NATIONAL ROUND TABLE ON THE ENVIRONMENT AND THE ECONOMY
TABLE RONDE NATIONALE SUR L'ENVIRONNEMENT ET L'ÉCONOMIE

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National Round Table on the Environment and the Economy

Table ronde nationale sur l'environnement et l'économie

A Practical Introduction to Environmental Management on Canadian Campuses

By Dixon Thompson and Serena van Bakel

THE UNIVERSITY OF CALGARY

CAUBO ACPAU

Marriott MANAGEMENT SERVICES

A Practical Introduction to Environmental Management on Canadian Campuses

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National Round Table on the Environment and the Economy

Table ronde nationale sur l'environnement et l'économie

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Canadian Cataloguing in Publication Data

A Practical Introduction to Environmental Management on Canadian Campuses

(National Round Table Series on Sustainable Development) includes bibliographical references
ISBN 1-895643-32-5

1. Universities and colleges — Canada — Environmental aspects. 2. College facilities — Canada — Environmental aspects. 3. Sustainable development — Canada. I. Van Bakel, Serena II. National Round Table on the Environment and the Economy (Canada). III. Title.

This book is printed on Environmental Choice paper containing over 50 percent recycled content including 10 percent post-consumer fibre, using vegetable inks. The coverboard also has recycled content and is finished with a water-based, wax-free varnish.

Cover Design: Shoreline Communications
Printed and bound in Canada by M.O.M. Printing

National Round Table Series on Sustainable Development

1. Sustainable Development: A Manager's Handbook
2. The National Waste Reduction Handbook
3. Decision Making Practices for Sustainable Development
4. Preserving Our World
5. On the Road to Brazil
6. Toward Sustainable Communities
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12. A Practical Introduction to Environmental Management on Canadian Campuses

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National Round Table on the Environment and the Economy
Table ronde nationale sur l'environnement et l'économie
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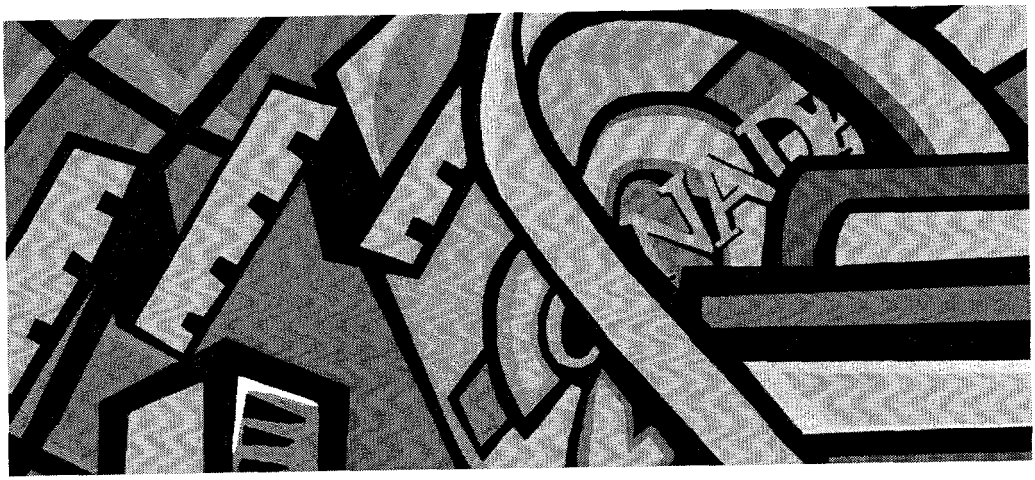
Tel: (613) 992-7189 Fax: (613) 992-7385



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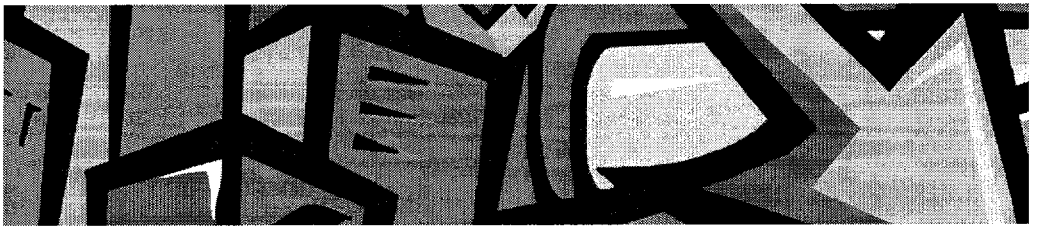
Canada

The National Round Table on the Environment and the Economy is pleased to present this book as a further contribution to the greater understanding of the concept of sustainable development and its practical applications.

The views expressed herein are those of the authors and do not necessarily represent those of the National Round Table or its members.



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Forewords

A Practical Guide to Environmental Management on Canadian Campuses should prove to be useful in helping universities to reduce costs and the potential for accidents. It focuses on redesign and renovation of the university's environment to reflect environmental ideals. The guide also promotes institutional self-assessment and the use of internal experts in the area of environmental management.

It is rewarding to see that a small University of Calgary initiative has been supported by the Canadian Association of University Business Officers, the National Round Table, and Marriott Corporation.

I encourage all universities to meet the commitments made in the Talloires Declaration (1990) and the Halifax Declaration (1991) which committed universities to improved environmental education and management.

Murray Fraser
President and Vice-Chancellor
The University of Calgary

As pointed out in the Introduction, governments at all levels and environmental advocacy groups have moved on to university campuses with demands for more regulations and reporting of environmental procedures. There is also a growing threat of legal action as evidenced by recent liability claims against boards of directors in the private sector. This publication shows how comprehensive environmental management mitigates against the potential cost of inadequate action, and at the same time, demonstrates that there is a genuine concern for protecting the environment. Another major benefit is the dissemination of useful tips on how to reduce expenditures on utilities.

The Canadian Association of University Business Officers (CAUBO) welcomes the opportunity to participate in a worthwhile addition to the impressive library of the National Round Table on the Environment and the Economy. We also acknowledge the significant financial contribution and involvement of the Marriott Corporation. Thanks are also due to the many reviewers for their

invaluable feedback to the preliminary draft. Finally, we are indebted to Professor Dixon Thompson and Serena van Bakel of The University of Calgary who made this publication possible through their missionary and professional writing.

Ken Clements
Executive Director
Canadian Association of University Business Officers

The benefits of protecting the world's environment are enormous. Future generations are completely dependent on what we do today as a world community to sustain our environment.

Individuals, governments, associations and businesses are all stakeholders in assuring that our environment is protected. Through cooperation between these stakeholders, we must foster the development of new strategies to ensure this takes place.

It is in this spirit that Marriott is proud to support the efforts of the The University of Calgary, the Canadian Association of University Business Officers (CAUBO) and the National Round Table on the Environment and the Economy (NRTEE) in the production of *A Practical Introduction to Environmental Management on Canadian Campuses.*

The book is a guide to environmental management tools for Canadian campuses. It examines strategies for energy, water, solid waste, hazardous waste and transportation management. The guide also looks at various real-life examples of environmental programs on Canadian campuses. If we are able to solve problems , at least in part, on the college campus, the results could be translated into a model for the larger community.

We admire the dedication of the project authors, Dixon Thompson and Serena van Bakel, whose complete and sensible approach to a complex subject has made it very readable. *Environmental Management on Canadian Campuses* should be useful to both academic institutions and other organizations as a tool for developing their own environmental programs. As the dining and environmental services manager for over 150 college, university, business and hospital locations in Canada, Marriott has been an active participant in instituting its own energy, water and waste management programs. It is our intention for this document to be a learning and implementation guide for Marriott managers to improve our environmental programs.

We are pleased to participate in this project with the National Round Table on the Environment and the Economy and applaud the members of the Canadian Association of University Business Officers in their desire to develop and share management information with all those who want to improve our quality of life.

John Douglas
Vice-President
Marriott Corporation

The National Round Table on the Environment and the Economy is mandated by the Parliament of Canada to promote sustainable development in all sectors and regions throughout the country. We do this in a number of ways — through our advice to the Prime Minister and policy work with the federal government, by establishing

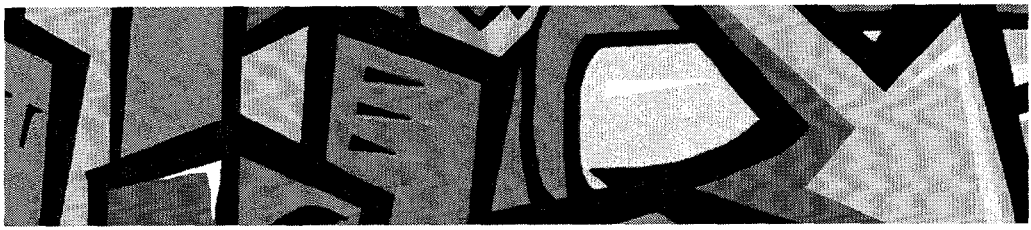
sector dialogues or round tables, and through a public education and communications program.

However, no single organization can pretend to have all the answers or resources needed to promote sustainable development. It requires partnerships based on broad coalitions of interest, and we firmly believe in the value of working together with other organizations in achieving our mandate. We are pleased to publish *A Practical Introduction to Environmental Management on Canadian Campuses*, the 12th book in our sustainable development series, in partnership with The University of Calgary, the Canadian Association of University Business Officers and Marriott Corporation.

University and college campuses represent large and complex institutions that can play significant roles in moving society toward more environmentally responsible and sustainable forms of management and behaviour. We hope this book will serve as a useful complement to an earlier book in our series, *Green Guide: A User's Guide to Sustainable Development for Canadian Colleges. A Practical Introduction to Environmental Management* will be a practical guide for campus decision makers, and for other institutions — academic and non-academic — who face some of the same environmental challenges that campuses do.

We are grateful for the efforts and contributions from CAUBO, the Marriott Corporation, The University of Calgary and the authors, Dixon Thompson and Serena van Bakel. Together we have produced a useful guide that can be used as a practical tool not only on university campuses, but in the community at large.

George Connell
Chair, National Round Table on the Environment and the Economy

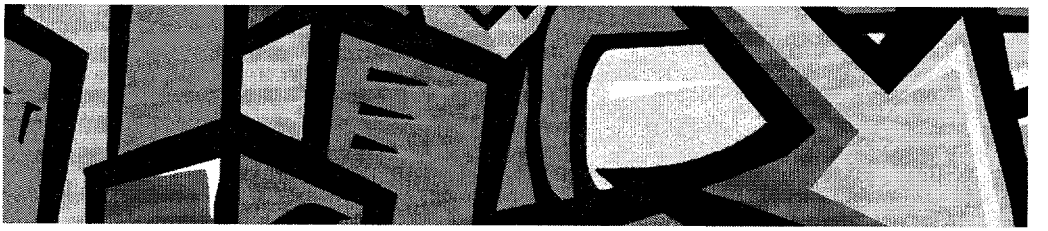


Acknowledgements

We extend our sincere thanks to the many people who have supported this endeavour:

- Kenneth Clements, Executive Director, Canadian Association of University Business Officers (CAUBO) for his initial suggestion that we publish our work, and for his encouragement and contribution to making this book possible;
- Kelly Hawke Baxter, Director of Communications, Moira Forrest, Project Manager, and David Baslaw, former Project Manager, National Round Table on the Environment and the Economy;
- Dr. Keith Winter, Vice-President (Finance and Services), The University of Calgary, and Dr. John Kendall, Dean of the Faculty of Science, The University of Calgary, both of whom were committee members of, and provided financial support for, Serena's Master's Degree Project (thesis), upon which this manuscript was based;
- The University of Calgary Endowment Fund and the Physical Plant at The University of Calgary, who both provided finances and information for this project;
- Marriott Corporation, whose financial contribution helped to make this book possible;
- Madhav Badami, a graduate of the Faculty of Environmental Design, whose Master's Degree Project on Transportation Audits formed the basis for Chapter 7;
- Former and current Environmental Science students at the Faculty of Environmental Design who provided some of the foundation for this work, among them: Melvin Wilson (Environmental Audits), Grete Bridgewater (Policy EIA), Chris Ryley (Environmental Policy Statements), Carole Weaver (Environmental Management), and Adrienne Schipperus (Environmental Reporting and Environmental Indicators);
- The people who took the time to review our draft manuscript and provide comments: Bill Ross, Ken Clements, William Louch, Mayja Embleton, Chris Ryley and Andrew Higgins;
- Serena's family: Michael, Christa, Karl, Erna, Adrian and Inge.

We would also like to acknowledge the unique setting offered by the Faculty of Environmental Design which nurtures interdisciplinary efforts to solve environmental problems.



Author's Note

The preparation of this book has been a struggle because efforts to present the material in a logical fashion with coherent elements, which were nevertheless written in digestible pieces, failed or were short of expectations. It became clear that there were two basic problems. The first was that the environmental problems on campuses were systems problems: they did not fit into tidy academic or bureaucratic boxes. Systems problems are those problems that arise because of the nature of the system (size, complexity, or interaction between components) or similar kinds of problems that arise in different areas of the same system. The second difficulty was a concern about presenting incomplete analysis and imperfect solutions while still maintaining that action should not be delayed for "further research and study."

