- Reuse of wastewater or stormwater
- Recycling of materials

D Preservation of natural environment
- Controlled use of plywood
- Treatment of wastewater during use
- Treatment of harmful [solid] wastes
- Preservation of soil, use of infiltration paving
- Preservation of existing trees on site
- Planting new trees on site

E Safe and comfortable city planning
- Consideration of harmonisation and activation of local industry and human environment
- Consideration of safety of vicinity
- Consideration of load on infrastructure
- Fire resistant, earthquake resistant, water [flood/rain?] resistant design
- Consideration of a disaster prevention point
- Consideration of the handicapped or weak

F Waste disposal
- Control of quantity of waste in construction
- Control of quantity of waste in use
- Clean refuse disposal

G Creation of landscape
- Historically, geographically and biologically conscious design
- Harmonisation of surrounding natural environment
- Consideration of adaptation to local planning and "openheart" to community
- Consideration of landscape at large, medium and small scales
- Consideration of harmonisation with the street
- Consideration of visual factors e.g. paving, grass, lighting

H Creation of comfortable environment
- Consideration of wind hazard
- Consideration of sunshine and light reflection hazards

Consideration of noise and vibration
Consideration of waste heat, exhaust and odour
Consideration of jamming [traffic jams?]
Creation of amenity

Sustainable Design Guide - Design Method Collation Table
Produced by the JIA (Japan Institute of Architects, not to be confused with the AIJ!). This document tabulates a series of 22 design policies (e.g. discreet use of wood-based materials, use of durable materials, preservation of traditional skills, landscape/waterscape preservation) against a series of 32 design methods (e.g. flexible space planning, control of air pollution, water recycling, high quality acoustic environment).

ECO-LABELLING
EcoMark
See Report, section 4.4.

APPENDIX B: BUILDING ENVIRONMENTAL ASSESSMENT SCHEMES

The contents of this table are a simplification only, for comparative purposes. Some issues covered are not listed, some are subsumed into others. Fuller schedules are given for some in Appendix A.

Issues covered	**BE2AM**	**Ecological criteria in buildings**	**DUBO**	**Ecoprofile**	**BREEAM**	**BEPAC**	**Green Building Challenge**	**LEED**	**Green Home Scheme**
Countries where scheme is used	Europe	Finland	Nether-lands	Norway	UK, USA, Canada, Hong Kong	Canada	Canada, World-wide	USA	New Zealand
Building types			Housing		Offices				Homes
Building in use issues: Energy of building in use/carbon dioxide emissions	·	·	·	·	·	·	·	·	·
Use of renewable energy	·	·	·	´	´	·	?	·	·
Ozone depletion due to CFCs/HCFCs	·	´		·	·	·	·	·	´
Halons	?				·		·	·	´
NOx emissions	·	´		·	·	´	?	´	´
SOx emissions	´	´		´	´	´	·	´	´
Particulate emissions	´				´		·	´	´
Noise pollution	´	·	·	·	·	·	·	´	´
Water economy and/or quality	·	·	·	·	·	·	·	·	·
Lighting/daylighting	·	´		·	·	·	·	·	·
Thermal comfort	·		·	·	·		·	·	´
Radon	·	´		·	·	·	·	´	´
Ventilation & fresh air delivery/monitoring	·	·	·	·	·	·	·	·	·
Humidity control/ avoidance of legionella	·	·		·	·	·	·	´	´
Harmful emissions from building materials	·	·	·	·	·	·	·	·	·
Car pooling/ park & ride	´				·(USA)	·	·		´
Transport e.g. cyclist's facilities/ access to public transport	·	´		·	·	·	·	·	·
Recycling facilities	·	·		·	·	·	·	·	·
Control of building services	´			·	´	·	·		´

Issues covered	**BE2AM**	**Ecological criteria in buildings**	**DUBO**	**Ecoprofile**	**BREEAM**	**BEPAC**	**Green Building Challenge**	**LEED**	**Green Home Scheme**
Site/construction issues: Ecological value/ enhancement of site	·	·		·	·	·	·	·	´
Construction waste disposal	·	·	·	·	´	·	·	·	´
Shade								·	
Erosion control								·	
Energy used in construction	´	´			´	´	´		´
Materials: Use of sustainable resources (resource depletion)	·	·		?	·	·	·		·
Reuse of materials and building components	·	·			´	·	·	·	·
Use of recycled materials	·	·	·		·	·	·	·	·
Recyclable materials and building components	·	·			´		·		´
Energy content (embodied energy)	·	·			´	´	· (dropped)		´
Transport/ use of local materials	·	·			´	´	?	·	´
Hazardous waste/ emissions during manufacture	·	·	·		´	´	·		´
Damage to ecosystems due to extraction/ manufacture	·				´	´			´
Prevention of unnecessary use/ efficient use of materials	´				´	·			´
Avoiding composite materials	·				´				´
Durability and reparability	?	·	·		?	·	·		´
Exclusion of materials	·				·		?	·	´
Dismantling of building on demolition	´				´				´
Avoiding over specification	´				´	·	?		´
Low maintenance	?		·	·	´		·		´
Other issues: Flexibility	´				´		·		´
Design &	´				´		·		´

Issues covered	**BE2AM**	**Ecological criteria in buildings**	**DUBO**	**Ecoprofile**	**BREEAM**	**BEPAC**	**Green Building Challenge**	**LEED**	**Green Home Scheme**
construction process - environmental strategies									
Building operations planning	´				´		·		´

´ indicates not included; ·indicates included; blank indicates uncertain [?]

APPENDIX C: LEGISLATION: CONTROLLED PRODUCTS

Construction materials banned or restricted in legislation around the world include:

- Antimony or antimony compounds, used in paints.
- Asbestos (brown, blue and white).
- Barium salts, used in paints.
- Cadmium or cadmium compounds, used in paints and electroplating.
- Calcium chloride admixtures, used in concrete.
- Chlorofluorocarbons (CFCs) and HCFCs, used in refrigeration systems, extinguishants and thermal insulation.
- Chromates, used in paints and timber preservatives.
- Creosote, used as a timber preservative.
- Formaldehyde, used in urea formaldehyde foam insulation and in UF adhesives for reconstituted timber products (e.g. particleboard, plywood, glulam).
- Halogenated electrical cable insulation and sheathing.
- Hemp, used in fabrics and boards.
- Halons, used in gas flooding systems and extinguishers.
- Lead or lead compounds, used in paints, piping, solder, roofing.
- Some mahoganies, and some other timber species (trade controlled under CITES).
- Mercury mildewcides/fungicides, used in paints.
- Mineral wools, including glassfibre, used in bulk thermal insulation.
- Organochlorine insecticides (dieldrin, aldrin, chlordane, heptachlor), used as termiticides and in timber preservatives.
- Organophosphate insecticides, used in termiticides [and in timber preservatives?].
- Peat and other mulches from non-sustainable sources.
- Pentachlorophenol (PCP), used in timber preservatives.
- Phthalate plasticisers, used in vinyl flooring and wall coverings, and in electrical cable insulation and sheathing.
- Phosphogypsum, used in plaster (emits radon gas).
- Pitch and tar, used in roofing and tanking membranes.
- Polychlorinated biphenyls (PCBs), used in transformers.
- Polyvinyl chloride (PVC).

- Potting soil.
- Rainforest timber species generally, except from sustainable sources.
- Selenium or selenium compounds, used in paints.
- Sulfur hexafluoride, used in switchgear and controlgear and acoustic SIG units.
- Tributyltin oxide, used in timber preservatives.
- Vermiculite, used in fire-rated plasters.
- Vinyl chloride monomer, used to make PVC.
- Volatile organic compounds (VOCs), used in paints, sealants, adhesives.

This is not a comprehensive listing, of course. In any particular jurisdiction, some of these won't be controlled, and other construction products will be.

APPENDIX D: NATIONAL MASTER SPECIFICATIONS

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INTRODUCTION

This Appendix comprises responses to the questionnaire prepared by John Gelder, then of CIS Australia, and sent to ICIS members. Response was uneven, and this is reflected in the contents, which have been supplemented in some instances with other material. The blank survey is given below. Under each of the national responses, only the queries which elicited a response, or for which a response could be generated, are included. A couple of responses were substantial, and the extra material has been included.

#	***Query***	***Response***
1	Whose initiative was the work?	
2	Is there a background policy to the work?	
3	Does the work cover statutory & voluntary green issues, & OHS?	
4	What green issues are being considered? Is there a model?	
5	What is the priority of the work?	
6	What are the work stages?	
7	What reviews are planned?	
8	How is the work being staffed? and funded?	
9	What will be the outcome?	
10	Will specification text be modified? Will global bans be used?	
11	How pragmatic will the greening be?	
12	Will guidance material be provided? What form will it take?	
13	Are any work groups being prioritised?	
14	Are new worksections proposed?	
15	Are you willing to share the outcomes with other ICIS members?	

Figure D.1: Blank response form

D.1 EUROPE

Czech Republic

URS Praha a.s. publishes the Czech national master specification system (Catalogues of Descriptions and Directive Prices for Construction Work, and for Assembly Work). URS Praha is an ICIS member.

URS Praha did not respond to this part of the survey.

Finland
BII (Building Information Institute) publishes Finland's national master specification, RYL (Rakennustoiden yleiset laatuvaatimukset - Code of good building practice) 2000. BII is an ICIS member.

#	*Query*	*Finnish Response*
9	What will be the outcome?	... RYL 2000 ... has been published in three volumes [over] 1997 and 1998. ... The volumes are: - MaaRYL 2000 (Earthworks). - RunkoRYL 2000 (Building frame and external envelope). - SisaRYL 2000 (Internal subdivision and finishing). All these volumes are internally divided into three parts according to the national classification Construction-90: - Elements of construction. - Work sections. - Specification writer's checklist. The first two parts contain "green" text sections. The part of elements is aimed at designers and gives advice on functional design, service life and operation economy. The part of work sections is aimed at contractors and is invoked by reference in project specifications. Every work section has a systematic subdivision. [The last two items are] as follows: 8. Repair work (e.g. openings in load bearing and non load bearing elements). 9. Environmental impacts. At least [these] are "green". In some work sections, however, the contents of "green" items are pretty thin. This is caused, naturally, by the fact that the building industry is not yet very green itself. I am sure, that the next edition will have more muscles around the bones.

Germany
GAEB (Gemeinsamer Ausschus fur Elektronik im Bauwesen) prepares the German national master specification, StLB (Standardleistungsbuch f **ò** r das Bauwesen), which is published by DIN (Deutscher Institut fur Normung). GAEB is a committee in the federal Ministry for Regional Planning, Building and Urban Development, and is an ICIS member.