These factors led Serena and me to stress the complexity of the problems and universities' organizational structures, and the need to involve the large number of diverse stakeholders who exist in universities. We attempted to develop a systematic approach to environmental management problems, through the application of a set of environmental management tools. These tools can be systematically applied regardless of the particular issues at hand, such as energy conservation or hazardous waste. We also repeated the need for starting to act while maintaining a program of "continuous improvement."

Late one night I gave up trying to find the words that would "make it all come together." After a meeting to discuss the nearly completed rough draft of the manuscript, Ken Clements recommended Peter Senge's *The Fifth Discipline* (1994) for insights into the management problems we were encountering. I picked up the 400-page paperback in the hope that it might help me get to sleep. It had just the opposite effect. I found an articulate and authoritative voice which stated clearly much of what we had been struggling with. It also included a warning about grasping fads for solving management problems, which American gurus had been producing on a regular basis. That caveat had a great deal of appeal.

Senge (1994, 5–11) outlines five disciplines of the learning organization: (i) systems thinking; (ii) personal mastery; (iii) mental models; (iv) building shared vision; and (v) team learning. This reinforced our decision to emphasize the importance of using the tools as a set (system), the importance of the environmental policy statement (building shared vision) and the importance of involving all the various groups on campuses (team learning).

Implicit in what Serena and I outline is that the academic community examine established administrative and academic models. We assert that those responsible for both the administrative systems and the academic curricula, especially at the graduate level, examine the need to develop skills and knowledge in three areas: (i) synthesis and integration of knowledge from separate and relatively isolated departments; (ii) communication or dialogue — the transition of data into effectively formatted information with which various stakeholders can educate themselves and make effective decisions; and (iii) teamwork skills which involve organization, group, and meeting management skills and communication skills.

The campus is a model of larger communities. How we are able to solve our problems will influence, at least in part, environmental management in these communities. The campus can be effectively used as a laboratory where environmental management principles can be researched, developed, tested and taught.

The academic community may have fallen behind the private sector in (i) innovating effective management strategies and practices; (ii) carrying out rigorous academic research on environmental management, behavioural and technical innovations and practices; and (iii) providing a curriculum and an academic setting for effective environmental managers who have skills and knowledge firmly based in sound science and effective management. If this assertion seems to go beyond the mandate for *A Practical Introduction to Environmental Management on Canadian Campuses*, we believe that it does not. Serena and I submit that both the effective and pragmatic management of environmental problems on individual campuses, and the skills and knowledge that our graduates possess are critical elements in the long-term well-being of our planet.

Dixon Thompson
Professor of Environmental Science
Faculty of Environmental Design
The University of Calgary

Dixon Thompson is Professor of Environmental Science in the Faculty of Environmental Design at The University of Calgary, which he joined in 1971. Dr. Thompson stresses the importance of a strong background in the natural or applied sciences (his Ph. D. is in chemistry) with a good understanding of management and decision making. He has developed and taught a graduate course in management for environmental scientists over the past 10 years.

Serena van Bakel graduated from the Environmental Science Program in the Faculty of Environmental Design, The University of Calgary, in 1994. She conducted a preliminary environmental audit of The University of Calgary for her Master's Degree Project. She was awarded the Faculty of Environmental Design Gold Medal for her work.

1. Introduction

Environmental issues have become a major concern of all institutions in Canada over the last few years. For 20 years, environmental organizations have stressed the importance of protecting the environment, and corporations have come under increasing pressure from the public and governments to do just that. Now those pressures, laws and regulations are being applied to universities.

Universities and colleges in Canada must respond effectively and efficiently to the increasing demands to reduce their adverse impacts on the environment, and to bring down the costs of those impacts and their control. This book provides advice on why and how universities can start to respond practically and effectively, in complex and rapidly changing circumstances, both within the institutions and outside. It focuses on how to start the process or improve on the many initiatives that have already taken place on campuses across Canada. The advice is based upon teaching and research carried out in an academic setting and then tested and applied in the private sector and in academic institutions.

An initiative to introduce environmental auditing at The University of Calgary (van Bakel 1994) came to the attention of Ken Clements, Executive Director of the Canadian Association of University Business Officers (CAUBO), who took the idea for this project to the National Round Table on the Environmental and the Economy (NRTEE), where it was warmly received.

The original proposal for this document included a review of the internal and external forces compelling universities and colleges to become environmentally responsible campuses; a discussion of a menu of options that universities and colleges might implement to help ensure sound environmental management of their campuses; and, through a survey of the actions being taken at Canadian universities, a set of case studies, carefully researched and analysed, that other institutions could follow. The proposal for case studies encountered two problems: funding was not available for the

extensive travel and research that would have been necessary to provide a fair and comprehensive picture of the work in progress throughout Canada; and the situation was changing rapidly, which would have made the findings out of date and unfair to those whose actions had outpaced our knowledge of them.

These circumstances forced a revision of the proposal. Instead of case studies, examples of actions that are being taken at a few universities are described in each section. It would be fruitful if a Canadian clearinghouse or network could be set up to keep track of such initiatives and their effects. It is inefficient for institutions to learn the same lessons independently, given that developing effective and efficient environmental management capabilities will be an ongoing learning process.

Our work is based on two assumptions. The first assumption is that good environmental management requires both a good understanding of the science and technology, and sound management skills. On the one hand, a good understanding of environmental problems and of the technical and behavioural options for solving the problems is needed. On the other hand, proficient management skills and knowledge are required for selection of the best options, effective implementation and continuous improvement.

The second assumption is that effective environmental management calls for a systems approach. A systems or systematic approach is required for those environmental problems which arise because of the size or complexity of the system, or which arise in different places in a large system, or which arise from or with respect to the system's own characteristics (i.e., they are not a component problem). This integrated approach must go beyond a set of single sector management activities such as solid waste management, hazardous waste management, energy and water conservation. Rather than adding it onto an existing program, an environmental management system must eventually become an integral part of everyday activities at one level and strategic planning at the other.

What follows is an overview of the literature addressing environmental management. This chapter concludes with a very brief description of some of the unique characteristics of universities and colleges that can make problem solving on campuses complex and difficult, and an outline of the forces that are driving universities and colleges to take action. Chapter 2 outlines the set of environmental management tools that can be applied at universities and colleges. We then describe, in Chapters 3 to 7, some of the specific environmental challenges faced by universities and colleges: energy, water, solid waste, hazardous materials and transportation.

Readers will note different levels of detail in some of the topics addressed. In particular, environmental audits, recycling and hazardous wastes receive more detailed consideration than some other topics. This difference in level of detail arises from our experience, from the relative importance of the topic, and from the level of development or state of advancement of the tools or solutions to the problems.

Good problem definition is an essential part of problem solving. Our understanding of the detailed nature of the problems and their management will improve with experience in the application of environmental management tools. It is important to start managing environmental problems without delay, and to begin reaping the benefits, while taking

into consideration the longer-term commitment required for continuous improvement. It is essential to avoid procrastination by recommending further study before any action is taken. Each institution will have to assess the magnitude, seriousness, associated costs (environmental and financial) and public perceptions of specific problems when assigning priorities for action. As a result, what follows does not attempt to describe environmental problems in detail, but tries to describe effective means of assessing problems, setting priorities, implementing solutions, and tracking and reporting the success of those solutions.

The implementation of a cost-effective action plan or plans is, of course, the whole point of this book. We have not provided information on the formulation of action plans, implementation, or data on cost-effectiveness because, as van Bakel (1994) showed, until recently most universities were just starting or contemplating such programs. Implementation, therefore, starts with the careful development and application of the tools for assessment and accountability. Carrying out strategic environmental assessments, developing environmental policy statements, putting in place effective management structures, conducting audits and so forth, will be the first steps required to effectively introduce systematic approaches to specific problem areas. Those steps and the introduction of useful accounting procedures, in particular, will be necessary to help determine the cost-effectiveness of initiatives. The specific steps for implementing action plans that solve the identified problems will be highly site specific, as will be the results of cost benefit calculations.

This book is not a technical manual. Rather, it is meant to appeal to and motivate the general campus audience. As will be stressed repeatedly, for effective action on campus environmental problems, the stakeholders must be well informed and prepared to assume responsibilities and to play their parts in making solutions work. Efforts must be made to get this book into the hands, and thence into the minds, of governance bodies, such as boards of governors and senates, administrators and their staff members, faculty associations, faculty members, employee unions and students.

Environmental philosophies and ideologies are important factors in environmental management at universities and colleges, especially given the high profile they often have with students and faculty members. We believe, however, they cannot overshadow the economic, social, political and educational perspectives that must be applied. Accordingly, green ideology receives little attention in this document. Readers wanting a broader description of environmental problems and their longer-term solutions are referred to Suzuki's *Inventing the Future* (1989) or *Time to Change* (1994), Daly and Cobb's *For the Common Good* (1989), Hawken's *The Ecology of Commerce* (1993) and Meadows et al.'s *Beyond the Limits* (1992).

There may be some concern by people who believe that those proposing environmental management want to force green ideology down their throats. Some of that concern may be justified since that is often the intent of some strident green ideologues. However, this is the very antithesis of our intent.

On the other hand, there may also be criticisms raised because we have not been ideologically pure — "true green." Not being able

to decide on how dark green to be, we decided to avoid the issue of correct campus green ideology. We do not believe that the proposals we have made are adequate to solve the global problems of population growth, resource consumption and pollution. There is a difference between short-term incremental steps and the major changes needed to solve global environmental problems and achieve sustainable development. We do believe that what we have proposed is a sound beginning and is also an approach that makes good management sense for Canadian universities in the 1990s.

We have chosen to use an academic form of referencing because of the academic nature of our audience, to lead readers to other work, and to show skeptical readers that we are basing our work on a firm foundation rather than presenting personal opinions. We believe that some readers, with particular interests and responsibilities, may read only one particular chapter. Given our philosophy of the need to combine sound understanding of the science and technology with good management, we felt the management segment should be repeated in each chapter. We apologize if this causes frustration.

Although we sometimes refer specifically to universities, most of the basic principles outlined here are applicable to Canadian community colleges as well. The major differences are that the organizational structure of colleges may not be as decentralized as in universities, and research activities and graduate students are not likely to be present at colleges.

Review of Literature on Campus Environmental Management

The purpose of this book is to provide an overview of environmental management at universities and colleges. Members of the university community and other stakeholders may wish to refer to information that explores specific areas in more detail than can be accommodated in this book. The following brief literature review is meant to facilitate the acquisition of such information.

Van Bakel (1994) reviewed the literature on environmental management at universities and found that within the few existing publications, very few described and dealt with the responsibilities of the various campus groups in an integrated or systematic fashion. The majority focused on single sector programs, such as energy or solid waste, rather than on developing and implementing the campus-wide management systems required for effective management. Information on the rationale, options and strategies for developing and implementing environmental management systems at universities is scarce.

The most widely distributed publication on environmental concerns at Canadian colleges is the *Green Guide: A User's Guide to Sustainable Development for Canadian Colleges* (Association of Canadian Community Colleges 1992). It describes a vision of a model "green" institution, outlines the environmental policy and practice recommendations of Red River Community College and describes the experience of some colleges in developing courses and training programs for sustainable development. The *Green Guide*, aimed at teaching staff and administrators, focuses on the educational initiatives that the institutions can take toward sustainable development. It does not cover the various environmental management tools and how to implement them.

Creating a Common Future: Proceedings

of the Conference on University Action for Sustainable Development (Jenks Clarke 1992) discusses the challenges for university leadership in sustainable development. Although it urges universities to ensure that the day-to-day operations of universities are as environmentally benign as possible, it focuses mainly on the educational and research aspects. It is aimed at faculty and senior university administrators.

The Campus and Environmental Responsibility (Eagan and Orr 1992) addresses some of the driving forces for and issues of environmental management through case studies of some American universities. Again, this book is written mostly for administrators and faculty, although it has more relevance for the entire campus community than other texts.

In Our Backyard: Environmental Issues at UCLA, Proposals for Change, and the Institution's Potential as a Model (Brink et al. 1989) was one of the first reports on environmental auditing at universities. It was a cooperative Master's thesis by six graduate students in the Graduate School of Architecture and Urban Planning at the University of California, Los Angeles (UCLA).

Smith, one of the authors of the UCLA thesis, developed the experiences and knowledge she gained through that project into a guide for auditing the environmental impacts of universities and colleges. *Campus Ecology: A Guide to Assessing Environmental Quality and Creating Strategies for Change* (Smith et al. 1993) is primarily suited for students. It is most useful for people who have little experience or knowledge in assessing environmental impacts. The book lists the basic questions to be asked of any educational institution, likely sources of information, and generic recommendations to minimize adverse environmental impacts. It also provides published references, and a list of institutions and organizations that can provide further information and expertise in the assessment areas.

There are also publications devoted to campus operations. *Case Studies in Environmental Health and Safety* (Association of Physical Plant Administrators of Universities and Colleges 1990) relates the experiences of some universities that are attempting to minimize the adverse environmental impacts of their operations. It addresses some management issues along with more technical issues. *Facilities Manager*, a periodical of the Association of the Higher Education Facilities Officers, has published a number of articles on various aspects of environmental management.

The business community, currently providing leadership in this area, is the main source of skills and knowledge in the environmental management field. The literature on environmental management in the private sector has grown rapidly in recent years, compared to 10 years ago when there was almost nothing available (Thompson and McKay 1984). Many references are quickly becoming out of date because the field is evolving so rapidly. Weaver (forthcoming) recommends that readers take into consideration the date of publication and seek titles that are the most appropriate for their organization or stage of environmental management. Readers should also be aware that, although the literature available is plentiful, the quality of work can vary greatly.

Weaver found, through her Master's Degree Project at the Faculty of Environ-

mental Design, University of Calgary, that while handbooks and industry manuals dealing with environmental management are abundant, books are not. Some publications take a comprehensive view of environmental management while others focus only on a specific aspect of environmental management. Some of the more noteworthy and recommended documents are listed below.

Members of various campus stakeholder groups who want to understand more about the business community's approach, may want to refer to some of the following references. *Environmental Management and Business Strategy* by Richard Welford and Andrew Gouldson (1993) is a comprehensive volume that provides a European perspective. *Changing Course: A Global Business Perspective on Development and the Environment* by Stephan Schmidheiny with the Business Council for Sustainable Development (1992) provides a global perspective, and is written by business leaders worldwide. *From Ideas to Action: Business and Sustainable Development* by Jan-Olaf Willums and Ulrich Golüke (1992) and published by the International Chamber of Commerce, was written in preparation for the Earth Summit in 1992. It discusses the International Chamber of Commerce's Business Charter for Sustainable Development.

Business Strategy for Sustainable Development: Leadership and Accountability for the '90s by the International Institute for Sustainable Development (1992) defines sustainable development from a business perspective and identifies the challenges confronting businesses as they integrate environmental issues into their operations. *Environmental Strategies for Industry: International Perspectives on Research Needs and Policy Implications* edited by Kurt Fischer and Johan Schot (1993) is a product of the Greening of Industry Network, a U.S.-European partnership dedicated to improving the understanding of corporate environmental management. This book also points to the unimpressive track record of scholarship on the greening of industry. Although there has been a good deal of publishing in the environmental management area, very little of it has been by academics and scholars.

Sources of literature with a more narrow focus include: *Accounting for the Environment* by Rob Gray with Jan Bebbington and Diane Walters (1994); *Coming Clean: Corporate Environmental Reporting* by the International Institute for Sustainable Development (1993); and *Workplace Guide: Practical Action for the Environment* by the Harmony Foundation of Canada (1991), which targets office practices and policies.

The Canadian Standards Association has published guidelines pertaining to environmental issues: *Guideline on Environmental Labelling CSA Z761-93* (1993a); *Life Cycle Assessment, Z760-94* (1994a); *User's Guide to Life Cycle Assessment: Conceptual LCA in Practice, PLUS 1107* (1994b); and *Guidelines for Environmental Auditing: Statement of Principles and General Practices, CSA Z751-94* (1994c). The Canadian Standards Association has also published, in draft form, *Guideline for a Voluntary Environmental Management System CSA Z750* (1993b). The first edition is expected soon.

Total Quality Environmental Management: The Primer by the Global Environmental Management Initiative (1993) and *Accounting for the Environment* by the

Society of Management Accountants of Canada (1992) are both small booklets that outline basic concepts, and are expeditious references.

The Nature and Characteristics of Universities and Colleges

To introduce effective environmental policies, practices and management systems, it is essential to understand the nature, organizational structure, and decision-making systems of the institution responsible for making the necessary changes.

Universities and colleges have important roles as educators, research institutions, sources of new technologies, methods and skills, role models, and leaders in change. As the setting for the education of future professionals and leaders, the milieu that universities provide for that education must be consistent with the knowledge, skills, ethics and morals they are imparting. They also have responsibilities to the communities, governments, other institutions and industries that support them, and to their alumni, students, graduate students, faculty members and support staff.

Institutions of higher education have evolved over a long and sometimes troubled history. That evolution has led to such concepts as academic freedom and tenure and the current academic and bureaucratic structures. Universities have developed into elitist organizations, which are now attempting to change the ivory tower image through ideas of openness, freedom of thought, democratic processes and transparency.

The history of universities has led to the development of diffuse and complex decision-making and governance structures. In corporations it is often possible to assign responsibilities for environmental matters to a particular office and establish decision-making and reporting structures that ensure the exercise of those responsibilities produces acceptable results. This is much more challenging in the decentralized organizational structure of universities, which contains large numbers of actors who influence decisions and their implementation.

The curriculum related to environmental problems is a very important part of education. We will not address the matter of curriculum here, even though it is recognized that our recommendations have serious implications for content and curricula the relationships between course content and curricula, and the setting within which they take place. The value of student and graduate student research and action, especially given the levels of interest, the cost-effectiveness of student (volunteer) labour, and the necessity of recruiting student involvement and commitment, is also important.

Driving Forces: Why Is Effective Action Essential?

Corporations are taking leading roles in trying to solve environmental problems or are being forced to do so. Many of the factors that have forced corporations to take such action also apply to universities and colleges. Just as with corporations, it is important that the different groups of actors on campuses understand why changes must occur before discussing the specifics of what to do and how to do it.

The following driving forces, developed during teaching and consulting activities, have been adapted from a list of forces causing change in industry. The driving forces are not listed in any order of priority because the pri-

BOX 1–1
The Due Diligence Defense

A due diligence defense is only possible in certain circumstances. There are many different ways of categorizing and defining offenses. In one approach there are three categories: real or traditional criminal offenses, absolute liability and strict liability. In real or traditional criminal offenses the prosecution must prove that the accused committed the offense and that there was intent. No due diligence defense is possible, although the defense might raise mitigating circumstances to have a charge or a sentence reduced. Absolute liability offences are generally those of a less serious regulatory nature. Intent is irrelevant and the due diligence defense is not possible. Examples are speeding or parking tickets.

Only in strict liability cases can a due diligence defense be mounted (Jeffrey 1992; Lucas 1992a; Lucas 1992b). In these cases, the onus reverses (guilty until proven innocent) to the accused to prove that there was no intent and that the accused had been "duly diligent" in carrying out his or her responsibilities. A due diligence defense means that the person or institution must show that he, she or it took all reasonable precautions to avoid a breach. The due diligence defense is available to one who can show that he or she did everything reasonably within his or her power to prevent the offense, or that this person reasonably believed in a mistaken set of facts that, if true, would render the act or omission innocent (R. v. Sault Ste. Marie, 1978, cited in Saxe 1990).

Environmental management systems, containing a functional organizational structure and decision-making system, environmental policy statements, environmental audits, and education and training programs, are all important means of proving due diligence.

ority will vary with an institution's activities and setting. Each university will have to review these factors and assess the extent to which they currently affect the university's activities and the extent to which they may affect its activities in the future. It is significant that the following nine driving forces are different in nature and come from different sectors. This means that if only one or two forces are driving change at a particular institution, it is possible to respond to those forces directly, rather than with a broader, more systematic approach.

1. **Strict Legislation and Enforcement.** International agreements, federal, provincial and municipal legislation and their enforcement are getting tougher. For various reasons, corporations have borne the brunt of these developments, but now institutions and governments are increasingly under scrutiny. Dianne Saxe (1994) provides evidence of this in her article, "The Worm Turns." She describes two cases where government departments were sued for alleged regulatory negligence. In one case the government was held liable; in the other proceedings are still under way. She expects that we will see many more

BOX 1-2
Developing a Model

The Canadian Association of University Business Officers (CAUBO) could develop a model patterned after the industry prototype to assist members in the environmental management field. If every university, especially a smaller one, tries to develop and implement a complete environmental management system on its own, the process will be time-consuming, expensive and inefficient. Industry associations such as the Canadian Association of Petroleum Producers and the Mining Association of Canada have produced models, codes and advice on management systems which their members can adapt to their particular circumstances. This is particularly important when developing "practice manuals," that provide staff with detailed technical instructions on how to ensure that policies are implemented effectively.

CAUBO could identify those institutions that have particular expertise or have taken particular initiatives and ask them to develop model materials for other CAUBO members. Undergraduate and graduate student and faculty expertise should not be ignored in these exercises.

cases alleging regulatory negligence by environmental regulators in the next few years. Government regulators and institutional decision makers are facing the same sanctions as corporate executives.

Fines, jail sentences and the requirements for due diligence defenses now apply to university and college officials (see Box 1-1). For example, an American university recently "agreed to pay the state of California nearly $1 million to settle a protracted dispute over charges that the university has mishandled hazardous wastes, the bulk of which is chemicals from its research laboratories" (Cohen 1994).

The fact that enforcement of regulations has moved from the private sector to the public sector leads one to believe that universities will come under the same sort of scrutiny. Just because no specific prosecutions have taken place against Canadian universities, as far as we know, this does not mean that there is no risk of prosecution and that universities can afford to be complacent.

2. **Environmental Codes and Guidelines.** Industry associations, such as the Canadian Chemical Producers Association (1991), the Mining Association of Canada and the Canadian Association of Petroleum Producers, have produced, or are preparing, environmental guidelines for their members, producers, suppliers, buyers and users of products and services. Similarly, professional associations of engineers, geologists and geophysicists have published environmental guidelines or drafts for their members. Universities and colleges using these products and skills, or teaching them, must understand and abide by the guidelines. Box 1-2 outlines a potential role for CAUBO in developing a model for universities.

BOX 1–3
The Talloires Declaration

We, the presidents, rectors, and vice chancellors of universities from all regions of the world, are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources. Local, regional, and global air and water pollution, accumulation and distribution of toxic wastes, destruction and depletion of forests and soil, depletion of the ozone layer and emissions of greenhouse gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns of the world.

We believe that urgent actions are needed now to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of industrial and agricultural technologies which minimize resource depletion, pollution and waste and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature. Universities have a major role to play in education, research, policy formation, and information exchange to make these goals possible.

University heads must provide the leadership and support to mobilize internal and external resources so that their institutions respond to this urgent challenge. We, therefore, agree to take the following actions:

1. Use every opportunity to raise public, government, industry, foundation, and university awareness by publicly addressing the urgent need to move toward an environmentally sustainable future.

2. Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward a sustainable future.

3. Foster programs to produce expertise in environmental management, economic development, population, and related fields to ensure that all university graduates are environmentally literate and responsible citizens.

4. Foster programs to develop the capability of university faculty to teach environmental literacy and responsibility to all undergraduate, graduate, and professional school students.

5. Set an example of environmental responsibility by establishing programs of resource conservation, recycling, and waste reduction at the universities.

6. Encourage the involvement of government at all levels, foundations and industry in supporting university research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with nongovernmental organizations to assist in finding solutions to environmental problems.

7. Convene deans of appropriate schools and environmental practitioners to develop research, policy, and information exchange programs and curricula for an environmentally sustainable future.

8. Establish partnerships with primary and secondary schools to help develop the capability of their faculty to teach about population, environment, and sustainable development issues.

9. Establish a steering committee and secretariat to continue this momentum and inform and support each other's efforts in carrying out this declaration.

The Talloires Declaration was developed in October 1990.
Reprinted from Smith et al. (1993).

Guidelines can be important in a due diligence defense, should an infraction occur. There are two existing university declarations of an environmental nature: the Talloires Declaration and the Halifax Declaration. These declarations, shown in boxes 1–3 and 1–4, could serve as the basis for environmental guidelines for universities.

3. **Financiers and Insurers.** Lending institutions have become concerned with the environmental status of their corporate clients. There have been recent cases in Canada where banks have assumed liability for contaminated land held by bankrupt clients. In the Northern Badger Oil and Gas Company case, the Alberta Court of Appeal ruled that the assets of the bankrupt company must be used to mitigate environmental problems before going to creditors (Canadian Bankers Association 1991; Lalonde 1991). This driving force does not generally apply to universities, but under current circumstances of rapid change it might in the near future.

Insurance companies are also concerned with the potential environmental liability of their clients. The Canadian Universities Reciprocal Insurance Exchange's (1993) *Risk Management Newsletter* published an anonymous university's response to environmental risk. It calls for an environmental management program that includes the development of an environmental policy; the appointment of an official responsible for ensuring the university's compliance; the conduct of environmental audits; the implementation of systems to ensure compliance; and the establishment of a reporting system.

4. **Financial Donors and Research Grants.** Increasingly universities are dependent on donations from individuals and corporations. Potential financial donors are often concerned about image and responsible community relationships. Sound environmental management is an integral part of maintaining a favourable

BOX 1–4
The Halifax Declaration

Human demands upon the planet are now of a volume and kind that, unless changed substantially, threaten the future well-being of all living species. Universities are entrusted with a major responsibility to help societies shape their present and future development policies and actions into the sustainable and equitable forms necessary for an environmentally secure and civilized world.

As the international community marshals its endeavours for a sustainable future, focused upon the United Nations Conference on Environment and Development in Brazil in 1992, universities in all countries are increasingly examining their own roles and responsibilities. At Talloires, France in October 1990, a conference of university presidents from every continent, held under the auspices of Tufts University of the United States, issued a declaration of environmental commitment that has attracted the support of more than 100 universities from dozens of countries. At Halifax, Canada, in December 1991, the specific challenge of environmentally sustainable development was addressed by the presidents of universities from Brazil, Canada, Indonesia, Zimbabwe and elsewhere, as well as by the senior representatives of the International Association of Universities, the United Nations University and the Association of Universities and Colleges of Canada.