#	*Query*	*German Response*
3	Does the work cover statutory & voluntary green issues, & OHS?	Everything in GREEN is handled by German Federal Law.
5	What is the priority of the work?	At this [time] GAEB is doing nothing in GREEN-Specifications. Perhaps next year???

The Netherlands
STABU (Stichting Standaardbestek burger-en Utiliteitsbouw) Foundation publishes the Dutch national building specification, the STABU System. STABU Foundation is an ICIS member. CROW (Centre for Research and Contract Standardisation on Civil and Traffic Engineering) publishes the Dutch national civil engineering specification, RAW Systematics. CROW is also a member of ICIS. The following is about STABU.

#	***Query***	***Dutch Response***
1	Whose initiative was the work?	Follows the request of the Ministry of Housing, Planning and the Environment to add the directives of the government covenant, the National Package for Sustainable Building (Duurzaam Bouwen Nationaal pakket Woningbouw, Nieuwbouw - DUBO) (housing and new building?), to the STABU System.
2	Is there a background policy to the work?	The covenant (DUBO). See Appendix A.1.
3	Does the work cover statutory & voluntary green issues, & OHS?	The covenant (DUBO) is currently voluntary, but will become mandatory in due course (via the Housing Act). [no response on OHS]
4	What green issues are being considered? Is there a model?	Materials, energy, water, and inner environment/milieu [IAQ?]. STABU System contains most of the directives that can be easily be turned into sustainable building specifications. See Appendix A.1. Example of the way information is presented in the STABU System: Product group mentioning SBR rule S039: - B531110 WATER HEATERS - B533130 HEATING APPARATUS - B536110 GAS GEYSER - B536120 GAS BOILER [no response on model - but see Appendix A.1]
5	What is the priority of the work?	[high priority - underway now]
6	What are the work stages?	The work is staged so that it runs parallel with the update cycles of the STABU-system, which is every six months. The project had three phases: 1. Checking the rules to see if they can be defined in the STABU system. Not all of the rules are suitable for the STABU system. Some of the rules are for design requirements only, other rules apply to parts of the specification which will have to be added to the existing specification variant, and for some of the rules a new type of specification will have to be developed. Result phase 1: An overview of the rules in relation to the specification in the STABU system. [done?] 2. Using existing tools in the STABU system, new specifications are to be added to the where blanks in phase 1 have been detected, and specification variants with specific information about the rule are to be made. Result phase 2: Specific "m"-specification variants

#	*Query*	*Dutch Response*
		including the specification choices and information needed to conform to the specific rule, which is identified by its number. Implementation date: January 1997. [done?] 3. Using new tools in the STABU system, a technique will be developed along existing lines so that the STABU users can consult a special help text window which will display the relevant part of the rule. This will be an extra aid in choosing specifications. Result phase 3: Help screens with the text of the relevant part of the rule at the level of choice in the "m"-specifications. Implementation date: January 1998. [done?]
7	What reviews are planned?	The STABU Foundation has been asked to amend/update the STABU-system every six months with the new rules/measures in the covenant.
8	How is the work being staffed? and funded?	[no response on staff] There is no separate budget/subsidy for the work undertaken by STABU.
9	What will be the outcome?	The STABU building specifications for sustainable building are modified basic [i.e. non-sustainable] specifications that supply the most useful information of the rules/measures for sustainable building.
10	Will specification text be modified? Will global bans be used?	In the STABU-system an alternative basic specification ("m"-variant), with the information about the rules/measures for sustainable building which are supported, can be viewed and selected. [no response on global bans]
11	How pragmatic will the greening be?	The STABU Foundation however only has the authorisation of the STABU Board to support broad initiatives within the Building Industry. The STABU Foundation assists/supports the Building Industry by standardising specifications. It is not the intention of the STABU Foundation to promote products/materials used by the construction market.
12	Will guidance material be provided? What form will it take?	STABU is developing two new tools for the user to help them with the selection from the package of rules/measures for sustainable building ("m"-specifications): - Help screens which will display the most relevant part of the rule/measure at the level of choice in the "m"-specifications. - A toolbox will help the user select the "m"-specifications from the total package of specifications in the STABU-system. In this way a project specific selection of specifications is created by the delimiting choice of the rules.

#	*Query*	*Dutch Response*
		The price consequences for choosing "green" specifications are not visible in the STABU System.
13	Are any work groups being prioritised?	The priority is determined by the package of rules/measures: 1. Rules for the building of houses. 2. Rules for renovation and refurbishment of houses. 3. Rules are being developed for the building of utilities. Another project will start in 1998 to implement the rules for sustainable renovation. This project for renovation is to run parallel with the project for housing.
14	Are new worksections proposed?	There are several new products promoted in the package of rules/measures e.g. sun boilers. Other examples: Applying the directives to the specifications for cement types led to new green specifications for in situ flooring, sheet flooring, cement mortars, masonry mortars, and prefabricated concrete elements such as floor slabs. Directives on re-use of PVC, energy performance requirements, environmentally aware paint products, burglar resistance, accessibility etc. have led to new green specifications. For services installations, directives on the NOx issue, high-efficiency boilers, re-use of PVC, and economical use of water have led to new green mechanical services specifications. For electrical services, lighting fixtures and kilowatt energy meters have new green specifications. In the future a new option in the STABU system will be developed. The option of pre-selecting a part of the system specially for environmentally friendly demolition will be added to the selection of U-specifications (U = utility) or W-specifications (W = housing).
15	Are you willing to share the outcomes with other ICIS members?	The STABU Foundation is willing to share the results of the work they have done with the other ICIS members.

Norway

NBR (Norges Byggstandardiseringsr¯d) publishes the NS 3420 *Specification texts for building and construction* series, as part of the NSF Norwegian national standards system. A number of other Norwegian standards cover plant, technical [services?] installations, tendering and contracts. NBR is an ICIS member.

> "As you may know, our specification system is very much a specification system. It is not a system for planning or design. That means that the designer should have done most of his environmental thinking before he sits down with our specification system."
> Kjell-Ivar Bakkmoen, NBR

#	*Query*	*Norwegian Response*
1	Whose initiative was the work?	[no response] [government?]
3	Does the work cover statutory & voluntary green issues, & OHS?	Health, environment and safety.
4	What green issues are being considered? Is	We are discussing just how we shall handle the use of recycled materials - the question is whether the use of such materials should

#	*Query*	*Norwegian Response*
	there a model?	be allowed always or only when specified. There has been a Norwegian study by the Norwegian centre for sustainable production and consumption concerning the environmental profile for buildings [see Appendix A.1]. I think this work has some similarities with the UK's BREEAM. This work will be important for us when we are going to expand our specification system to also include specifications based upon functional requirements and also for bigger parts than the ordinary work sections.
7	What reviews are planned?	Our new publishing policy where we will publish the specification system in many parts, small groups of work sections, with a frequency of two mailings of new or revised parts to the subscribers each year, is partly made in order to make it possible to adjust the requirements to the work sections as new environmental questions rise.
9	What will be the outcome?	Our concern is to make it possible to make a specification for a construction and a construction process which is the best possible for the environment. The general clauses will be enlarged with new requirements concerning health, environment and safety. There will also be new clauses concerning what is called "clean building". This [also] means ensuring responsible waste handling and making it possible to specify demolition.
10	Will specification text be modified? Will global bans be used?	For example are we trying to include green products and solutions where applicable in order to make it as easy to specify alternative green solutions as others. This results in new specification texts. We open up for requirements to work sections and designed elements concerning design life. This will be more important when we expand our specification system to include performance specifications on a less detailed level. For example, when you specify a complete wall it has to include requirements for heat loss etc. When you specify a complete house or construction you probably want to specify how much energy it will use for heating and operating and you may want to specify its design life and how much waste it is allowed to accumulate through its service life. You may want to classify this building into a certain environmental class or give it a certain eco-profile if such tools exist. [no response on global bans]
11	How pragmatic will the greening be?	However, we will not try to tell people not to use materials which we don't like from an environmental point of view. We will handle all materials and solutions which are allowed according to Norwegian law in the same way. The specifier can choose solutions which are good or bad for the environment.

Sweden
SBC (Svensk Byggtj¬nst - Swedish Building Centre) publishes AMA (General Material and Workmanship Specifications), the Swedish national master specification. SBC is an ICIS member.

#	***Query***	***Swedish Response***
1	Whose initiative was the work?	[no response]
2	Is there a background policy to the work?	Our next AMA generation due to be published autumn 97 - autumn 98 has developed a specific environmental policy which we follow.
4	What green issues are being considered? Is there a model?	In AMA for Civil Engineering we have both vegetation and environmental issues. In the other parts of AMA (Housing, Installation) we have naturally only environmental issues [i.e. not vegetation] and of course natural materials in a few constructions for housing.
6	What are the work stages?	The time schedule for AMA is: - Housing - books exist and database under construction. - Installation - books and database in November [1998?]. - Civil engineering - books and database late next year [1999?].
7	What reviews are planned?	... we see changes for many years ahead as the consequences on the content of specifications are developing all the time. ... not so much text for the moment but in the regular updates of AMA (2 times a year) we believe there will be quite a lot of text in some years time.
8	How is the work being staffed? and funded?	We are understaffed as most companies nowadays. [i.e. being done with existing staff][no response on funding]
9	What will be the outcome?	In this work we are revising existing text and commentary and adding text about environmental issues. We are developing an environmental product base to supplement other product information services from our centre. We produce books on environmental issues. We arrange study visits to interesting sites.
10	Will specification text be modified? Will global bans be used?	Yes [e.g. contractor should be asked to submit declarations of product contents, to show conformance to Ecocycle Council requirements.] [no response on global bans]
12	Will guidance material be provided? What form will it take?	We are not producing separate green guides for specifiers. [but commentary is provided]

Switzerland
CRB (Swiss Research Centre for Rationalization in Building and Civil Engineering) publishes the Swiss national master specification system, CSD (Catalogue of Standard Descriptions, or Normpositionen-Katalog - NPK). CRB is no longer an ICIS member.

> "May I first draw your attention to ... three projects in which we are/have been involved. Oeko-DB (Eco-Declaration Database ...), OELV (Ecological Bills of Quantities ...) and OGIP (Optimisation of Total Energy Requirement, Environmental Impact and Construction Costs ...), to which I will refer in the following paragraphs."
> Hans-Peter Goeggel, CRB

The first is a product database organised around the Swiss Society for Engineers and Architects' standard "declaration grid". The second involves supplementing CRB's "catalogue of standard descriptions" (CSD) with flags for existing environmentally-sound descriptions, new such descriptions, and guidance. The third project is for a computer-based design tool combining capital cost, embodied energy, environmental impact and energy-in-use for construction materials and components. OGIP is described in more detail in Appendix A.1.