The Halifax meeting added its voice to those many others worldwide that are deeply concerned about the continuing widespread degradation of the Earth's environment, about the pervasive influence of poverty on the process, and about the unsustainable environmental practices now so widespread. The meeting expressed the belief that solutions to these problems can only be effective to the extent that the mutual vulnerability of all societies, in the South and in the North, is recognized, and the energies and skills of people everywhere be employed in a positive, cooperative fashion. Because the educational, research and public service roles of universities enable them to be competent, effective contributors to the major attitudinal and policy changes necessary for a sustainable future, the Halifax meeting invited the dedication of all universities to the following actions:

1. To ensure that the voice of the university be clear and uncompromising in its ongoing commitment to the principle and practice of sustainable development within the university, and at the local, national and global levels.

2. To utilize the intellectual resources of the university to encourage a better understanding on the part of society of the inter-related physical, biological and social dangers facing the planet Earth.

3. To emphasize the ethical obligation of the present generation to overcome those current malpractices of resource utilization and those widespread circumstances of intolerable

human disparity which lie at the root of environmental unsustainability.

4. To enhance the capacity of the university to teach and practise sustainable development principles, to increase environmental literacy, and to enhance the understanding of environmental ethics among faculty, students, and the public at large.

5. To cooperate with one another and with all segments of society in the pursuit of practical capacity-building and policy measures to achieve the effective revision and reversal of those current practices which contribute to environmental degradation, to South-North disparities and to inter-generational inequity.

6. To employ all channels open to the university to communicate these undertakings to UNCED, to governments and to the public at large.

This declaration was completed at Dalhousie University, Halifax, Canada, on the 11th day of December 1991. Reprinted from Jenks Clarke (1992).

image.

Stipulations for the use of responsible environmental management strategies may be attached to research grants more often in the future. Applicants may be required to describe in the application how waste will be handled. Research grants may not be awarded unless such assurances can be made. Currently, for example, all work with radioactive materials is strictly controlled.

5. **Accounting Practices.** The Canadian Institute of Chartered Accountants has changed accounting procedures to require that environmental factors be included in accounting practices (CICA 1994, 1993). Environmental accounting is becoming a routine environmental management practice. The normal accounting practices within most universities must change to meet these new standards.

6. **Cost-Effectiveness.** Initiatives such as energy and water conservation, and solid and hazardous waste minimization and disposal programs are becoming a necessary practice for cost savings, especially in the current climate of fiscal constraint.

7. **Employees and Students.** People within the university community who are already concerned about environmental issues and, more specifically, about the environmental impacts of their universities are another source of pressure. Many university members are already instituting changes to improve their university's environmental performance. However, sometimes the practicality and effectiveness of the actions are not taken into account. Coordination and integration between initiatives is often lacking.

Student groups across North America are also focusing on the environmental impacts of their respective institutions. Networks such as the Student Environmental Action Coalition and organizations such as the American National Wildlife Federation's Campus Outreach Program, Cool it!, were established to help students encourage, develop, organize and implement activities to raise awareness about environmental issues on their campus,

and to take action to minimize adverse environmental impacts (Smith et al. 1993; Student Environmental Action Coalition 1991).

Another significant factor is that industry and government are increasingly demanding graduates who are environmentally literate. Orr (1992, 3–4) explains that:

> *"Environmental mismanagement is too often the work of highly educated people.... The challenge before educators is that of developing in themselves and their students, mindsets and habits that enable people to live sustainably...."*

If students are not taught the environmental standards they will have to meet in industry and if their institutional practices are less strict, then students will not be as prepared for employment as they should be.

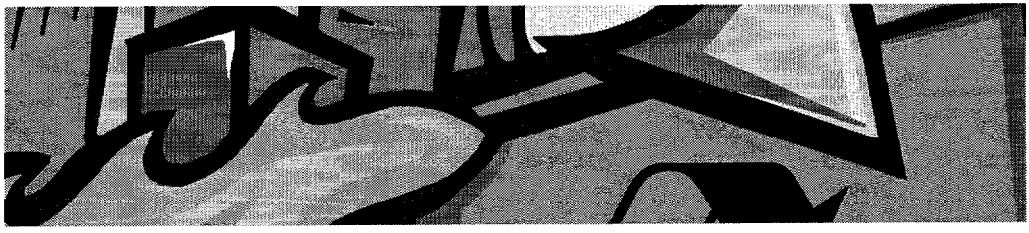
8. **Milieu of Academic Institutions.** The setting in which the principles and practices of sustainable development are taught must demonstrate these principles and practices to avoid cynicism and skepticism. George Stanton, Chief Officer of the Further Education Unit in England, explains that:

> *"If the environmental understanding being encouraged through the curriculum is not reflected in the practices of the institution itself, then not only are important (if informal) learning opportunities being missed, but there is a likelihood that the mismatch between the institution's rhetoric and its behaviour will undermine the whole process" (Ali Khan and Parkin 1992, v).*

The Conference on University Action for Sustainable Development was held in Halifax, Nova Scotia in December 1991, during which the importance of implementing environmentally sound policies and practices at educational institutions was recognized. Howard Clark, President and Vice-Chancellor of Dalhousie University, and Robert Page, Dean of the Faculty of Environmental Design at The University of Calgary, both explained that if a university is to provide environmental leadership it must first set its own house in order (Jenks Clarke 1992, 2-3 and 22-24). The conference produced the Halifax Declaration, shown in Box 1–4, and an action plan for sustainable development at universities.

In October 1990, at another conference, 22 university leaders worldwide convened at the Tufts European Center in Talloires, France to discuss the role of universities and their leadership in environmental management. Conference participants developed and signed the Talloires Declaration (see Box 1–3) as a statement of their commitment to environmental responsibility. They issued a challenge to their colleagues around the globe to join them in this commitment (Smith et al. 1993). The signing of this declaration was a sound initial step, but having signed the declaration university administrations must be prepared to act on it.

9. **Community Concerns.** Residents are often concerned about environmental stewardship in their community. This concern extends to the environmental impacts of organizations, such as universities.



2. Environmental Management Tools

Industry, government, and institutions such as universities require a set of management tools that apply effectively to environmental problems. Too often the approach to solving environmental problems has been either reactive rather than proactive, or preoccupied with a detailed description of the specific problem and descriptions of the technological options that might be applied. Not enough attention has been paid to the management and decision-making systems that must select and implement the solution and monitor effectiveness over the long term.

We have identified a set of environmental management tools through teaching, research and consulting:

- Strategic Environmental Assessment and Planning
- Organizational Structure and Environmental Decision Making
- Environmental Policy Statements
- Environmental Audits
- Economic Instruments
- Environmental Impact Assessment
- Product and Technology Assessment
- Life Cycle Assessment and Life Cycle Costing
- Environmental Performance Indicators and Environmental Quality Indicators
- Environmental Reporting
- New Systems of Accounting

Other management tools can also be applied to environmental problems, such as education and training, and risk management (which includes risk identification, risk analysis, risk management and risk communication).

This set of tools is being applied with increasing frequency and rapidly becoming standardized. The popularity stems from the advantage that they are the same no matter which environmental problem is being tackled and no matter what the organizational or institutional circumstances. Most, if not all, are identified in literature on environmental management systems and the standards for such systems established by the British Standards Association, GEMI (Global

BOX 2–1
Environmental Management Systems

The Canadian Standards Association (1994d) has compiled the following definitions for an environmental management system:

1. The organizational structure, responsibilities, practices, procedures, processes and resources for implementing environmental management. (Environmental Management Systems Glossary of Terms)
2. An organization's structure of responsibilities and policies, practices, procedures, processes and resources for minimizing the organization's impact on human health and the environment and managing environmental issues. (National Sanitary Foundation Environmental Performance Evaluation Guidelines)
3. The aspect of the overall management function that determines and implements the environmental policy and the organizational structure, responsibilities, procedures, processes and resources for implementing the said management function. (KPMG)
4. The system to ensure compliance with the environmental policy of an organization. It includes policy, objectives and targets, key roles, responsibilities, departmental linkages and the practices and procedures adopted to implement the policy and ensure continuous improvement. (Information Management for Environmental Management Systems)
5. An organization's plans, programs and management control processes, including organization monitoring, record keeping, planning documents, internal inspection programs and physical controls to achieve stated policy objectives and goals. (National Sanitary Foundation Environmental Auditing Guidelines, National Sanitary Foundation Requirements for Environmental Management Systems)

Environmental Management Initiative) and the Canadian Standards Association (CSA). The CSA's definition of an environmental management system is contained in Box 2–1.

Recently, KPMG (1994) stated that although two-thirds of the respondents to their environmental management system (EMS) survey believed that they have effective environmental management systems in place, fewer than three percent of respondents had all the key components that developing international standards suggest are essential parts of an effective system. Universities were included in the survey.

Some of the management tools are appropriate for routine use on Canadian campuses:

- Strategic Environmental Assessment
- Organizational Structure and Environmental Decision Making
- Environmental Policy Statements
- Environmental Audits
- Economic Instruments
- Environmental Impact Assessment

- Product and Technology Assessment

All of these environmental management tools have developed enough that they can be, and have been, applied by universities in Canada. In each case, it will be necessary to adapt these tools to the particular circumstances that apply in academia. In all cases there is likely to be a rather steep learning curve. In other words, it will be a while before we can apply these tools easily and efficiently. Experience in the private sector, however, is showing them to be effective.

In the following sections, these seven tools are defined and described, and references to the most useful literature are provided. Where possible, suggestions about where to start the process of applying these tools are provided.

EXAMPLE

University of British Columbia

The University of British Columbia is developing information materials and training packages to help individuals achieve environmental compliance goals as well as increase their environmental awareness. It has developed an Environmental Programs Course for supervisors and administrative heads that informs them of their environmental roles and responsibilities. UBC is also planning an Environmental and Emergency Planning Seminar series for 1995.

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The other four tools (environmental performance indicators, life cycle assessment and life cycle costing, environmental reporting, new systems of accounting) are developing rapidly and will become available for routine application on Canadian campuses in the next few years.

Strategic Environmental Assessment

Recently strategic environmental assessment (SEA) has been receiving attention in the literature as a means of ensuring that adequate consideration is given to environmental factors during the strategic planning process (Lee and Walsh 1992; Pinfield 1992). Without such a system in place, environmental factors are only considered after the fact, and their inclusion in planning and implementation causes delays or is rejected as expensive and impractical. Strategic environmental assessment is basically the application of the environmental impact assessment process to university plans and policies. The knowledge that an environmental assessment process will be carried out generally results in planners and policy makers consulting the right experts and gaining access to the pertinent environmental information before, or in conjunction with, their planning and policy making. This reduces, but does not eliminate, the need for assessments and subsequent amendments.

Environmental impact assessments (EIAs), described later, of specific construction projects are easier to conduct because of their direct alterations of the biophysical environment and because of the greater experience with them. EIAs of plans and policies are more difficult because plans and policies come in various forms and formats, their impacts

are not as direct, and there is much less experience in performing them (Bridgewater 1992).

At this stage it is enough that administrations recognize that environmental factors need to be considered during planning and policy formulations, to learn where to get the information and expertise. They should begin submitting strategic plans and policies to an environmental impact assessment in order to become familiar with the SEA process and gain valuable experience.

Organizational Structure and Decision-Making Systems

This may prove to be one of the most difficult aspects of environmental management on campuses. Academic decision making is diffuse and fragmented and often bound up in a complex and ponderous committee structure. It is possible for individual units, such as caretaking or the safety office, to develop and implement aspects of environmental policies. However, it is generally difficult to translate such initiatives into an overall environmental management system because of the challenge of getting the support and cooperation of others on campus. Effective leadership is often absent on issues involving many facets of campus activities.

In the case of corporations, when the need for change is recognized by senior management, they are generally able to change the corporate structure and the reporting mechanisms; to assign the responsibility for environ-

EXAMPLE

University of British Columbia

The University of British Columbia (UBC) has drafted an environmental conformance plan as part of an overall environmental management system that integrates environmental concerns with UBC's management structure. The conformance plan is being developed with help from the Board of Governors, the Environmental Programs Advisory Committee, faculty, staff and students.

UBC has created a position of Manager of Environmental Programs, responsible for environmental audits, central monitoring, recording and reporting progress (and instances of non-compliance) on environmental protection issues, providing training to the campus community, and serving as the central information source about current and anticipated legislation applicable to UBC. It has also appointed a full-time Waste Reduction Coordinator and a full-time Coordinator for the Greening the Campus Program at its Sustainable Development Research Institute. Greening the Campus is a collaborative program involving student research projects, facilitated by staff and supervised by faculty members. The program analyses the potential for improving the quality of the campus environment while at the same time reducing the overall operating costs of the university.

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BOX 2-2
Environmental Management Organizational Structure at University X

University X will form a Health, Safety and Environment Management Committee (HSE). The HSE will comprise senior administrators (VP 1, VP 2 and VP 3), senior representatives from major stakeholders, and campus staff members whose job descriptions give them significant responsibilities for the HSE. The HSE will report annually to the president, board of governors and senate.

Standing technical subcommittees will be formed for each major policy area (energy and water, solid waste, hazardous materials, transportation, and education and training). These subcommittees will provide technical and policy advice to the HSE. The technical subcommittees will be formed from those on campus having relevant technical expertise, some stakeholder representatives, and outside representatives and expertise where necessary (e.g., local transportation planners, provincial hazardous materials representatives, and energy utility representatives). The technical subcommittees will report to the HSE annually. Each subcommittee will assist with the development of appropriate "practice manuals," in close cooperation with those directly responsible for its implementation and the day-to-day work.

mental issues to someone who will be made accountable for successful implementation; to allocate the required resources; and to demand behaviour that works toward those corporate goals. This will probably be much harder to do at most universities because of their complex, diffuse decision-making systems. There may be considerable resistance to change and, therefore, it may be more difficult to develop a structure and assign campus-wide responsibilities.