#	***Query***	***Swiss Response***
1	Whose initiative was the work?	The three above-mentioned projects are all essentially external projects based on the specification system and tools devised and marketed by CRB, hence CRB's involvement. Initiatives have come mainly from government e.g. requirement of authorities to implement ecological/conservationist principles in public sector projects ...
2	Is there a background policy to the work?	No (apart from legislation).
3	Does the work cover statutory & voluntary green issues, & OHS?	Only statutory issues. The human toxicity issue is incorporated as a facet in OGIP i.e. assessments based on a single facet are possible.
4	What green issues are being considered? Is there a model?	OGIP is not based on any established model.
5	What is the priority of the work?	With the completion of the research phase, considerable funding is now required to develop and implement the associated user products. This is not easy in view of the small market. At the moment, the further development is not clearly defined.
6	What are the work stages?	Staged implementation will no doubt be expedient in view of uncertain funding. For OGIP the stages ("packages") have been defined ...
7	What reviews are planned?	The review process is continuous in view of the fast-moving nature of the new science. Ecological data must be constantly refined/updated.
8	How is the work being staffed? and funded?	Research has been financed by the involvement of other institutions ... In view of the considerable funding necessary for further development, this has not yet been clearly defined.
9	What will be the outcome?	OGIP was a pilot project to produce a prototype design instrument. OLV and Oeko-DB aim at facilitating the ecological assessment of existing bills of quantities/construction products. The ultimate aim of this research is to develop products to enable ecologically-oriented decision-making by the designer during the whole of the construction process.

#	*Query*	*Swiss Response*
10	Will specification text be modified? Will global bans be used?	See OELV project summary [not attached]. [no response on global bans]
11	How pragmatic will the greening be?	The aim of OELV is only to indicate ecologically relevant items and put the client in a position to prescribe these.
12	Will guidance material be provided? What form will it take?	In the OELV guidance notes the user is provided with facts and explanations about the criteria used in the selection of the "ecological" items.
13	Are any work groups being prioritised?	Work groups which have the greatest ecological effect are being prioritised.
14	Are new worksections proposed?	No. However, with the incorporation of individual items into existing work sections the limited demand is being catered for.
15	Are you willing to share the outcomes with other ICIS members?	The resulting products will be freely available on the market.

United Kingdom

NBS (National Building Specification) Services, a division of RIBA Companies Ltd, publishes NBS, the UK national building specification. NBS Services is an ICIS member. NES (National Engineering Specification) is wholly owned by CIBSE (Chartered Institution of Building Services Engineers), and covers building services. NES is not an ICIS member. The following is about NBS.

#	*Query*	*UK Response*
1	Whose initiative was the work?	We were originally approached by ECD Energy & Environment Ltd with a proposal to jointly produce recommendations for improving coverage of green issues in NBS. The work is funded by a grant from the Department of the Environment (DOE). ECD have undertaken to carry out the research and NBS Services have committed to implementing the results into the specification system.
2	Is there a background policy to the work?	A draft report has just been submitted for our comments. There is no policy against which the work is being undertaken.
3	Does the work cover statutory & voluntary green issues, & OHS?	The study is dealing with statutory and voluntary green issues, and also health and safety matters.
4	What green issues are being considered? Is there a model?	The study is taking account of embodied energy, resource depletion, durability, recyclability, etc. where appropriate to the materials and products under consideration. It also relates to the BREEAM environmental assessment method. What do you mean by biodiversity and how does it relate to construction? Are you thinking of things like bat roosting sites in old buildings?
5	What is the priority of the work?	The implementation of the work is high priority in that we are fully committed to implementing the results. However, it is likely to take about three years to update all the affected sections of NBS. This will be as part of the normal updating cycle and consequently the effect on resourcing is hard to quantify.

#	*Query*	*UK Response*
6	What are the work stages?	The stages for the work are: - Production of the first draft of the report (completed mid-July 1996). - Correlation to NBS July to October 1996. - Final report by 30 November 1996. - Implementation report by 30 November 1996. [done?] - Implementation in NBS during 1997 to 1999.
7	What reviews are planned?	Review programme not yet formalised. Will be linked to the normal technical review and updating of NBS (i.e. twice a year).
8	How is the work being staffed? and funded?	The research is being carried out by a team of three at ECD. The whole of the NBS technical team (9) will be involved in commenting with coordination by one team member and one director. Funding initially is by the grant from DOE; thereafter from revenue.
9	What will be the outcome?	The work will result in a report (to be published), new specification text and new guidance in NBS.
10	Will specification text be modified? Will global bans be used?	Most of it is guidance but we introduce clauses where we can - the specification text will be modified where appropriate. NBS is not mandatory in any sense and therefore cannot impose standards on specifiers. However, we can inform and recommend together with the appropriate specification text for selection and editing by green minded designers. Global injunctions such as "Do not use PVC" are not considered to be helpful. They give a false sense of being environmentally concerned but encourage laziness by the specifier. It may look good to the client initially but may well lead to problems on site if it is found that alternatives are too costly and/or the designer has also specified PVC products without realising they are prohibited by the general specification. Consequently we intend to deal with each issue on a section by section basis.
11	How pragmatic will the greening be?	We will be very pragmatic. We will not be producing green specifications but providing our users with the means to do so. However, we will try to encourage them not to specify what is impractical or unverifiable.
12	Will guidance material be provided? What form will it take?	We envisage that most of the information provided in NBS about green issues will be guidance rather than specification text. It will be mainly general notes at the beginning of each work section supplemented by notes adjacent to clauses - although this will be mainly cross-reference.
13	Are any work groups being prioritised?	We will not be prioritising any particular work groups. Greening NBS is being carried out as part of the normal publishing programme, i.e. section by section.
14	Are new worksections proposed?	New work sections, whether green or not, tend to be determined by demand from users.
15	Are you willing to share the outcomes with other ICIS members?	Yes, we are prepared to share the results of the work with other ICIS members, subject to agreement with ECD."

> "... I was referring to the difficulties of tracking and verifying timber from sustainable sources. A file is attached which contains notes prepared by Norman Carless the author of NBS section G20 Carpentry, etc. Norman took a view that tended to favour the Forests Forever Campaign (FFC). Unfortunately the ECD report [*The Greening Report*] leans towards the approach of the Forest Stewardship Council. The guidance note as published took a neutral position to avoid any conflict! The attached notes are what Norman originally wanted to publish."
> Colin McGregor, NBS

Refer to *The Greening Report* (available separately from NBS) for details of NBS's activities. The standard letter dated March 1998 accompanying the Report advises subscribers that "guidance on environmental issues has been introduced in sections C52 (timber preservatives), G20 (timber), H32 (plastics), Q30 and Q31 (peat)."

Norman Carless' (NBS) notes [edited a little] follow to illustrate a common problem in working out how to respond to conflicting information:

"ENVIRONMENTAL ISSUES [Preliminary draft for NBS Guidance notes]
The issues involved in specifying timber and timber based products in an environmentally sound manner are complex and often controversial. In recent years various organisations have raised public awareness of the scale and rate of depletion of the world's rain forests. Unfortunately, in some cases the propaganda has been emotive rather than factual – so much so that the specification of *any* timber has been seen by some to be an environmentally unfriendly option. In particular, specification of tropical hardwoods has been deprecated, and there have been calls for trading in such timbers to be banned and producing countries to be boycotted. More recently timber from temperate and boreal forests[1] has been targeted.

However, studies by organisations such as the World Bank and the London Environmental Economics Centre (LEEC) show that restrictive trade measures do nothing to stop deforestation and can actually be counterproductive. A report produced by the World Bank in 1991 stated, "Tropical forests are being lost primarily to agricultural settlement (about 60% of the area cleared each year) with the balance split roughly between logging and other uses (roads, urbanisation, fuelwood, and so on)" – see also TRADA Research Report 6/85. Of the timber that is extracted, only an estimated 6% is traded internationally. Therefore a boycott of this trade would not be addressing the key issues and problems. The view taken by the Overseas Development Administration (ODA) is that "refusing to use tropical timber is not an environmentally or developmentally sound option. It would reduce the long-term economic value of forests and increase the likelihood of their conversion to other land uses".

Organisations such as the World Wide Fund for Nature (WWF) are committed to the concept of sourcing timber only from "well managed" forests (see WWF 1995+ Group "Philosophy and *modus operandi*"). The UK timber trade also has not ignored calls for action to be taken to ensure that only timber supplied from "sustainable" sources is imported. However, as yet, there is no internationally agreed definition of, or accepted criteria for "sustainability". A supplier may be able to provide evidence that timber comes from a "sustained yield" source i.e. managed to provide a continuous supply of timber, but sustainability encompasses many other issues, including bio-diversity, environmental impact and socio-economic problems. Until international agreement is reached, any claims regarding the supply of timber or timber-based products from a "sustainable" source should be treated with caution.

Timber certification
There is widespread acceptance worldwide of the concept of timber certification, and it is anticipated that internationally recognised schemes will be operational by the year 2000, the target date set by the International Tropical Timber Organisation (ITTO) for achieving sustainable management of all tropical forests, and will cover timber sourced from temperate, boreal and tropical forests.

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[1] Temperate forests: Mixed broadleaved and coniferous, located in the subtropical areas of Europe, Asia, Australasia, North and South America.

Boreal forests: Mainly coniferous, located across the far northern areas of Canada, Europe and the former USSR.

The certification process will be in two stages:

- Forest management certification: Independent assessment of forest management practices according to predetermined standards.

- Wood product certification ("labeling"): Tracing of wood harvested in certified forests through all stages of transport, processing and marketing to the finished product (the "chain of custody").

Further information on the progress in timber certification schemes worldwide may be obtained from Forests Forever (FFC), an independent advisory body initiated by the Timber Trade Federation (TTF).

Banned woods
The Convention on International Trade in Endangered Species (CITES) lists wood species that are threatened. Currently seven softwood species and two hardwood species are officially listed as endangered (Appendix I), and are banned from international trade. A further group (Appendix II) is subject to strict regulation in order to avoid utilisation incompatible with the survival of the species. For further information see FFC Explanatory Note on CITES or contact the DOE, UK CITES Management Authority.

Specifying wood responsibly
FFC advise against using the terms "sustainable" and "independently certified" in specification clauses until international agreement on their meaning is reached, and *bona fide* certification schemes are in place. Instead, they recommend that specifications place conditions on the timber supplier, rather than on the "sustainability" of a particular species – see [proposed] Clause 140. A substantial number of timber related companies in the UK have adopted FFC's *Environmental Purchasing Policy* and should be able to confirm that all timber supplied has been derived from legal sources and, where possible, that it has been harvested in accordance with the laws and regulations governing forest management in the producer country. Details of the national forest management policies of the major countries supplying timber to the UK are given in a guide published by FFC.

The specification of familiar woods is common practice. However, where time for research is available, the use of less well known species should be considered. This takes pressure off overexploited species and encourages more productive use of forests containing a wide range of species. The Timber Trade Federation can provide information on the availability of particular wood species, and information on their technical properties may be obtained either from TRADA (Timber Research and Development Association) or BRE (Building Research Establishment).

References
Hansom , O P 1985 "TRADA Research Report 6/85: The tropical closed forest" TRADA

Overseas Development Administration "Forest strategy" [date, publisher]

WWF 1995+ Group 1995 "Philosophy and *modus operandi*" World Wide Fund for Nature

Forests Forever 1996 "Information Paper 2: Progress in timber certification schemes world-wide: Summary" RJW Oliver, October

Forests Forever 1996 "Directory of National Forest Policies" FFC/TTF, September

Forests Forever 1996 "Explanatory Note on CITES" FFC, January

[Proposed] Clause 140 [Not included in NBS]
140 ENVIRONMENTAL POLICY FOR WOOD AND WOOD BASED PRODUCTS:
- Timber and wood based product suppliers must have adopted an environmental policy for wood and wood products and must show evidence of commitment to that policy. A copy of the policy must be provided upon request by the CA [contract administrator].

- For each parcel of timber or wood based products provide CA with details of source of wood and where possible the nature of forest management at source."

D.2 NORTH AMERICA

Canada

CSC (Construction Specifications Canada) is the national Canadian association of construction specifiers and product representatives, mirroring the US CSI. CSC is an ICIS member. While CSC does not produce a specification, the Canadian Government does. The NMS (National Master Specification) is produced by Public Works and Government Services Canada's (PWGSC) Real Property Services (RPS). PWGSC is not an ICIS member. There is also a private sector system, CMS (Canadian Master Specification). CMS is not an ICIS member. The response given here is about NMS.

> "Generally, Canadians have not been very "environment" oriented in the recent past. I am not sure of the reason except to suggest that we have so much land area, so much in natural resources (exporting most of it), that we are probably far too casual with respect to our own bad habits. Our federal government has recently become more interested in this area and hence have charged Ian [Bartlett] to get involved."
> Wayne Watson, W2 Consultants

This table summarises Ian Bartlett's response, which follows in full:

#	***Query***	***Canadian Response***
1	Whose initiative was the work?	Canadian Government via the "Auditor General Act" amendments of December 15, 1995.
2	Is there a background policy to the work?	PWGSC's Real Property Services (RPS) "Sustainable Development Strategy".
3	Does the work cover statutory & voluntary green issues, & OHS?	Yes, all three.
4	What green issues are being considered? Is there a model?	The 6 priority issues are: - toxic or hazardous substances and waste management; - ozone depleting substances; - non-hazardous solid waste management; - energy and water efficiency in facilities; - contaminated sites management; and - land and marine/fresh water activities management. Mostly based on these Canadian Standards: - CSA Z760 -94 - Life Cycle Assessment. - CSA Z762 -95 - Design for the Environment.
6	What are the work stages?	NMS staff developed an action plan with goals and objectives, directly supporting integration of RPS sustainable development principles into NMS policies and operations. The RPS SDS was examined in detail to see where the NMS already had sections which could be updated to meet the sustainable development requirements, and to identify where there were gaps in the coverage of the NMS for sustainable development purposes. This allowed the NMS to identify pertinent goals. The NMS database of sections was then scrutinized to decide on the most effective way to improve these areas. NMS was then modified (see below).

#	*Query*	*Canadian Response*
		Then NMS staff undertook communication and training about this initiative.
8	How is the work being staffed? and funded?	Staffed internally, by NMS. [no response on funding]
9	What will be the outcome?	Environmentally responsible specification text (amended and new) and guidance.
10	Will specification text be modified? Will global bans be used?	Yes - environmentally responsible choices have been added to many sections (see full 1998 list below). [no response on global bans]
12	Will guidance material be provided? What form will it take?	The environmentally responsible choices are highlighted by prefacing each paragraph containing an environmentally responsible choice with a SPEC NOTE: ENVIRONMENTAL. The environmental group at PWGSC has published a document titled *An Architect's Guide to Sustainable Design in Offices and Buildings*. NMS staff took excerpts from this document and related them directly to many of the existing NMS sections.
13	Are any work groups being prioritised?	Yes - see the full text of Ian's response, below.
14	Are new work sections proposed?	Nine new green sections were published over 1998: 01355 Waste Management and Disposal 01356 Procedures for Deconstruction of Structures 01357 Hazardous Waste Materials 01358 Toxic Waste 02115 Underground Storage Tank Removal 02227 Deconstruction of Structures 02952 Contaminated Sites 13285 PCB (Polychlorinated Biphenyl) Abatement 13286 Hazardous Waste Materials Several other new green sections were published in 1997.

"SUSTAINABLE DEVELOPMENT STRATEGIES
Public Works and Government Services Canada (PWGSC)
Public Works and Government Services Canada have advanced a Sustainable Development Strategy (SDS) in response to the Auditor General Act.

Directorates within PWGSC have responded with supporting SDSs. One such Directorate is Real Property Services (RPS) who have a Sustainable Development Strategy in place to efficiently and effectively manage environmental issues in federal buildings under its custody, and in the service s provided to its clients.

RPS is the federal government's centre of expertise for environmentally sound real property management. They are a team of experts from coast to coast with experience in handling environmental issues through the entire life cycle of buildings.

They keep abreast of the rapid changes in the environmental scene and in new environmental technology. Through research and development, they continuously enhance their skills and knowledge base and find improved ways of doing things. One of their current focuses is on developing new, cost-effective green construction, demolition and renovation practices.

NATIONAL MASTER SPECIFICATION (NMS)

Methodology

As a result of amendments to the Auditor General Act on December 15, 1995 each federal government department was required to table a Sustainable Development Strategy (SDS) prior to December 31, 1997. Ministers are required to update their SDS every three years and report annually on their progress towards sustainable development in Part 3 of their Main Estimates. As a response to this legislative requirement, the Real Property Services (RPS) branch of Public Works and Government Services Canada (PWGSC) developed an SDS which sets out the goals, objectives and actions required for integrating the sustainable development strategies into its policies and operations. The RPS strategy forms an integral part of the overall SDS for PWGSC.

The staff at the National Master Specification (NMS) in turn developed an action plan with goals and objectives which directly support the integration of the RPS sustainable development principles into its policies and operations.

The RPS SDS was first examined in detail to see where the NMS already had sections which could be updated to meet the sustainable development requirements as well as to identify where there were gaps in the coverage of the NMS for sustainable development purposes. This allowed the NMS to identify pertinent goals. Through these goals, the NMS has been able to provide a tool which supports RPS and assists in the integration of a comprehensive environmental management system into the overall RPS management framework. This will assist RPS in demonstrating due diligence, and will ensure that environmental performance is achieved and sustained according to established objectives.

The criteria used by the NMS to determine the environmentally responsible choices (ERC) which have been added to the NMS are based, for the most part, on the requirements of two Canadian Standards Association documents: CSA Z760 -94 - Life Cycle Assessment, and, CSA Z762 -95 - Design for the Environment.

The NMS staff identified several areas of concern within the RPS SDS where the NMS could be used as an effective tool to implement the SDS objectives. Although the goal is to “green” all of the NMS sections, there were six areas identified within the RPS SDS that could immediately be targeted for action. These six were chosen as having the greatest environmental impact. They were:

- toxic or hazardous substances and waste management;
- ozone depleting substances;
- non-hazardous solid waste management;
- energy and water efficiency in facilities;
- contaminated sites management; and
- land and marine/fresh water activities management.

Each of these items was identified as a high priority item in the “greening” process of the NMS.

The NMS database of sections was then scrutinized to decide on the most effective way to improve these areas. The following is a description of the actions taken.

Toxic or hazardous substances and waste management

There were several places in the NMS where this was addressed. First of all, three existing sections dealing exclusively with asbestos abatement were updated to include the most current practices, codes and regulations for the asbestos abatement industry:

- A new Division 1 section was developed for the removal and disposal of hazardous materials.
- A new Division 1 section was developed for the removal and disposal of toxic materials.

- A new technical section was developed for the removal and disposal of hazardous materials.

A new technical section was developed for the storage, safety and management of PCB materials. This new NMS section written to address

- decontamination requirements for reuse and recycling of polychlorinated biphenyl (PCB) transformers; storage site management; and

- leak and spill safety and labeling.

Twenty existing NMS sections were updated to include information advising against the selection of PCB containing products.

The two existing NMS sections for the installation of aboveground and underground storage tanks were updated to reflect more environmentally responsible practices. Additions have been made throughout each of these sections encouraging maximum leak and spill protection.

A new NMS section was also developed for the removal of underground storage tanks. The new section outlines the basic procedures that must be followed when removing underground storage tanks, including government regulations, safety and environmental requirements and licensing.

Ozone depleting substances
Seventeen sections of the NMS were identified as having an impact on ozone depletion. These were reviewed by specialists in that field and updated with more environmentally responsible choices and practices.

Non-hazardous solid waste management
The existing NMS sections dealing with construction related demolition were updated to reflect more environmentally responsible procedures. There were also two new NMS sections developed dealing with deconstruction and dismantling. The first new NMS section was a Division 1 section addressing the administrative and procedural aspects of deconstruction and dismantling, and the second new NMS section was a Division 2 section addressing the more technical aspects of deconstruction and dismantling.

One other important initiative that was undertaken by NMS staff in this area was the negotiations that took place with the committee that was updating *SectionFormat* ©. [2] A new article heading in Part 1 of *SectionFormat* © which reads "Waste Management and Disposal" was included in the updated version of the format document. This may not seem like much at first glance, but does in actual fact have far reaching consequences. What this simple article heading means is that the NMS (and every other master construction specification for that matter) now has a consistent place to address this problem in every specification section. The NMS is treating the waste management and disposal of materials on the construction site in a manner similar to its use of the article for shop drawings (i.e. the Division 1 section deals with the administrative and procedural aspects related to shop drawings and the technical sections deal with the technical and specific requirements for materials and products included in the individual sections. e.g. the Division 1 section explains how shop drawings should be submitted, their size and how many copies are required, whereas, the technical section for, say, doors would outline the requirements that should be included on the shop drawing such as hardware locations).

As a result of this new article in *SectionFormat* ©, the NMS has produced a new Division 1 section and is in the process of including a Waste Management and Disposal article in each and every technical section in Divisions 2 through 16.

Energy and water efficiency in facilities
Twenty-eight existing NMS sections were identified as having a direct effect on energy conservation through the use of energy efficient products and equipment, practices and were updated with information outlining more environmentally responsible choices. This mainly targeted products and equipment that use energy such as

[2] *SectionFormat* is a North American specifications formatting document jointly owned and published by Construction Specifications Canada (CSC) and the Construction Specifications Institute (CSI) in the United States.

electricity, gas or oil directly. Items such as thermal insulation or insulated glass units are being dealt with separately.