The best way to start dealing with the problems of organizational structure and decision making is to identify all the campus elements that have, or should have, environmental responsibilities and show where they sit on an organizational chart. Job descriptions and job titles will identify those who have formal responsibilities. Most of these campus-wide responsibilities will likely be in administrative units and include such divisions as safety, caretaking, and risk management. It is unusual to find formal, campus-wide responsibilities for environmental issues as they relate to academic and research activities. Many environmental activities have been started on an informal, voluntary basis.

Two related activities could arise from describing the current organizational structure. The first is the hiring of a qualified coordinator in an attempt to achieve some order and effectiveness on ad hoc efforts in isolated areas. This person would not likely be senior enough to decide on and implement required structural changes. A short-lived but high-powered task force could be struck to devise the best means of implementing environmental management for the university. It is unlikely that radical changes will be frequent or easy.

In the corporate setting, centralized environmental management systems (a special environmental unit within a line department) and decentralized management systems (individuals spread throughout the organization) have advantages and disadvantages (Thompson and McKay 1984). Corporate use of these alternatives changes with management style, perceived needs, and stage of evolution of sophisticated environmental management systems. The most popular corporate structure now combines the decision-making power of the centralized system in a small corporate policy and evaluation unit, with the effectiveness of the decentralized system with environmental responsibilities spread throughout the organization (Weaver, forthcoming).

Universities typically have three or more bodies dealing with governance and decision making (e.g., senate, board of governors, general faculties council, deans council) and two or three units dealing with administration (e.g., academic, research, finance, facilities and services). University presidents are often principally concerned with the relationship between the university and external agencies. There are also often five or more separate groups who have their own organization and administrative units, and who must be effectively involved: administration, undergraduate students, graduate students, faculty and support staff. It may be a challenge to develop a structure that includes adequate representation from these groups without becoming so large as to be ineffective. Further, if the representatives are senior enough to make and

EXAMPLE

Dalhousie University

Each of Dalhousie's operating and academic units is responsible for introducing environmentally sound practices and ideas into its own programs and activities. A University Committee on the Environment has also been established to support and coordinate campus-wide efforts. This committee reports to the Senate and is composed of nine faculty members from across campus, three student representatives, 10 representatives from other groups, such as the staff association, the computer centre, and Environmental Health and Safety, and the President and the Chair of Senate. The University Committee on the Environment recommends policies, practices, guidelines and codes of good practice; identifies environmentally unacceptable practices, policies and programs; recommends modifications when necessary; encourages or undertakes education projects and programs when appropriate; and liaises with and coordinates its activities with groups and committees both within and outside the university.

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BOX 2-3
Development of an Environmental Policy Statement at University X

Policy for Year 1
University X will prepare a preliminary environmental policy statement and start it through the normal policy approval process. The policy statement will comprise (a) an environmental philosophy (vision) statement of one page or less, (b) a set of policy statements specifying specific actions, specific outputs, and accountability (where possible); and (c) a list of topic areas for which policies are being or will be developed.

(The faculty association, the staff union, graduate and undergraduate student groups, and individual faculties may want to start the same process.) The approval process will solicit input from relevant campus stakeholders, to ensure buy-in and commitment from these stakeholders and, therefore, more effective implementation.

Policy for Year 2
The environmental policy statement will be reviewed and reapproved annually by a designated body at the university. The university will seek parallel re-endorsements of the policy statement from the faculty association, the staff union, and the undergraduate and graduate student associations. This policy will be submitted to the council of each faculty for reaffirmation.

Policy for Year 3
For each policy statement, the appropriate technical subcommittees will identify an environmental performance indicator or a set of indicators that will measure progress on implementation of the policy. The technical subcommittees will work with administrators to develop effective accounting and reporting procedures.

implement campus-wide decisions, it is unlikely that they will have the detailed technical expertise, familiarity with campus operations, and access to information that good decisions will demand. It is, therefore, recommended that technical subcommittees be formed for specific topics, such as energy, solid waste and transportation. These subcommittees would formulate policies specific to their area of concentration, answer technical questions, and prepare annual reports on their area. An example of such a structure is provided in Box 2-2.

Environmental Policy Statements

Environmental policy statements are a very important management tool, but they are difficult to design and implement (Ryley, forthcoming). These statements often include three different but related components characterized by increasing levels of detail. The first is a

mission, vision or environmental philosophy statement for the institution. This statement is usually stated in one or two sentences, one page at most. The second level is a set of environmental policies which commit the institution to specific actions, specific outcomes and, wherever possible, some form of accountability for all environmental concerns. The third level is environmental practice manuals which provide detailed information on how specific actions are to be carried out. Box 2-3 provides an example of the possible stages of development of a policy statement.

The wide range of interests and philosophical and political views on environmental matters will likely make it difficult to reach consensus on environmental policies. To reduce this problem, and to maintain an up-to-date system, should one be required such as in a due diligence defense, there must be a commitment to a periodic review, update and re-endorsement of the institution's environmental policies. As well, changing external circumstances (legislation, technology, economics) and institutional and individual experience dictate that policies be reviewed and modified regularly. This will make participants more confident about compromising on policy statement development and less likely to worry excessively about the exact wording,

EXAMPLE

University of Calgary

The University of Calgary set an important precedent for making decisions on matters involving campus-wide activities when all three vice-presidents (Academic, Research, and Finance and Services) set the terms of reference and struck a Hazardous Waste Task Force to investigate hazardous waste issues on campus. Through the participation of the three vice-presidents, responsibility and accountability in separate administrative units was resolved.

The University of Calgary is currently creating a committee responsible for policy and other matters concerning health, safety and the environment. The three vice-presidents and other senior managers sit on the committee that will review existing policies and recommend changes or new policies which promote programs, services and procedures to further the health and well-being of students, faculty and staff and ensure high standards of environmental protection.

To support this committee, environmental technical review subcommittees will be created in order to help draft and implement environmental policies; develop pragmatic, practical and cost-effective plans; establish a database of on-campus expertise; establish task forces to examine specific issues; bring attention to and advise on matters which might require action; review the effectiveness of environmental policies to determine their technical feasibility, practicality and cost-effectiveness; provide advice on environmental performance indicators; and draft annual reports.

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because they are assured that the policy will be reviewed regularly. Annual review might be expensive but with the current rapid rate of change it may be necessary.

The general steps to be followed in developing and endorsing a set of environmental policy statements include:

- Draft the mission statement (sometimes called a vision or philosophy statement). Keep it to a simple statement initially to improve the likelihood of consensus. Send it out for comment and endorsement.
- Conduct brainstorming sessions, involving concerned stakeholders, to identify issues which might require an environmental policy.
- Divide the issues identified during the brainstorming into categories of important,

EXAMPLE

Carleton University

Carleton University has initiated an effort to maintain and improve the indoor and outdoor environment by providing a healthy workplace, and maintaining initiatives and practices for sustainable development and ecological responsibility. This effort included creating an Environmental Officer position. The Environmental Officer works in conjunction with the Manager of Occupational Health and Safety and the University Safety Officer on issues related to the environment, regulations compliance, the implementation of an emergency response plan, and coordination of efforts with university officials and the environmental committee.

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EXAMPLE

Dalhousie University

Dalhousie University's "environmental policy" recognizes that the university has a special responsibility to conduct its activities in an environmentally sound manner and stipulates that the university community must strive to conduct its activities in ways that do not cause unacceptable degradation of the environment. The cornerstones of the policy include: offering academic courses that disseminate information about environmental issues and solutions; conducting its research activities in environmentally appropriate ways and encouraging research on the causes and mitigation of environmental degradation; achieving a healthy educational and working environment; managing its buildings and grounds in an environmentally appropriate manner; and ensuring that its corporate operations become as environmentally sound as possible given contemporary technology, economics and common sense.

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moderately important, marginal or potentially important.

- Draft the preliminary individual policy statements. This can be done by assigning topics to subgroups or to those most likely to be directly responsible for implementation. This is the difficult step. Start approval processes and seek feedback and commitment from stakeholders. Emphasize annual review and revision to keep stakeholders from slowing or halting the approval process.

At each step, if conflict arises, remind participants that there will be regular opportunities to review and revise the policies so a compromise does not commit the institution to a particular wording for a long period of time.

It is important to reach agreement on some form of policy statement and start to implement it. It is likely that the policies will always be incomplete and imperfect because of changing experience, circumstances, technology and economics. However, if the policies are seen more as a process rather than a product,

EXAMPLE

University of Calgary

The University of Calgary's environmental policy states that it is "committed to establishing and maintaining high standards of health, safety and environmental protection and undertakes to be a responsible steward of the environment." The policy, which has moved through the approval process, outlines the principles that the U of C will embrace: resource conservation, compliance with all laws and by-laws, reduction of adverse impacts, environmentally sound purchasing guidelines, waste minimization, prompt mitigation of problems, proactive stance on the environment, energy conservation, and periodic conduct of environmental audits.

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EXAMPLE

University of Toronto

The University of Toronto also developed an environmental protection policy that outlines three fundamental principles: minimization of negative impacts on the environment; conservation of resources; and respect for biodiversity. It lists specific objectives that the university will strive to meet: minimizing energy and water use; minimizing waste generation, pollution effluent and emissions, noise and odour pollution; minimizing the use of chemicals; including environmental factors in planning and landscape decisions; and meeting and, where possible, exceeding environmental standards, regulations and guidelines. It also describes the roles and responsibilities required in implementing the policy.

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the imperfections will be easier to live with. The experience gained and applied in the first reviews, revisions and re-endorsement will be more valuable than efforts to perfect the first environmental statement.

A venue for public participation, comment and feedback will be required given the large number of different interest and stakeholder groups on campuses. Their acceptance of and commitment to the policies will be essential. This ongoing process is important because the frequent turnover of the student body requires an annual education and commitment process.

It may be desirable for each stakeholder group to start developing its own environmental policies. This would familiarize them with the issues, help them articulate their concerns and approaches, and provide the basis for their input to the institution-wide set of environmental policies.

Environmental Audits

Environmental auditing is quickly becoming a standard tool in the environmental management of corporations and other organizations. It is a systematic assessment of corporate, institutional and government management systems, policies and practices as they affect the environment and resource use. An environmental audit comprises five basic activities (Thompson and Wilson 1994):

1. examination of an organization's environmental management system;
2. determination of an organization's compliance with regulatory requirements;
3. determination of an organization's conformance with the organization's own policies and with related industry or institutional standards or guidelines (Halifax Declaration and Talloires Declaration);
4. evaluation of an organization's routine management and housekeeping practices;

EXAMPLE

University of British Columbia

The Board of Governors of the University of British Columbia approved the Policy on Environmental Protection Compliance in January 1994. Concerns about liability and due diligence prompted the development of this policy. The policy's focus, therefore, is on compliance and includes detailed procedures for implementation and administration. A second portion, currently being drafted, will focus on sustainable development.

The policy states that:

> *"UBC will act responsibly and demonstrate stewardship in protecting the environment. All individuals in the university community share the responsibility for protecting the environment ... Procedures and reporting structures for matters of compliance with environmental legislation are necessary to demonstrate due diligence of UBC, its Board of Governors, senior officers, students, and members of faculty and staff, by addressing responsibly, activities which have potential for exposure to lawsuits and prosecution."*

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5. creation of an action plan to correct any identified deficiencies.

The environmental management system, similar to those recommended by the Canadian Standards Association, Global Environmental Management Initiative, and the British Standards Association, is likely to be a major focus of an initial environmental audit. It is important to determine the status of the university's environmental management system. If the framework is not sound then further environmental initiatives, such as responding effectively to other environmental audit findings, are likely not to be effective (Cahill and Kane 1991). The environmental management system is examined by verifying the accuracy of information and examining and evaluating the effectiveness of management system components such as record-keeping, policies, training of employees, emergency response, and the upkeep of facility equipment and grounds (Wilson 1992).

EXAMPLE

University of Calgary

In an effort to introduce established corporate environmental practices that respond to external pressures and requirements, two Master's degree theses on environmental audits were completed at The University of Calgary. This cost-effective approach was given credibility through direct involvement of senior academics with administrative positions (such as a dean and a vice-president). The audits were facilitated by the enthusiastic cooperation provided by physical plant managers and staff. One of these environmental audits, Introduction of Environmental Auditing as an Environmental Management Tool for The University of Calgary, evolved to provide the basis for this book. The other audit is the basis for Chapter 7, Transportation.

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Types of Environmental Audits

Several different types of environmental audits, including facility and waste audits, have been developed (Cahill and Kane 1991; Thompson and Wilson 1994). Universities, especially when developing initial environmental auditing programs, will be primarily concerned with facility audits. Facility audits are environmental audits of an organization's facilities conducted in order to collect information for corporate management. Facility audits are mainly concerned with compliance, conformance and routine management at a facility.

Waste audits, examinations of the various wastes generated by an operation or facility, are often an integral component of comprehensive facility audits and should be a part of any comprehensive auditing program at universities. They determine compliance with regulations and conformance with standards, and identify opportunities for waste reduction, reuse or recycling (Thompson and Wilson 1994). Other specialized audits, such as energy, transportation, water, and health and safety, may also be included as subsets of a facility audit.

Stages of an Audit

There are three basic stages to an audit (Wilson 1992). General activities in each stage are outlined below.

- **Stage 1: Pre-audit activities**

This stage involves the preparation for the audit:

1. Affirm commitment from top manage-ment to the audit
2. Confirm audit purpose and objectives
3. Establish audit scope
4. Select audit team members
5. Establish audit methodology
6. Inform facility management about the audit
7. Review information in preparation for the site visit
8. Finalize logistics

- **Stage 2: On-site activities**

This stage includes all the activities that occur at the facility:

1. Conduct opening meeting
2. Interview facility management and key personnel
3. Review documentation from facility files
4. Inspect facility
5. Perform preliminary evaluation of information
6. Conduct exit meeting

- **Stage 3: Post-audit activities**

This stage includes information analysis, reporting and the design and execution of action plans:

1. Evaluate audit findings
2. Prepare action plan and presentation
3. Review report draft
4. Write and distribute audit report
5. Present audit results

These activities are rarely performed in a linear fashion, especially in first-time audits. Feedback loops will be typical in each stage because the information required for one step may not be acquired until a later step.

First-time and Follow-up Audits

Audits can be divided into first-time audits and follow-up audits. The planning and execution of a first-time audit is more complex than a follow-up audit because of the greater uncertainty surrounding the most appropriate audit processes and objectives, and the greater difficulty in obtaining and organizing the necessary historical information. Historical information can identify past events that may have

EXAMPLE

University of British Columbia

The University of British Columbia is developing an environmental auditing process that will systematically cover all areas and activities on campus under control of the university. It has produced a document outlining the scope and procedures of the university's environmental compliance audits. These audits will identify environmental risks, and determine the extent of compliance with UBC policies, and federal, provincial and municipal legislation. UBC will be using in-house expertise to perform the environmental audits.

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a lingering environmental impact or liability. After such historical information is gathered in the initial audit, only the events that happened since the last audit will need to be researched in subsequent audits.

First-time audits are likely to have more feedback loops between stages than established audit programs, as already noted. This proved to be the case with the introduction to an environmental audit at The University of Calgary (van Bakel, 1994).

EXAMPLE

University of British Columbia
Faculty and staff at UBC produce an in-house environmental newsletter, *WasteWatchers,* that focuses on regulatory responsibilities, waste minimization and current issues on campus. Substance Assessment Fact Sheets are also produced that describe the health and environmental effects of specific hazardous chemicals.

The Sustainable Development Research Institute at UBC produces the *SDRI Newsletter,* which includes descriptions of the environmental and sustainable development initiatives on campus. UBC also publishes an *Environmental Programs Year End Summary* which describes the activities within the calendar year.

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Common Barriers to Environmental Audits

Seven reasons are commonly given when objecting to the conduct of an environmental auditing program at an organization: extra costs involved; fear of personal or performance appraisal; fear of potential legal problems; fear of adverse publicity; uncertainty of audit benefits; reluctance to find out what problems exist; and satisfaction with current environmental performance (Thompson and Wilson 1994). These barriers are based on unsound rationales as discussed in the following paragraphs.

- **Cost**

The cost of conducting an environmental audit is variable. Universities and colleges have a unique opportunity to use faculty and student expertise to offset the costs. However, the potential costs of not conducting environmental audits can run much higher. If a serious environmental incident occurs, the costs of fines, time delays, and clean-up could be much greater than the costs of an audit.

- **Fear of personal performance appraisal**

Some employees may mistakenly believe that they will be held personally responsible for the environmental problems identified through the environmental audit, and that their jobs may be on the line. However, environmental audits are used to assess management systems, not employees. If there are problems with management systems, then changes in policies, training, communications, and possibly job descriptions will be recommended. Emphasis must be placed on the action plan to correct any problems identified by the audit.

- **Fear of potential legal problems**

Some organizations may fear that audit information may be used against them by regulators as evidence of noncompliance. However, if noncompliant activities are discovered by regulators, high fines and clean-up costs may result. Environmental audits help to reduce noncompliance, and can also be used to show due diligence should an environmental incident occur.

- **Fear of adverse publicity**

Some organizations may think that there would be adverse publicity if audit results should be released. However, greater adverse publicity would result if an environmental incident occurred and the company was not adequately prepared to respond to the incident. Environmental audits have become equated with good management. Those organizations that do not conduct audits may be viewed as poor environmental managers.

- **Uncertainty of audit benefits**

This may have been a valid reason a few years ago but, as information is increasingly being published, evidence of the benefits of environmental auditing is growing.

- **Reluctance to find out what problems exist**

Some organizations may not want to know what problems exist because knowing about the problems suggests an obligation to correct the problems immediately. However, if an environmental incident occurs, the courts may decide that the organization should have known about the problems and may find the organization negligent.

- **Satisfaction with current environmental performance**

Some organizations may feel that their environmental performance is already satisfactory and that nothing would be gained by conducting an environmental audit. But how do they know? Environmental audits document strengths as well as identify weaknesses. If the environmental performance is satisfactory, the audit document becomes proof of compliance, conformance and effective management.

Potential for all of these barriers exist at universities. If they are encountered, it is likely that lack of knowledge, understanding and experience with environmental audits may be the underlying problems.

Environmental Impact Assessment

Universities and colleges only have to contemplate a complete environmental impact assessment (EIA) when large construction projects are undertaken, something that is happening less frequently under current budget constraints. Figure 2–1 outlines the general steps

EXAMPLE

University of Toronto

The University of Toronto produces an environmental newsletter, *4R Environment,* that reports on developments in U of T's waste management strategy, and offers an open forum for discussion of environmental issues.

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of the EIA process. Efforts are being made to harmonize federal and provincial processes so that corporations and institutions will only have to go through one process. However, progress on harmonization has been slow to date. Municipal-level EIA requirements are now being contemplated (Perks et al., forthcoming).

Comprehensive EIA would not always be required under current legislation and by-laws but access to sound advice on the circumstances in which federal, provincial and municipal legislation applies should be readily available. It should be part of the strategic environmental assessment when major projects are being planned. There may be occasions when universities will carry out EIAs not required by legislation, to ensure sound environmental protection and to avoid expensive mistakes.

It is not just large projects that should receive the scrutiny of an EIA. Small projects often do not receive a full EIA because their scale and budget do not warrant the time and costs involved. But the impacts of a number of small projects could cumulatively create a significant net impact. These small projects can be assessed using a class impact assessment, which is often a checklist of things to consider in a specific type of small project whose biophysical and socio-economic impacts are reasonably well understood. Such class EIAs might be developed and routinely applied by those responsible for landscaping, relatively minor changes to transportation systems, building renovations, etc. (Government of Canada 1994; Ontario Ministry of the Environment 1978). Class EIAs could also help avoid the use of routine, but environmentally unacceptable, approaches to project construction.

It would be interesting to develop a set of class EIA procedures that could be applied when new experiments above a certain size are being designed. These would be particularly important for safety considerations, hazardous materials management and hazardous waste minimization.

Economic Instruments

Economic instruments are economic incentives and disincentives and other techniques that attempt to apply market forces to move action in desired directions and to internalize what had previously been external costs. They include effluent fees, tradable emission permits, subsidies, product taxes, deposit return systems, feebates (fees and rebates), and sharing savings from conservation programs (Alberta Environment 1990; Government of Canada 1992).

Effluent fees and tradable emission permits are unlikely to work at the institutional level, although universities might want to take part in such programs if they are conducted at the provincial or regional level.

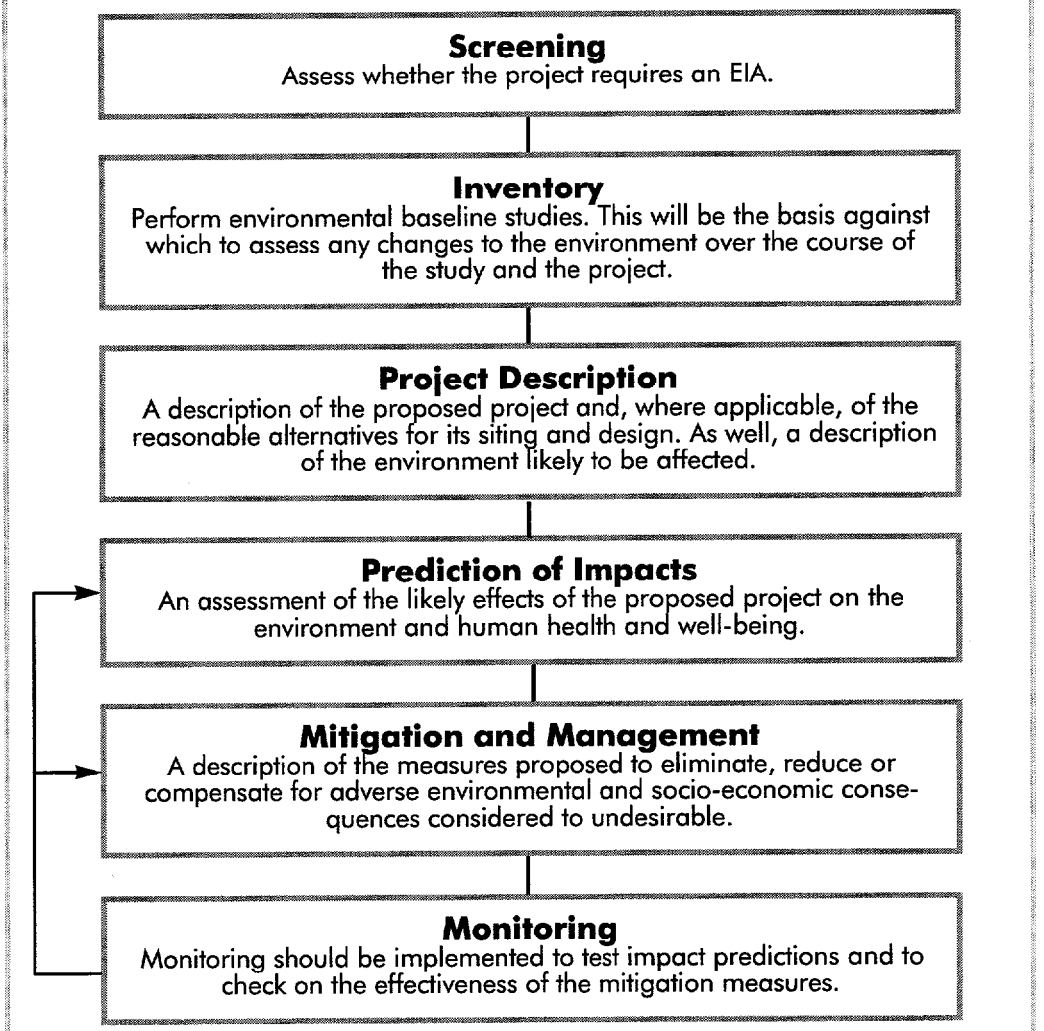
Deposit and return systems can be used whenever management wants to encourage return of materials to be reused or recycled rather than sent for disposal. This could apply to packaging, pallets, containers of all sorts, and solvents that could be distilled for reuse rather than disposed of.

Economic incentives for appropriate behaviour could include discounts for bringing a reusable food or beverage container; reductions in the occupancy fees for tenants who effectively support waste minimization, recycling and composting programs; and sharing savings from energy and water conserva-

tion programs. Disincentives could be applied as direct, full-cost recovery on hazardous waste disposal charges, charges for disposable food containers, and penalties for failing to abide by recycling guidelines (e.g., placing cardboard, paper, or beverage containers in disposal bins, or mixing classes of waste paper).

Feebates are systems where fees are charged to those indulging in wasteful or environmentally damaging behaviour and a portion of those fees are rebated to others who go

Figure 2-1
Steps in an Environmental Impact Assessment



out of their way to act in an appropriate fashion. On campus this could mean higher fees for renting or leasing less fuel-efficient vehicles with a rebate for those using more efficient ones that could fulfill the same purpose. The same could apply for parking spaces, especially if parking lot design were to designate spaces for small vehicles and large vehicles, since more small vehicles can be parked in the same space and they generally cause less environmental damage.

Careful assessment of the costs of utilizing economic instruments is required, including enforceability, likelihood of avoidance, and administrative costs. Some are really no-regrets policies while others need careful analysis before all the costs and benefits will be understood. No-regrets policies are those policies that can be put into place with minimal potential risks. This is, in effect, a strategic environmental assessment and cost benefit analysis of the proposed policy (the application of an economic instrument).

Product and Technology Assessment

Product and technology assessment is a systematic effort to assess the health, safety and environmental impacts of products and technologies. It requires a description of the populations and regions that would be affected by the product or technology, efforts to predict adverse impacts on the population and environment, the development of measures to reduce those impacts, and a monitoring system to ensure success and adequate management. The assessment must be based upon the life cycle of the product or technology (cradle to grave, or cradle to cradle).

Most assessments are done in a qualitative or relative fashion rather than quantitatively because quantitative baseline data are not available. This is particularly the case with the life cycle assessment component of product and technology assessments, which is developing very rapidly but is not yet at the stage where it can be applied routinely. The Canadian Standards Association (1994a, 1994b) has published guidelines for life cycle assessments which will facilitate their application by reducing the debate about methodology. Universities can begin employing life cycle assessments by referring to the Canadian Environmental Choice Program, which does a technical review of product groups based on life cycle assessments.