Contaminated sites management
The existing NMS database of sections did not address the problems associated with contaminated sites. A new Division 1 section was developed to address the administrative and procedural aspects associated with contaminated sites. Two other new technical sections were developed to deal with specific areas of concern. The first deals specifically with hydrocarbons and the other section addresses other forms of site contamination.

Land and marine/fresh water activities management
Four existing NMS sections were identified as having an impact on wastewater management. These sections were reviewed and updated to include the most current environmentally responsible choices and practices.

A further six existing sections relating directly to marine activities were reviewed and updated to include the most current environmentally responsible choices and practices. These activities included dredging, channel excavation, pontoons and other mooring devices, and the preservation of water courses.

Other initiatives
The NMS includes information aimed directly at specification writers to assist them in making informed and correct decisions about the various choices and options available to them in the master specification when they are preparing their project specific contract documents. The vehicle that the NMS uses to highlight this information for specification writers is called a SPEC NOTE. The environmentally responsible choices are further highlighted by prefacing each paragraph containing an environmentally responsible choice with a SPEC NOTE ENVIRONMENTAL.

The environmental group at PWGSC has published a document titled *An Architect's Guide to Sustainable Design in Offices and Buildings*. The NMS was able to take excerpts from this document and relate them directly to many of the existing NMS sections.

The most difficult thing in an initiative such as has been undertaken by the NMS staff is how to communicate to the rest of the construction industry exactly what is being done. The NMS staff have approached this in several different ways. There have been workshops for federal government people from all across the country who are involved with writing construction specifications and contract documents. There has been a cross-country tour to all regions of PWGSC with a presentation outlining the RPS SDS of which the "greening" of the NMS is an integral part. The NMS has held an Environmental Update Forum and several meetings with interested private sector groups, particularly trade and manufacturers' associations. The NMS staff have also written articles for construction and environmental related magazines and newsletters.

However, the most important tool that has been used to communicate this information is the NMS itself. This is not only through the sale and distribution of the NMS, but through the NMS staff encouraging as many public and private sector groups and individuals to become involved in the NMS review and update process. The NMS staff has asked for, and received, the "buy-in" to the whole review and update process by, for the most part, the Canadian construction industry.

Conclusion
The "buy-in" of the process for "greening" of the NMS has shown that the Canadian construction industry as a whole, for the first time, is making a concerted effort to develop a construction contract documents tool which embodies the principles of sustainable development and which can be integrated not only into the operations of federal government buildings, but for buildings owned and operated by other governments and private sector entities. Participation in this initiative by the private sector has enhanced the outcome and highlights the opportunities for achieving more sustainable building practices in the future.

LIST OF NMS SECTIONS WITH ENVIRONMENTALLY RESPONSIBLE CHOICES
(Sections with + will be updates for 1998. Sections with ** are new NMS sections.)

Division 1
+01355 Waste Management and Disposal **
+01356 Procedures for Deconstruction of Structures **
+01357 Hazardous Waste Materials **
+01358 Toxic Waste **
+01561 Environmental Protection
+01562 Environmental Requirements (presently under review)

Division 2
+02115 Underground Storage Tank Removal **
02221 Demolition of Structures Short Form
+02222 Demolition of Structures
+02225 Sitework Demolition and Removal
+02227 Deconstruction of Structures **
+02231 Clearing and Grubbing
+02233 Preservation of Topsoil
02311 Site Grading
+02315 Excavating, Trenching and Backfilling
02361 Chemical Control of Vegetation
02379 Preservation of Watercourses
+02476 Fixed End Caisson Piles (Rock Socketed)
+02530 Sewerage
02531 Sewage Force Mains
+02541 Precast Concrete Septic Tank
02542 Disposal Fields for Septic Tanks
02553 Telethermics - Thermal Insulation
02622 Foundation and Underslab Drainage
02630 Storm Drainage
02742 Asphalt Concrete Pavement for Section Building Sites
02747 Reshaping Asphalt Pavement
02870 Site Furnishings
+02901 Tree and Shrub Preservations
02911 Topsoil and Finish Grading
+02952 Contaminated Sites **

Division 3
+03100 Concrete Forms and Accessories
03200 Concrete Reinforcement
03300 Cast-in-Place Concrete Long Form
03301 Concrete for Bridge Decks
03302 Cast-in-Place Concrete Short Form
+03306 Underwater Concreting
03361 Concrete Floor Hardeners
03362 Concrete Floor Treatment
+03371 Shotcrete
03410 Plant-Precast Structural Concrete
03450 Plant-Precast Architectural Concrete
03481 Precast Concrete Parking Curbs

Division 4
+04411 Marble
04412 Granite
04420 Collected Stone

Division 5
05210 Steel Joists

Division 6
+06071 Historic Structures: Long-Term Treatment of Wood
+06072 Historic Structures Eradication of Insects in Wood
+06073 Historic Structures - Antiseptic Treatment for Wood
+06100 Rough Carpentry Long Form
06101 Rough Carpentry Short Form
+06131 Historic Structures Period Horizontal Log Work
06180 Glued-Laminated Structural Units
+06200 Finish Carpentry
+06400 Architectural Woodwork
06911 Historic Structures: Splicing of Wooden Components
06912 Historic Structures Storage and Protection of Wood

Division 7
07212 Board Insulation
07213 Batt and Blanket Insulation
07215 Spray-Applied Cellulose Insulation
07217 Spray Applied Mineral Fibre Insulation
07610 Sheet Metal Roofing
+07900 Joint Sealers

Division 8
+08110 Steel Doors and Frames

Division 9
09250 Gypsum Board
09310 Ceramic Tile
09510 Acoustical Ceilings
+09651 Resilient Tiles Flooring
+09652 Resilient Sheet Flooring
+09710 Acoustical Wall Treatment
09721 Vinyl-Coated Fabric Wall Fabric
09911 Interior Painting
+09912 Exterior Painting

Division 10
10200 Toilet, Bath and Laundry Accessories
+10618 Stud Type Demountable Partitions

Division 11
+11405 Prefab Walk-In Freezers and Coolers

Division 12
12500 Furniture

Division 13
+13201 Oil Storage Tanks - Underground (Including Mounded)
+13202 Oil Storage Tanks - Aboveground
+13281 Asbestos Abatement Minimum Precautions
13282 Asbestos Abatement Intermediate Precautions
13283 Asbestos Abatement Maximum Precautions
+13285 PCB (Polychlorinated Biphenyl) Abatement **
+13286 Hazardous Waste Materials **
+13930 Wet Pipe Fire Suppression Sprinklers
13935 Dry Pipe Fire Suppression Sprinklers

13961 Carbon Dioxide Extinguishing Systems - Total Flooding
13962 Carbon Dioxide Extinguishing Systems - Local Application
13966 Pre-Engineered Wet Chemical Fire Protection System
13971 Pre-Engineered Dry Chemical Fire Protection System

Division 15
+15401 Plumbing Specialties and Accessories
+15411 Plumbing Fixtures and Trim
+15440 Plumbing Pumps
+15531 Forced Air Furnaces
15601 Process Refrigeration
15621 Packaged Reciprocating Water Chillers
15622 Packaged Centrifugal Water Chillers
15623 Packaged Absorption Water Chillers
15624 Packaged Rotary-Screw Water Chillers
15641 Cooling Towers - Induced Draft Crossflow
15702 Forced Air Heaters
15703 Incremental Heating and Cooling Units
15721 Built-Up Air Handling Units
15722 Packaged Air Handling Units
15731 Computer Room Air Conditioning System
15740 Heat Pumps
15763 Baseboard Convectors - Residential (presently under review)
+15764 Baseboard Convectors - Commercial (presently under review)
+15765 Unit Heaters (presently under review)
+15766 Unit Heaters (presently under review)
+15767 Unit Ventilators (presently under review)
+15768 Electric Infrared Radiant Heaters (presently under review)
+15769 Cabinet Convector Heaters (presently under review)
+15771 Heating Cables - Snow Melting (presently under review)
+15772 Heating Cables - Floor Warming (presently under review)
15821 Dampers - Balancing
15822 Dampers - Operating
+15831 Commercial Fans (presently under review)
+15832 Domestic Fans (presently under review)
15861 Filters and Filter Gauges
15916 Electric Heating and Cooling Controls

Division 16
16061 Grounding - Primary
16121 Power Cable and Overhead Conductors (1001 V)
16139 Multi-Outlet Assemblies
+16221 Motors-Fractional Horsepower
+16222 Motors: [1 to 200 hp] [0.746 kW to 149 kW] to 600 V (presently under review)
+16223 Motors Starters to 600 V
+6224 Motors Controllers - 2000 to V (Non-Hazardous)
+16225 Motor Control Centre (presently under review)
16273 Transformer Vault Equipment to 15 kV
16274 Distribution Transformers-Liquid Cooled
16276 Pad Mounted Distribution Transformers
16278 Outdoor Substation to 15kV
16281 Capacitors for Power Factor Correction
+16302 Hospital Operating Rooms, Isolated Power Supply
+16341 Primary Switchgear Assembly to 15 kV
+16361 Unit Substation to 15 kV
+16422 Fire Pump Control
+16423 Control Devices
+16431Secondary Switchgear

16442 Panelboards Switch and Fuse Type
+16443 Generator Switchboard To 600V
+16444 Generator Switchboard Over 600 V
+16461 Instrument Transformers
+16505 Lighting Equipment
+16512 Inset Lighting (presently under review)
+16521 Airport Lighting General
+16525 Floodlighting - Exterior (presently under review)
+16527 Visual Approach Slope Indicator System
+16528 High (and Low) Intensity Approach Lighting System
+16529 Low Intensity Approach Lighting System
+16531 Exit Lights (presently under review)
+16563 Red Hazard Beacon
+16571 Lighting Control Equipment Dimming - Incandescent (presently under review)
+16572 Lighting Control Equipment Dimming -Fluorescent (presently under review)

ARCOM, United States
ARCOM is a private company of architects, engineers, researchers, computer scientists, and support personnel engaged in the business of researching, writing, and publishing master construction specifications for use by architects and engineers. ARCOM has a contract with the American Institute of Architects (AIA) to maintain and sell MASTERSPEC Specifications on behalf of the AIA. AIA retains the copyright for MASTERSPEC. ARCOM is a member of ICIS and Michael J. King, Director of Engineering Specifications, is the Delegate to ICIS representing ARCOM.