For universities, product and technology assessments can be applied with a more limited scope because the concern is over impacts that relate to a small area and a specific population. The assessments can have a particular focus such as energy or water conservation, solid and hazardous waste minimization. Product and technology assessments are the basis for the development of purchasing guidelines to minimize resource consumption, waste and disposal costs. The CSA's guidelines on product labelling (CSA 1994c) will help those struggling with purchasing guidelines to understand what is, or at least should be, meant by various claims for "friendly" environmentally green products.

Other Environmental Management Tools

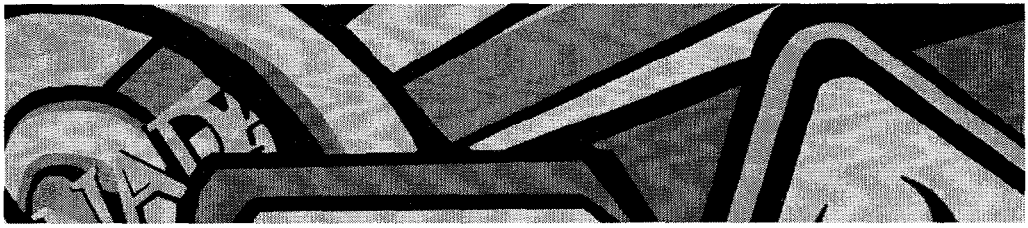
The other four environmental management tools in the set cannot be routinely applied on Canadian campuses until the previous seven tools are being applied effectively or because they are not yet at a mature enough stage of

development. They are briefly discussed here since they are likely to become routine environmental management tools in the near future.

Some governments regularly report on the state of the environment using evolving sets of environmental indicators. For example, the Government of Canada (1986, 1991) prepares *State of the Environment* reports every five years and discusses the reports and the indicators used in them in the *State of the Environment Newsletter* and *State of the Environment Fact Sheets.* Corporations report on their impacts on the environment through environmental reports (International Institute for Sustainable Development 1993) using environmental performance indicators (EPIs). The development of criteria for selecting and designing indicators is still at an early stage. Nevertheless, environmental reporting and environmental indicators are extremely important because of the various roles they play in environmental management, especially education, setting baselines and feedback (Schipperus, forthcoming).

Life cycle assessments are developing much more rapidly than might have been expected a few years ago, especially with the publication of the CSA's guidelines (1994a, 1994b). However, they are still difficult, expensive and controversial. Nevertheless, universities should expect that they will be doing, or using the results of, life cycle assessments routinely within the next few years. Life cycle costing is an attempt to account for direct capital, operation and maintenance costs over the lifetime of a product or technology. This tool provides information that can help make sound decisions about where to allocate scarce resources, particularly if there is concern about the up-front capital costs required to gain the economic benefits of resource conservation.

New systems of accounting are being developed by chartered accountants and by corporations because the Canadian Institute of Chartered Accountants ruled that environmental liabilities had to be charged against assets (Canadian Institute of Chartered Accountants 1993, 1994). Governments are working to develop effective means to adjust gross national product estimates to better reflect national well-being by subtracting estimates of resource depletion and environmental degradation (Canadian Institute of Chartered Accountants 1994, Thompson and Wilson, 1994). Because these accounting practices are becoming standard practices in the private sector, they may ultimately have to be adopted by institutions such as universities.



3. Energy

Many universities have flirted with energy conservation programs since the impact of higher energy prices in the 1970s, when it was recognized that energy conservation was necessary to cope with the soaring costs of power for lighting, heating and air conditioning. These early energy conservation initiatives were primarily developed as cost-cutting measures and were typically implemented without the guidance of a comprehensive plan. Often their effectiveness was never fully demonstrated and the programs lacked clear objectives and properly designated overall management responsibility (Smith and Gottlieb 1992; Brink et al. 1989; Pierce 1992).

Over the past few years the environmental consequences of campus energy use has come under scrutiny (Pierce 1992). Although university campuses are diverse in building design, engineering, fuels used, ages and functions and in energy use and costs, most universities are large consumers of energy because of their size and hours of operation (Bomar and Hirsch 1981a). Altogether, Canadian universities spent approximately $265 million on utilities in 1993 (Canadian Association of University Business Officers and Statistics Canada 1994). Accordingly, universities can benefit from reducing energy consumption costs — in terms of both reduced costs and environmental stewardship.

The Harmony Foundation (1991) predicts much stronger legislation may come to bear on energy use in Canada. A federal government discussion paper, *Energy Use and Atmospheric Change: A Discussion Paper* (1990, cited in Harmony Foundation of Canada 1991), recommends that the federal government implement a new Energy Efficiency Act to increase energy efficiency requirements across all sectors including commercial, institutional and industrial. Universities must develop and implement effective and efficient energy management systems so they can prepare for this potential legislation (Smith and Gottlieb 1992; Brink et al. 1989; Pierce 1992).

Conserving energy through behavioural

changes and increasing energy efficiency through technological changes have great potential to minimize adverse environmental impacts and save energy and operating costs. They can both be pragmatic, no-regrets approaches to energy management, which make economic and environmental sense whether or not predicted environmental problems occur. No-regrets initiatives can lower energy consumption with minimal potential risk while providing time and finances for longer-term, more expensive initiatives.

Not all efforts to reduce energy expenditure pose minimal risk, however. For example, one of the most obvious targets for energy conservation is reducing ventilation. Cutting back on air supply rates translates directly into reduced power consumption by the fan. It can dramatically reduce winter heating and summer cooling costs. However, in many large buildings, including some university buildings, cutting back in these areas (or deficiencies in the original design) has contributed to illness among building occupants. Even where serious illness does not occur, occupant dissatisfaction and productivity losses can be serious (Louch 1994).

EXAMPLE

Memorial University

Memorial University contracted an external company to carry out capital improvements and retrofitting of the university's mechanical, electrical and energy management system. The $3 million cost of these improvements will be recouped in the projected annual energy savings of $600,000, which is 13% of its annual energy costs.

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Energy Management

An effective energy management system can be developed with the elements listed in Box 3–1.

In setting up an energy management system, some elements will require more attention or consideration than others, at least initially. These elements include an energy policy, accountability and management structure, monitoring and information management, education and training. In addition, it is important that the energy management system address three categories of energy conservation initiatives to be optimally effective: technological initiatives alone, technological initiatives that require some sort of behavioural change, and institutional and behavioural initiatives. The remainder of this chapter focuses on these elements and categories.

Energy Policy

A generic energy management policy might be to reduce energy expenditures as much as possible within technical and economic limits without adversely affecting the mission of the university (Pierce 1992). The policy can include simple "rule of thumb" guidelines that encapsulate the goals of the plan. These guidelines can facilitate the widespread implementation of a program (Pierce 1992; Harmony Foundation of Canada 1991). Pierce (1992) and the Harmony Foundation (1991) both suggest a similar set of three rules

BOX 3-1
Key Elements of an Energy Management System

- energy use policy statement
- designated organizational and decision-making structure
- risk assessment
- energy management considerations integrated into strategic planning
- energy conservation training and education strategy
- resources available for energy conservation initiatives
- information management
- measuring, monitoring and auditing (including management system audits)
- communication and reporting
- continuous improvement of all components of the energy management system

that guide an energy conservation program (the Harmony Foundation's three-point plan is shown in brackets):

- If not needed, turn it off (conserve what sources of energy we have by eliminating wastefulness).
- When on, make it run as efficiently as possible (be more efficient in how we use energy by improving or changing processes, equipment and practices).
- Select the proper fuels and conversion processes for the particular situation (use and encourage alternatives to non-renewable energy sources, such as solar, wind and geothermal).

Accountability and Organizational Structure

The energy management system should include thorough monitoring and gathering of information to provide personalized feedback to energy consumers (an integral part of both the education and management processes) and a formal strategy for education and training in energy conservation. Typically, a university is billed for its entire utility consumption in one lump sum. This can lead to a lack of accountability for energy consumption among all three constituents of a university (faculty, staff, and students). Increasing accountability through education, incentives, and feedback from metering and monitoring is likely to be much more successful than measures such as isolating building temperature controls from occupants (Corless and Ward 1992).

Feedback in identifiable units is essential as part of an education and incentive program so that each unit can know how much energy it is using and can tailor its actions accordingly. Feedback in discrete units can identify the

most cost-effective interventions. It also allows the development and implementation of economic incentives and rewards for effective action on energy conservation and penalties for failure to work diligently to improve energy conservation. This type of feedback would make each unit accountable for its energy use.

Monitoring and Information Management

To successfully plan and monitor conservation measures, detailed information must be gathered on an ongoing basis. It provides feedback about the effect or lack of effect of conservation efforts. Monitoring energy consumption meters, which can be installed in campus buildings, is the first step in providing this information.

The information gathered should be disaggregated into small units — each department or program if possible — that people can identify with, to make it personally relevant and encourage energy conserving behaviour. Then people can see the effect of and receive recognition for their conservation actions. Further energy conservation initiatives, such as competitions, become feasible with this type of feedback.

The trade-offs between the costs of obtaining such detailed information and the benefits that could accrue must be considered in setting priorities for gathering information. At some point the cost of getting more and more detail starts to exceed the benefits derived from the information.

Categories of Energy Conservation Initiatives

Energy management programs must address both technical and non-technical aspects of energy conservation (Bomar and Hirsch 1981a). Creighton and Cortese (1992) found that it is important to explore ways to combine technological changes with changes in institutional policy and individual behaviour. These aspects can be divided into three distinct categories of change:

1. technological initiatives alone;
2. technological initiatives requiring user acceptance; and
3. institutional and behavioural initiatives.

Technological Initiatives

Technological initiatives are those changes to electrical or mechanical equipment that do not require behavioural change on the part of the campus community and produce no noticeable changes in the campus environment. Improving the efficiency of electric motors is an example. Increasing the energy efficiency will decrease energy costs, since less energy will be used, which will, in turn, decrease adverse impacts on the environment (Creighton and Cortese 1992).

Given Canada's cold climate, another common example is the use of a thermostat and timer to control parking lot car plug-ins to significantly reduce power consumption. However, as with most initiatives, there are trade-offs to consider, such as the increased pollution and wear and tear associated with starting a car when it is cold.

Universities can use their in-house expertise, namely faculty and students, to develop technical solutions. This is a unique resource for universities that is often overlooked. Sometimes, however, this expertise may be too theoretical and impractical.

Universities can obtain much valuable

information and advice regarding their energy management strategies by collaborating with external groups. Local energy utility companies and energy consultants can be approached for advice and potential financial assistance. As explained by Westerman (1993, 10):

> *"It is cheaper for energy and water suppliers to make efficient use of existing capacity, than to find and develop new sources. Thus, they happily urge and assist their commercial and industrial customers toward greater efficiency.... suppliers hope to satisfy as much future demand growth as they can with efficiency measures today. Their methods include:*
>
> - *rate restructuring – raising rates, fees, and charges and reducing or eliminating volume discounts;*
> - *providing efficiency audits for customers, and in some cases, supplying equipment, arranging retrofits and financing; and*
> - *producing educational materials."*

Fairly new external resources are energy service companies (ESCOs). These firms provide both technical and financial support which may be well beyond what is normally available from utility companies. They are usually paid out of the operational savings from the capital energy expenditure. In the current climate of financial restraint where capital funding is difficult to find, ESCOs can be an effective option (Louch 1994).

Care must be exercised when selecting an

EXAMPLE

Carleton University

Carleton University's Energy Savings Program is designed to reduce the consumption of electrical power, natural gas and water. This will reduce utility costs, reduce the deferred maintenance backlog by retrofitting complete building systems and retiring equipment that otherwise would require replacement, and improve air quality. It is too early to evaluate the success of the program in terms of money saved, but the program has already been successful in other areas.

Recent projects include replacing old-fashioned T12 fluorescent lamps with more efficient T8 lamps (generating an annual saving of $200,000 on a capital outlay of $1,600,000) and utilizing the geological features beneath the campus, which contain water, to provide pre-cooling and pre-heating through heat exchangers and coils to an 8,000 m^2 building. As well, four other projects are in progress: retrofitting the heating, ventilating and air conditioning systems for four buildings; introducing water saving measures that eliminate city water to cool and adjust mechanical systems; installing additional T8 lamps; and a campus-wide metering system that measures utilities in each building.

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ESCO if it is an equipment manufacturer or a representative of one, because that may limit technical options. The best ESCOs are often those not wedded to a particular product line.

Identifying and solving energy supply management issues usually requires more specialized expertise than do demand management issues. Supply management is concerned with selecting the proper fuels and conversion processes for a particular situation. Unlike consumption management techniques that can apply broadly to virtually every institution, supply management can vary greatly between campuses and even between parts of the same campus. New installations and replacements should not just follow "established engineering practices," nor should they follow the pattern of what has already been done, since these practices do not necessarily embrace the concept of efficiency and may have evolved before the concept of sustainable development (Pierce 1992).