MASTERSPEC is sold on an annual license basis. Licensed users of MASTERSPEC are sent updated and new sections every three months during the license year. MASTERSPEC is licensed in packages of specifications sections organized by design discipline. The following are packages:

Architectural/Structural/Civil
Mechanical/Electrical
Structural/Civil
Interior Design
Landscape Architecture

In 1998, there were a total of 9,170 licensed users of the various MASTERSPEC packages listed above. There are also separate packages of special specifications as listed below:

Small Project Specification: for project that are short in duration and modest in scope.
Outline Specifications: for use in early design phases to communicate design decisions between the architect/engineer to the building owner.

ARCOM is currently developing a “Short Form” specification to complement the full-length specifications listed in the packages above.

Mike King, ARCOM
"Environmental issues are largely a design problem. However, where does design end and specifying begin. My belief is that there is no line separating these two activities. The common area to both activities is product selection. Once a product or system is selected, specifications can not make them ... more energy efficient, longer lasting, easier to recycle, or better serve the building's life cycle. The KEY is proper product selection and systems design. The PROBLEM is knowing where to get the information that facilitates that proper selection. My perception of the NEED is a resource guide like American Institute of Architect's *Environmental Resource Guide*, Washington, DC. John Wiley & Sons, Inc, 1998 ISBN 0-471-14043-0.

One concern is the extent of questions one must ask of manufacturers to get a comprehensive picture of their products in relation to environmental issues. Most manufacturer's representatives are not focussed on these issues and the information at their disposal is insufficient on these issues. When you do find someone with this interest, they can overwhelm you with data and it is difficult to sift through it all.

... I am finding some resistance to including research on environmental issues, primarily because there are so many other priorities. I think this is the same situation where many architects and engineers in the U.S.A. find themselves. ... It seems that the interest in environmental issues here is spotty, at best. Where there is interest, it is very intense; where there is no interest, well, it is more than indifference, I would say attitudes are unfortunately negative. The motivation for sustainable and energy efficient design must come from the building owners the architects and engineers serve. Architects and engineers can only encourage their clients toward being environmentally responsible, and when they do so, they must have the resources to support the effort."

Martha Radcliffe and Mike King, ARCOM

#	***Query***	***ARCOM Response***
1	Whose initiative was the work?	ARCOM has taken the initiative to include articles in the reference materials for each master specification section that addresses environmental and energy considerations. These articles are included in a document attached to each master specification section we call "Evaluations." The content of these articles will vary depending on the subject, but typically attempt to present the environmental and energy efficiency issues that architects and engineers should consider when making product selections and editing the specification.
2	Is there a background policy to the work?	No, there is no policy statement developed by ARCOM. The AIA has a "Professional Interest Area" (a group of volunteer members) who meet to discuss environmental issues, but the PIA is not regulatory, only informative. Federal Government agencies have been given some mandates for energy efficiency. However, the regulations and their promulgation are extremely difficult to find and understand.
3	Does the work cover statutory & voluntary green issues, & OHS?	With the exception of the regulatory issues mentioned above for Federal Goverment agencies, most, if not all, "green work" is voluntary.
4	What green issues are being considered? Is there a model?	Most of the "green issues" focus on energy efficieny. This is due primarily because there is a direct and reasonably quick payback to building owners. This payback makes convincing owners to be environmentally responsible easier. There is no general model for energy efficiency and environmental or sustainability issues. Each subject (construction product or activity) is considered on its own merits. The AIA *Environmental Resource Guide* offers some appearance as a model by identifying issues for several products. One can glean from it ideas for questions to pose to product manufacturers relative to energy and environmental issues.
5	What is the priority of the work?	Unfortunately, the priority for ARCOM is lower than most other production issues. Within the architectural and engineering community, the priorities are also very low, taking a "backseat" to production and performance issues. Architectural and engineering design fees do not normally support the kind of research necessary for green design and product selection. Designers are squeezed for fees and production time which creates an attitude by architects and engineers towards expedient design solutions that are not necessarily environmentally responsible.
6	What are the work	ARCOM is adding environmental and energy efficiency

#	*Query*	*ARCOM Response*
	stages?	considerations articles to the "Evaluations" documents supporting each specification section through the updating process. This process takes ARCOM between three and five years to update the over 500 MASTERSPEC specifications sections. Most specifications sections have these articles, but they are currently not very comprehensive. There is a special project underway for Water Chillers. Plans are to update the current five master specification sections for the December 1999 update of the Mechanical/Electrical Library. See details below.
7	What reviews are planned?	MASTERSPEC specification sections are reviewed by a committee of volunteer, practicing architects and engineers. Part of that review includes a review of the Evaluations supporting the sections. In the Water Chiller update, the specifications sections are being reviewed and assistance is being rendered by Green Seal. See details below.
8	How is the work being staffed? and funded?	We have assigned one of our architectural writers [Martha Radcliffe] to be the focal point for environmental issues. We met with Sandra Mendler of HOK to see if it was feasible to co-operate on some efforts. We are still considering this question. For the Water Chiller update project, funds have been applied for through a proposal to the U.S. Department of Energy. However, most of the work will be done even if the Department of Energy does not grant the funds. Most funding will be absorbed by ARCOM in its normal update production costs, even if the DoE grants funds. See details below.
9	What will be the outcome?	Revised Section Text and Evaluations. Each section will have a comprehensive presentation of issues about environmentally responsible project selections and energy efficiency from which architects and engineers can use along with the many other project criteria for product selection. For the Water Chiller update project, the results will be a set of master specifications for water chillers that engineers can edit for energy efficiency and environmentally responsible selections. Green Seal has a certification program for electric water chillers and this will be an option for engineers to choose when editing MASTERSPEC for projects.

#	*Query*	*ARCOM Response*
10	Will specification text be modified? Will global bans be used?	Yes. Examples include: 02361 Termite Control. Inclusion of bait products. 02881 Playground Equipment. Inclusion of optional text for recycled plastic and sustainably sourced wood. 08163 Sliding Aluminum-Framed Glass Doors and 08263 Sliding Wood-Framed Glass Doors: Thermal considerations. Division 2: Options for stockpiling of topsoil, reuse of site soils, composting, tree protection, and recycling asphalt paving. Division 3: Reuse of aggregates as allowed per ASTM C33 and option for fly ash and silica fume. Waterproofing: Volatile Organic Compound (VOC) regulation. Flat Roofing: Thermal considerations. HCFC blowing agent and options for roof color. No global bans will be posted in MASTERSPEC since MASTERSPEC is used on a voluntary basis by architects and engineers and ARCOM and the AIA do not have regulatory authority for product selections.
11	How pragmatic will the greening be?	Pragmatic application of green issues is the primary way greening will take place in the U.S. Within MASTERSPEC, the answer is the same. Most research is done to find products that are nationally distributed, that meet regulatory requirements, industry and trade association standards, and can be specified in the framework of our system. Very little regulatory requirements and industry standards focus on environmental issues and only a few on energy efficiency issues.
12	Will guidance material be provided? What form will it take?	ARCOM has begun to address environmental issues in our "Evaluations" (what you called commentary). [For example:] 02361 Termite Control. Discussion of bait products using less pesticide or reduced risk pesticide, preventative design, and alternate methods including sand and basaltic rock particle barriers, stainless steel mesh, and biological agents. 02821 Chain-Link Fences and Gates. Discussion of lead free Zn-5-Al-MM alloy coating. 02881 Playground Equipment. Discussion of materials re environment in general. 08163 Sliding Aluminum-Framed Glass Doors and 08263 Sliding Wood-Framed Glass Doors: Thermal considerations. Division 2: Options for stockpiling of topsoil, reuse of site soils,

#	*Query*	*ARCOM Response*
		composting, tree protection, and recycling asphalt paving. Division 3: Reuse of aggregates as allowed per ASTM C33 and option for fly ash and silica fume. Waterproofing: VOC regulation. Flat Roofing: Thermal considerations.
13	Are any work groups being prioritised?	Water chillers and boilers are being prioritized for 1999. In depth research is being conducted primarily on energy efficiency issues and secondarily on environmental issues. For example, refrigerant types and refrigerant leaking issues are being researched for the major water chiller manufacturers in both the manufacturing and testing processes and the owner operating and maintaining arena.
14	Are new work sections proposed?	Some green sections exist e.g. 04901 Clay Masonry Restoration and Cleaning Section. We also have 04902 Stone Restoration and Cleaning and 02070 Selective Demolition which includes saving parts of existing buildings, salvaging, salvaging for reinstallation, etc. Thermal storage is propose for late in 1999 or early in 2000. Other energy recovery sections are on the list of proposed mechanical sections. In the electrical sections, new work is being done on electric motors and variable frequency controllers for motors.
15	Are you willing to share the outcomes with other ICIS members?	Yes.

WATER CHILLER UPDATE PROJECT

For this project ARCOM has entered into an agreement with Green Seal to serve as a consultant to ARCOM. To our knowledge, Green Seal is the only organization in the US recommending energy- efficient products that meet the EPA's standards for third party certification. Specifically, Green Seal has developed:

- An open, public process used to develop the Green Seal standards
- Transparent, published standards
- A system of data verification
- A peer-review process

In addition, Green Seal complies with ISO 14020 and ISO 14024 criteria and the standards of the Global Ecolabeling Network. Green Seal is the US member of this international harmonizing organization.

Green Seal is the sole source for recommendations of energy-efficient products that take a life-cycle approach. Green Seal's standard for electric chillers, for instance, includes requirements for energy efficiency, refrigerant, leakage, testing methods, noise levels, and labeling. By contrast, U.S. Federal Energy Management Program, with which Green Seal closely coordinated its standard, is concerned only with energy efficiency. Green Seal's life-cycle approach results in less impact on the environment.

Green Seal's staff and consultants are among the nation's leading experts on energy efficiency and green products. Green Seal's concentration exclusively on environmental procurement, its nine years of experience in the field, and its knowledgeable staff enable Green Seal to complete projects quickly and with authority.

Green Seal has extensive knowledge of HVAC because they have prepared standards for electric chillers, residential central air conditioners, heat pumps, and room air conditioners. Green Seal has certified products that comply with these standards for manufacturers like Carrier, Panasonic, and Trane.

The use of an independent, established, nonprofit organization to define environmental responsibility for the chiller specifications and reliance on Green Seal's publicly reviewed, transparent standards in MASTERSPEC Evaluations will increase the acceptance of MASTERSPEC chiller specifications.

Green Seal's project tasks include:

· Act as consultant, providing advice and counsel to ARCOM and the MASTERSPEC Engineering Review Committee on the definition, identification, and testing of environmentally responsible chillers.

· Provide comparisons of the energy and environmental impact of various types of chillers.

· Prepare and execute the announcement and promotion program.

· Review and update the existing Green Seal standards for electric water chillers.

· Direct the preparation of standards for direct- and indirect-absorption water chillers using a stakeholder process and public review.

· Prepare the audit plan and mail the questionnaire.

· Analyze the results of the questionnaire response and prepare a report.

· Interview manufacturers, compile, analyze results, and prepare a report.

· Solicit participation of national water chiller manufacturers in the Green Seal certification program.

The following is an excerpt from a letter sent to the five major water chiller manufacturers in a effort to solicit their participation in updating MASTERSPEC chiller specification sections. This excerpt discusses the update process and the goals of the update project. This is being viewed by ARCOM as a pilot project with hopes that other subjects can be done in a similar and comprehensive manner.

> "MASTERSPEC and Green Seal are beginning a project to develop environmentally responsible and energy efficient water chiller specifications for MASTERSPEC Specifications. This project will involve updating five existing MASTERSPEC sections. There are more than 2,200 licensed users of the Mechanical/Electrical Library of MASTERSPEC and many Federal government agencies require their contract A/Es use MASTERSPEC. The most notable is the General Services Administration.
>
> We are asking for your help on this project through your review of existing sections and contributions of technical information. The five existing sections include the following:
>
> 15621 — Indirect-Fired Absorption Water Chillers
> 15622 — Direct-Fired Absorption Water Chillers
> 15625 — Centrifugal Water Chillers
> 15628 — Reciprocating Water Chillers
> 15684 — Rotary-Screw Chillers
>
> The process for updating MASTERSPEC sections involves many people and spans several months. First, we have a technical review committee made up of six volunteers and seven consultants, and each is a professional engineer. These engineers come from variety of firm sizes and different parts of the U.S. and Canada. This committee met on 26-27 February 1999 and reviewed the five existing chiller sections.
>
> The next step is for the engineer responsible for updating the sections to conduct specific research. That research includes reviewing all applicable standards and trade association publications and

consulting with national manufacturers. The results of this research will be draft sections and their supporting documentation for a technical review. Once that is done there will be an editorial review and other processing for production and distribution to licensed MASTERSPEC users.

Our plans are to conclude the process by issuing the updated sections with our December 1999 update. Each of the current sections has a supporting document we call "Evaluations." This document includes information for MASTERSPEC users to help them make informed decisions during product selection and specifications development. Among the articles typically presented in our Evaluations are "Product Characteristics," "Product Selection and Application Considerations," Environmental Considerations," "Energy Considerations," "Referenced Standards," "References," and "Manufacturers." During this project, Green Seal will be working for us to research and write the articles for "Environmental Considerations" and "Energy Considerations."

This letter serves to introduce you to the two engineers who will be working on this project with me and who will be contacting you directly for specific information. The primary writer of these sections will be Jawahar Chaudhary, P.E. Chaudhary is a mechanical engineering consultant to ARCOM and has written several sections of MASTERSPEC for us. Chaudhary will be asking you various technical questions relating to the chillers you manufacture. His questions will cover a broad range of issues about chillers. Green Seal will be serving as a consulting firm for ARCOM and has assigned Mark Petruzzi as their project engineer. Mark will be focusing on the environmental and energy issues. Mark will be updating the Green Seal Standard GS-31 "Environmental Standard for Electric Chillers." He will also be gathering information for development of a potential, new environmental standard for absorption chillers. Mark will be gathering information for product comparisons among the various chiller types and among chiller attributes. This research will result in tables to be included in the MASTERSPEC Evaluations for these sections.

Our objective is to provide information that will allow engineers to decide first among chiller types (absorption and compression) and then among the various types within these to major categories based on their project requirements. MASTERSPEC will not be taking a position on which type is best, because only the project engineer can determine that and their determination is based on criteria and requirements unknown to the MASTERSPEC writers. We intend to identify and compare critical characteristics and attributes about chillers in general and about the environmental and energy issues in particular.

Our preliminary plans are to develop two questionnaires for you to answer. We see this as a multiple-step process. The first step is to solicit your help in developing the questionnaire. We will create a working draft for distribution, then invite your comments on the comprehensiveness and appropriateness of the questionnaire. Then we will meet with you to brainstorm the final questionnaire which will be mailed to each chiller manufacturer for response. The next step is to draft the updated sections and ask your critique of that material. If necessary, we will hold another meeting of the manufacturers to discuss questions and concerns. The draft will also be reviewed by our technical committee at several steps in the process.

Our schedule begins immediately. We are planning the first meeting on Monday or Tuesday 22 or 23 March in the ARCOM offices in Alexandria, VA. I propose convening the meeting at 10 am to allow for local travel and adjourn around 4 pm. We will brainstorm the questionnaire and related issues. A detailed agenda and directions to the ARCOM office will follow this letter in a few days.

Please contact me with your interest and let me know if you are the correct person to help us with this project. When I receive your response, I will arrange to have the current chiller sections mailed to you for your use on this project.

I am looking forward to working with you."

CSI, United States
CSI (Construction Specifications Institute) is an international association of building specifiers, building-sector trade representatives, and others. CSI publishes the journal *The Construction Specifier*, and co-publishes *PerSpective*™, a performance-based master specification, prepared in a joint venture with DBIA (Design-Build Institute of America). CSI is an ICIS member.

#	***Query***	***CSI Response***
1	Whose initiative was the work?	US Green Building Council. As for joint activities between USGBC and CSI my [Ross Spiegel] challenge this year (FY 1999, which runs from 01 July 1998 to 30 June 1999) is to create a strategic alliance agreement between the two organizations which sets forth common goals and programs we can achieve together. [CSI's Board approved the alliance in February 1999, USGBC's Board is expected to approve the alliance spring of 1999, with formalisation of the alliance due in June 1999.]
2	Is there a background policy to the work?	[USGBC's?]
4	What green issues are being considered? Is there a model?	[The model is USGBC's LEED - see Appendix A.2.] [The alliance specification will be based upon measures of environmental concern identified under the LEED program criteria.]
5	What is the priority of the work?	Hopefully this [project] will come to pass sooner rather later.
9	What will be the outcome?	USGBC has strongly indicated that they would like CSI to develop standard guide specifications for "green" building materials which would tie into their LEED Green Building Rating Criteria program. This can be one of the "products" our alliance can produce. [The alliance will develop a performance-based specification format supporting the LEED rating system. CSI will develop the specification language for the building materials, for systems and for installations.]
10	Will specification text be modified? Will global bans be used?	[A master specification system for design-build, PerSpective™, is was published in 1999, as a joint venture between CSI and the Design-Build Institute of America. It is not known if the alliance specification will be incorporated in PerSpective™.]
12	Will guidance material be provided? What form will it take?	see 9.
14	Are new worksections proposed?	[Not applicable.]

NIBS, United States
At the time of the survey, and until late 1998, NIBS (National Institute of Building Sciences) published and maintained *SpecText*™, a master specification system which is owned by Construction Science Research Foundation (CSRF). Neither CSRF nor NIBS are members of ICIS.

#	***Query***	***NIBS Response***
1	Whose initiative was the work?	NIBS is managing with a major environmental committee, I [MK] think it is primarily governmental agencies, but there may be other organisations.
2	Is there a background	Federal Executive Orders.

#	***Query***	***NIBS Response***
	policy to the work?	They [*SpecText*] are watching developments in the federal government carefully.
3	Does the work cover statutory & voluntary green issues, & OHS?	[Statutory only so far.]
4	What green issues are being considered? Is there a model?	SpecText has added recycling content requirements in accordance with federal Executive Orders, but thus far has not done much else. *SpecText* and BPPAP [Building Products Pre-Approval Program] are separate [NIBS] activities though they tend to inform each other. [For more on BPPAP, see Appendix A.2.]
9	What will be the outcome?	[Amended text - no reports or guidance material.]
10	Will specification text be modified? Will global bans be used?	Yes. [no response on global bans]
12	Will guidance material be provided? What form will it take?	[There is no commentary or guidance material provided with *SpecText*.]
15	Are you willing to share the outcomes with other ICIS members?	[Not applicable - NIBS is not an ICIS member.]

D.3 AUSTRALASIA

Australia
Construction Information Systems Australia (CIS) is a private company owned by 20 industry shareholders, including RAIA (Royal Australian Institute of Architects), IEAust (Institution of Engineers, Australia), AIQS (Australian Institute of Quantity Surveyors), MBA (Master Builders Australia), SAA (Standards Australia), BDP (Australian Council of Building Design Professions) and the 8 Australian public works authorities (e.g. NSW Department of Public Works and Services). CIS publishes NATSPEC, the Australian national master specification system. CIS is an ICIS member.

#	***Query***	***Australian Response***
1	Whose initiative was the work?	Because special funding is not available, CIS can only "green" NATSPEC as part of the normal maintenance and development program. It is doing this slowly, at its own initiative, and in response to specifier interest in this area. However, following an initiative by an ex-Greenpeace environmentalist and an architect who have been involved in Sydney 2000 Olympics projects, CIS has prepared proposals seeking funding from the Australian Greenhouse Office for the greening of NATSPEC. The proposal was titled *Sustainable Specifying - a plan for the greening of the national building specification*.
2	Is there a background policy to the work?	CIS does not have an environment policy, though several of its 20 shareholders do (notably the RAIA, IEAust and NSW DPWS). The Australian Council of Building Design Professions (BDP) is about to adopt the RAIA's *Environment Design Guide* (EDG), an indication of the importance of this issue in the Australian building design sector. The EDG is therefore a central document for green building design. *Sustainable Specifying* is aligned to the National Greenhouse Strategy, and draws on the policies of the Olympic Co-ordination Authority.
3	Does the work cover statutory & voluntary green issues, & OHS?	NATSPEC is progressively addressing statutory (e.g. organochlorine deregistration) and voluntary (e.g. water efficient fixtures) green issues, and OHS (e.g. maximum stone sizes for safe manual handling). *Sustainable Specifying* covers all three.
4	What green issues are being considered? Is there a model?	Issues in the RAIA *Environment Policy* are being picked up where relevant, and are reflected in the content of the EDG. Eco-labelling is being picked up where available. There is no building-wide model for evaluating green issues, such as BREEAM, in Australia. For *Sustainable Specifying*, see 2.
5	What is the priority of the work?	The same as for other routine development and maintenance work. *Sustainable Specifying* envisages a 3-year funded project, and is underway now.
6	What are the work stages?	Updates are issued every quarter. These may include new work sections.

#	***Query***	***Australian Response***
		Sustainable Specifying sets several projects for 1999/2000, and others for 2000 onwards. Maintenance and development continues after that.
7	What reviews are planned?	See 6.
8	How is the work being staffed? and funded?	No special staff, no special funding. *Sustainable Specifying* will use 2 consultants, CIS staff, and external reviewers. Funding will come partly from AGO ($135,000 a year), and partly from CIS and shareholders and in kind contributions.
9	What will be the outcome?	Eventually, environmental and OHS issues will feature throughout the Commentary alongside other issues, and Template text and prompts will reflect this. *Sustainable Specifying* envisages, in the short term, a green version of NATSPEC *Domestic*, a new (and green) *Fitout* specification, and national workshops on green specifying. Beyond these, existing text will have flagged green options, new generic green sections will be developed, new proprietary green worksections will be developed, and all will have appropriate commentary. CIS also envisages being involved in developing assessment and evaluation methods.
10	Will specification text be modified? Will global bans be used?	Text will be modified e.g. defaults neutralised, prompts for environmental issues added. Global bans will not be used - they are being replaced by more pragmatic text. Ditto for *Sustainable Specifying*.
11	How pragmatic will the greening be?	Very - CIS is not about to force green specifying on anybody. The intention is that all legal and readily available choices will be offered. For example, the *Termite control* section covers chemical (e.g. organophosphate) and non-chemical (e.g. graded stone, stainless steel mesh, ant caps) termite control methods. Ditto for *Sustainable Specifying*.
12	Will guidance material be provided? What form will it take?	Yes it will. Green advice will be rolled into the existing Commentary, and includes cross-references to EDG and other material where relevant. Ditto for *Sustainable Specifying*. Green commentary will be flagged.
13	Are any work groups being prioritised?	No, though systematic greening of Services material is not happening at the moment. *Sustainable Specifying* will tackle Fabric and Services sections at the same time.
14	Are new worksections proposed?	Yes. A *Monolithic stabilised earth walling* section was published in 1997, and *Earth block walling* and *Gas flooding* (non-halon systems) are worksections due for publication in 1999. *Sustainable Specifying* envisages preparation of perhaps 12 new sections over the 3 year period, possibly including deconstruction,

#	*Query*	*Australian Response*
		environmental protection, brick repair, straw bale construction, natural fibre floorcoverings, rainwater tanks, septic tanks, composting toilets, solar water heating, and photovoltaics.
15	Are you willing to share the outcomes with other ICIS members?	Yes.

New Zealand
Construction Information Limited (CIL) is a private company owned by NZIA (New Zealand Institute of Architects), BRANZ (Building Research Association of New Zealand), JASMAX Architects Ltd and NZMBF (New Zealand Master Builders Federation). CIL is an ICIS member. CIL publishes the NZ national master specification, MasterSpec™.

> "I have discussed this environmental issue with the New Zealand Institute of Architects who are one of our shareholders. ... The NZIA has promoted its Environmental Policy to its membership since 1992. This [promotion] consisted of 21 position papers ... [and] 20 wall charts ... While this provided designers with a valuable resource, there is little mainstream support for environmental issues as a significant design factor.
>
> For example, one of New Zealand's largest timber producers is currently promoting the use of "chemical-free" timber, and is finding little if any support from designers or builders. Most locally-grown softwoods are treated with either boron salts (for borer protection) or CCA (for durability in damp and/or subgrade locations).
>
> Much of the initiative for environmental issues, particularly those affecting safety and the workplace, come from the Department of Labour's network of OSH (Occupational Safety and Health) offices. Publications such as "Management of lead-based paints", "Safety and Health guidelines in working with precast concrete", "What every homeowner should know about asbestos", are referred to widely including in our own MasterSpec© specification systems.
>
> At this stage we don't have a work programme to change our master specification to become a "fully green" specification. Our approach is softer trying to stay with the market."
> Rolf Huber, CIL

#	*Query*	*NZ Response*
1	Whose initiative was the work?	Changes to MasterSpec™ are primarily made in response to - changes in the market - this may include physical changes i.e. new products becoming available, different work practices. We may also instigate changes as a result of a shift in attitude, particularly on green issues; and - legal changes - this includes issues such as asbestos, lead in paints etc.
2	Is there a background policy to the work?	NZIA environment policy.
3	Does the work cover statutory & voluntary green issues, & OHS?	In New Zealand there is comprehensive legislation dealing with Health and Safety issues. A separate body with wide ranging powers has been set up to uphold these standards. Naturally our specification has to comply with these standards. In addition we have (and are) addressing further voluntary environmental issues. Typical examples include solvent residues, smoking on site. It is however critical that we stay in tune with the

#	*Query*	*NZ Response*
		market on these issues.
5	What is the priority of the work?	In regard to the greening of MasterSpec™: This is a gradual but slow process. With every update we include "another shade of green" into our specification text.
9	What will be the outcome?	Our policy is to stay with the market and give specifiers options in specifying.
12	Will guidance material be provided? What form will it take?	I believe that a commentary or a "green guide" on specifying "environmentally friendly" could be helpful for New Zealand specifiers.

D.4 ASIA

Japan
I^2BH (Institute of International Harmonization for Building and Housing) was established to promote international cooperation and harmonisation of the Japanese construction industry. Members include over 40 construction sector organisations. I^2BH is an ICIS member.

While I^2BH does not produce a specification, specification documents used nationally exist in the form of the multi-disciplinary AIJ's (Architectural Institute of Japan) JASS (Japanese Architectural Standard Specifications), and the MOC's (Ministry of Construction) "Guide Specification for Public Building Works". Some of the JASS series of 26 architectural, structural and electrical work sections are quite old (a third pre-1990) and the series is not being greened. One would expect the MOC to be greening its material in line with its other environmental initiatives (see Appendix A.4), but it is not. MOC has an environment policy, however. Though the AIJ and MOC are not ICIS members, they do belong to I^2BH.

> "There is no National Master Specification in Japan. [but see note above] And our organisation (I^2BH) is not doing any work in making NMS or such kind of contents.
>
> But we are interested in environmental issues from the viewpoint of international standardisation of framework for construction information such as specification, BQ [bill of quantities], performance indication or CAD system. And each member of the Specification System Study Group in I^2BH, which consists of researchers, estimators, architects and so on, may be concerned with environmental issues more or less in each daily work."

Indeed, the Recycling Law of 1991, and the MOC's (Ministry of Construction) 1994 *Recycle Plan 21* (see Appendix A.4), both require owners to specify recycling issues such as location and standards for reused materials, taking waste to recycling plants, and disposal methods for site waste. Yasuo Omi therefore notes (his emphasis):

> "We must promote recycling movement in the construction field more and more, and in process of contract, we must specify the project considering environmental issues more strictly. <u>This is a capital chance to make a national specification system for Japan</u>."
> Yasuo Omi, I^2BH

The idea that environmental issues might generate a national master specification system is a good note on which to close Appendix D, and the Report!

APPENDIX E: SOME ENVIRONMENTAL STATISTICS

Indicator	**Czech Republic**	**Finland**	**Germany ***	**Nether-lands**	**Norway**	**Sweden**	**Switzer-land**	**United Kingdom**	**U**
LAND: Total area (1000 km^2)	79	338	357	42	324	450	41	245	93
Major protected areas (% of total area) [2]	**15.5**	8.3	**26.4**	11.5	**24.2**	4.7	**17.3**	**19.8**	**18**
Nitrogenous fertiliser use (t/sq.km of arable land)	7.0	7.2	14.9	37.2	12.6	7.1	12.2	23.3	**5.**
FOREST: Forest area (% of land area)	**34.0**	**76.1**	29.9	9.2	**39.2**	**67.8**	31.7	10.4	32
Use of forest resources (harvest/growth)	0.7	0.8	..	**0.4**	**0.5**	0.7	**0.5**	**0.5**	0.
Tropical wood imports (US$/capita) [3]	**0.5**	**3.2**	**2.5**	17.7	6.8	**3.8**	**1.2**	**4.0**	**1.**
THREATENED SPECIES: Mammals (% of species known)	29.9	11.9	39.8	15.6	8.0	18.2	33.8	22.2	10
Birds (% of species known)	28.2	6.8	39.6	27.1	10.4	8.6	44.2	22.6	7.
Fish (% of species known)	6.2	11.7	68.2	82.1	-	4.7	44.7	11.1	2.
WATER: Water withdrawal (% of gross annual availability)	15.3	**2.2**	25.3	**8.6**	..	**1.5**	**4.9**	13.7	18
Fish catches (% of world catches)	-	**0.2**	0.3	0.5	2.7	0.4	-	1.0	5.
Public waste water treatment (% of population served)	56	**77**	**89**	**96**	**67**	**95**	**94**	**86**	**71**

Indicator	**Czech Republic**	**Finland**	**Germany ***	**Nether-lands**	**Norway**	**Sweden**	**Switzer-land**	**United Kingdom**	**U**
AIR: Emissions of SO_x (kg/capita)	91.7	**18.8**	**26.1**	**9.6**	**8.0**	**10.6**	**4.7**	40.3	63
" (kg/1000 US$ GDP) [4]	10.1	**1.2**	**1.5**	**0.6**	**0.4**	**0.6**	**0.2**	2.4	2.
Emissions of NO_x (kg/capita)	41.9	50.5	**23.7**	**34.9**	51.1	40.9	**18.6**	**39.1**	75
" (kg/1000 US$ GDP) [4]	4.6	3.2	**1.3**	**2.0**	2.4	2.4	**0.9**	**2.3**	3.
Emissions of CO_2 (t/capita) [5]	11.7	**10.6**	**10.8**	11.6	**7.9**	**6.3**	**5.9**	**9.6**	19
" (t./1000 US$ GDP) [4]	1.35	0.67	**0.61**	0.66	**0.37**	**0.37**	**0.28**	**0.58**	0.
WASTE GENERATED: Industrial waste (kg/US$1000 GDP) [4, 6]	232	141	**48**	**30**	**39**	100	**9**	**59**	..
Municipal waste (kg/capita)	**230**	**410**	**400**	580	620	**440**	610	**490**	72
Nuclear waste (t/Mtoe of TPES) [7]	**1.2**	2.4	**1.4**	**0.2**	-	4.2	3.1	7.7	**1.**
NOISE: Population exposed to leq>65dB(A) (million inhabitants) [8]	1.5	**0.2**	9.5	0.6	0.5	0.3	0.8	5.7	17

NOTES: Data refer to the latest available year. They include provisional figures and Secretariat estimates. Partial totals are u comparability across countries.

.. not available - nil or negligible. * Figures in italics include: for Germany: western Germany only; for Un waste water treatment: Great Britain only; water withdrawal: England and Wales only.

2) Data refer to IUCN categories I to VI; Australia: national data. 3) Total imports of cork and

4) GDP at 1991 prices and purchasing power parities. 5) CO_2 from energy use only

6) Waste from manufacturing industries (ISIC 3). 7) Waste from spent fuel arisi metal, per million tonnes of o

8) Road traffic noise.

Bold figures indicate either better than OECD average, or the best of the set.

Source: Organisation for Economic Co-operation and Development: Environmental Data, Compendium 1998