Technological Initiatives Requiring User Acceptance

The success of some technological initiatives depends upon acceptance by affected users of the change produced by these initiatives. If the change in work environment is not accepted or understood, strained relations within the university community and productivity or lack of effective work activity may result. Examples of technological initiatives that fall into this category include:

- installing occupancy sensors to switch on lights in classrooms;
- adjusting lighting levels to suit task requirements;
- turning off building ventilation systems earlier in the evening;
- setting thermostats lower in winter and higher in summer; and
- supplying power intermittently to parking lot or plug-ins during winter.

Institutional and Behavioural Initiatives

Institutional and behavioural initiatives are those energy conservation efforts that depend wholly on the support, and in some cases the education, of university community members. This category includes personal behavioural changes, such as turning off lights or computers when they are not needed, and changes in institutional practices, such as routine housekeeping practices and the implementation of a university energy policy.

Energy management programs should involve all constituencies of the campus community to be optimally effective (Bomar and Hirsch 1981a). Administration, faculty, students and staff all have a vital role to play.

The approval, support and public backing of the top administration is critical to the success of any program and its acceptance by the campus community. Top administrators must devote time and institutional resources to these efforts, even though it is recognized that these administrators are probably already overworked. The official endorsement becomes the foundation of the program. A well-informed and committed senior administration can rally the community and bring together the decentralized campus constituents in support of an energy management program. Senior administrators should convey the program's importance to their constituencies in a positive manner, so that the administration is not seen as forcing yet another program and hindrance on the campus community (Bomar and Hirsch 1981a).

The collaboration of faculty with administration and staff on energy management issues is an excellent way for a university to involve its own in-house experts. Recommendations and cooperation from university faculty can be invaluable. Faculty can also focus the projects or research in the courses that they teach on campus energy management issues. Involvement of senior faculty and administrators can provide credibility and encourage buy-in from students for these initiatives.

Technical, clerical, operating and maintenance staff are particularly important since they will be responsible for implementing many of the initiatives. Staff input is essential because they have the technical expertise required and they are the most familiar with campus operations. University staff are also a group which can maintain a program's momentum.

Students are a more transient group and have the most varied interests and concerns. This transience and the typical life style changes that students are undergoing may make it difficult to obtain general support and commitment. Students, however, are a primary constituency of a university and a valuable resource. Pierce (1992) found that the involvement of students was of great mutual benefit to both the students and the energy management program. Students can be employed to do specific projects such as lighting audits, or these projects can be conducted as class or course projects. Whatever fields students choose after graduation, an intensive exposure to the realities of energy and environmental issues will make them not only better educated but also better citizens of the global community.

Education and Training

Ongoing education and training with the campus community can increase awareness and understanding of energy issues (Bomar and Hirsch 1981b). For behavioural and institutional conservation efforts to be most effective, the meaning and significance of important energy management concepts, such as peak demand, must be communicated and understood. Behaviour can then be modified accordingly.

Peak demand is a concept that is important from both the energy conservation and the power cost perspectives. Westerman (1993, 102) provides a straightforward explanation of the concept of peak demand management:

> *"The utility company sizes its plants to meet the peak demands, or loads, of their customers. You pay the utility to keep enough capacity in reserve to meet your maximum energy, or 'peak load', even if you only reach that level once a year."*

Reducing the peak demand level of a university will help reduce overall utility costs. In most cases where organizations have attempted to reduce peak demand levels, they have done so in technical terms (Louch 1994). There are, however, opportunities to address it in behavioural terms as well.

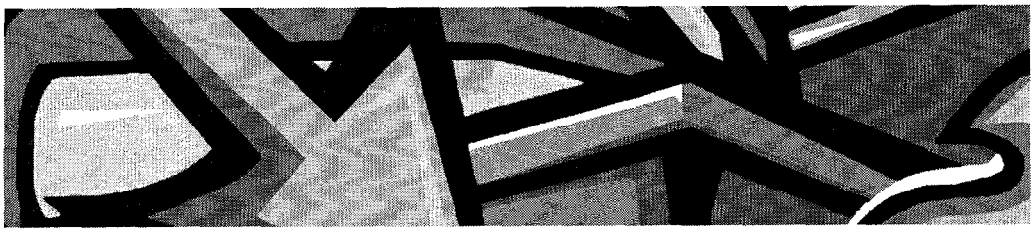
Education and training can be used to help to dispel some widely held myths about energy conservation. For example, many people believe that the practice of switching lights on and off reduces their burn life. In reality, while repeated switching shortens the total hours that bulbs will burn, their useful life can be increased and replacement costs delayed by keeping them off when they are not required

(Carriere and Rea 1989, cited in Creighton and Cortese 1992).

Information can be brought to the attention of the university community through a variety of methods. One method is campus newspaper articles. Another method is to design an energy meter, with a large display that shows instant demand and total daily usage of a building. This meter could be placed in the entrance of a particular building so that it was clearly visible to all the occupants of that building (Corless and Ward 1992).

Recognition of energy conservation efforts is another method to encourage behavioural change. Some universities are contemplating the introduction of financial rewards. A department may be given a percentage of the money that it saves by reducing its energy consumption (Corless and Ward 1992).

Competitions between campus groups such as departments or student residences to reduce energy, water consumption and minimize solid waste generation can also promote awareness and make conservation measures more personally relevant (Student Environmental Action Coalition 1991; Creighton and Cortese 1992).



4. Water

Universities can play an important role in conserving water and maintaining water quality, since they typically consume large amounts of water in their daily activities and operations (Student Environmental Action Coalition 1991; Brink et al. 1989). It is much easier and more cost-effective for consumers to implement water efficiency programs than for municipalities to tap further water sources and build more water and sewage treatment plants.

Accordingly, many schools, particularly those in arid regions of the United States, are developing and implementing initiatives for water conservation (Student Environmental Action Coalition 1991; Smith et al. 1993). Besides promoting environmental stewardship, water management strategies can make university operations more economical (Smith et al. 1993). Costs can be reduced by decreasing water consumption, reducing sewage generation and lowering energy requirements (for heating and pumping water).

Current water prices in Canada are relatively low and will likely have to increase significantly before Canadians implement comprehensive measures to protect their water resources (Government of Canada 1991). Conservation is motivated when the price of water rises (Brink et al. 1989; Harmony Foundation of Canada 1991; Government of Canada 1991). Many municipalities are already increasing their rates to better reflect the burden placed on water resources (Harmony Foundation of Canada 1991). Savings from water efficiency initiatives will only increase with substantial rises in user charges.

Water Management

There are two key objectives of a university's water management program. The first is to minimize water consumption within the constraints of meeting the needs of the water user. The second is to preserve water quality. Contamination of outgoing water with non-degradable wastes, such as metals and water insoluble organics or other hazardous materi-

BOX 4–1
Key Elements of a Water Management System

- water management policy
- designated organizational structure
- risk assessment
- water management considerations integrated into strategic planning
- water conservation training and education
- resources available to meet water management objectives
- information management
- measuring, monitoring and auditing (including management system audits)
- communication and reporting
- continuous improvement of all components of the water management system

als, must be minimized. Maintaining water quality is an integral part of a comprehensive hazardous waste management program (see Chapter 6).

An effective water management system can be developed using the elements listed in Box 4–1.

A successful management system should address three categories of water conservation initiatives: technological, technological requiring user acceptance, and behavioural and institutional changes. These three categories are the same as those described in Chapter 3, Energy.

Low-flow equipment such as urinals and toilets, water efficient machines such as dishwashers and laundry washing machines, and the recirculation of process water (for heating and cooling) are technological measures. They are not likely to affect the comfort or activities of users. Turning off automatic flushing systems in urinals during periods of low building occupancy (after work hours and on weekends) and low-flow showers are examples of technological measures that may require buy-in and understanding from affected users. Reducing personal use of water is a purely behavioural initiative and a significant part of any water conservation effort. Institutional water efficiency initiatives which do not affect users can include practices and procedures such as instituting regular maintenance checks for and prompt repair of water leaks, implementation of xeriscaping techniques, and shutting off landscaping fountains during hot or drought periods (to reduce water loss from evaporation).

Other aspects of water management are the monitoring of water consumption and associated costs, purchasing of equipment, and

external advice and assistance.

Monitoring

Monitoring water consumption by department, faculty or building may be more difficult than tracking energy consumption. Water meters for individual units are less likely to be in place and installing water meters may not be as straightforward as installing energy meters. Nevertheless, information gained from such metering could provide consumers with feedback about the effects of their water conservation efforts and hold them more accountable for the volume of water they use.

Monitoring waste water is also necessary to assess the composition of water discharges and to comply with the sewer discharge by-laws that are now coming into force in many municipalities.

Purchasing

Water management policies should be kept in mind when repairing or replacing existing equipment. For example, low-flow equipment can be bought to replace less efficient items. New buildings on campus could be fitted with low-flow equipment as a matter of policy. Extra capital costs for water conserving fixtures will likely be paid back quickly through reduced operational costs (i.e., reduced utility bills). Before any significant investments are made, life cycle costing and trial runs can be

EXAMPLE

University of Manitoba

The University of Manitoba has been reducing its city water consumption. The detection and repair of leaks has significantly reduced water loss. Measures to prevent underground pipes from corroding will reduce the need for future repairs.

The U of M is also reducing water consumption by changing from water distilling to reverse osmosis systems for water purification, by developing a chemical process to reduce the fresh water requirements of fish tank operations, and by implementing other technical changes.

Installing the reverse osmosis systems cost $265,000 (inflated to 1994 prices). The annual labour, steam, hydro and water savings are more than $200,000 (1994 costs) resulting in a payback in 1.33 years, or an overall savings of more than $2 million over the last 10 years. As well, breakdowns in the reverse osmosis systems have been almost nonexistent and the purified water quality has been improved. The program has been so successful that another, smaller reverse osmosis water purification system has been installed at the university's medical college campus.

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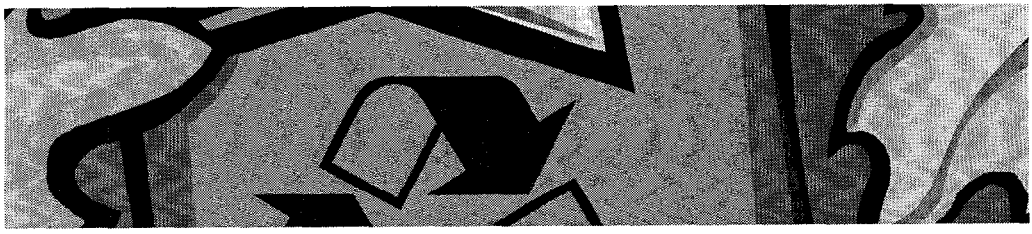
conducted to identify which equipment is an appropriate choice for a university. Documentation and testimonials from reputable sources about the equipment can also aid in decision making.

External Advice and Assistance

As in energy management, it is cheaper for water suppliers to use existing capacity efficiently than to find and develop new sources. Water suppliers can be approached for assistance in conducting efficiency audits, supplying equipment, and organizing financing (Westerman 1993).



5. Solid Waste

Campus communities can generate large amounts of waste. Much of this waste can be minimized, reused, recycled or composted (Smith et al. 1993). Factors encouraging implementing comprehensive waste management programs at universities include (modified from Ching and Gogan 1992):

- legislative mandates;
- shrinking landfill space;
- rising disposal costs;
- increasing purchase prices; and
- environmental concerns among members of the university community.

Solid Waste Management

The objective of solid waste management is to reduce the amount of waste being sent for ultimate disposal in the most cost-effective and environmentally sound method possible and to ensure that a university complies with all solid waste regulations. The implementation of a solid waste management system is an effective way to achieve these goals.

The elements in Box 5–1 are part of an effective solid waste management system. Waste audits, accounting, monitoring and measuring deserve special consideration. In addition, the waste management policy must address the 3Rs — source reduction, reuse and recycling initiatives. Box 5–2 outlines one way of getting started. Recycling programs are one of the most popular environmental initiatives on Canadian campuses (van Bakel 1994). Accordingly, this chapter concludes with a discussion of recycling program centralization, the increased workload for caretaking staff, and the scope of recycling programs.

Waste Audit

Implementing basic no-cost or low-cost measures can be a preliminary step in minimizing solid waste. These actions have a clear payback, are limited in scope, and require little or no sacrifice.

One of the most important steps in developing waste management measures is to "know your garbage" or, in other words, con-

BOX 5–1
Key Elements of a Solid Waste Management System

- waste management policy statements
- waste minimization policy
- purchasing guidelines/policy
- recycling and reuse policy
- composting policy
- waste disposal policy
- designated organizational structure
- risk assessment
- solid waste management considerations integrated into strategic planning
- training and education
- resources available for waste management initiatives
- information management
- measuring, monitoring and auditing (including management system audits)
- communication and reporting
- continuous improvement of all components of the waste management system

duct a waste audit. A waste audit, or waste composition study, is a specific type of environmental audit, examining the various wastes generated by an operation or facility. Compliance and conformance issues are typically addressed as part of the audit and a detailed action plan for further initiatives is usually prepared (Smith et al. 1993; Ryley 1993).

Waste audits can be conducted internally by university personnel, externally by consultants or by a combination of both. In the latter case, the university gathers basic data and then seeks outside assistance.

Waste audits help develop an effective waste management program by allowing an understanding of what materials are in the campus waste stream, from which buildings, and at what point in the academic year they are generated (seasonal trash tonnage can vary significantly) (Ching and Gogan 1992). The information can then be used to decide how reduction, reuse and recycling activities can be implemented most effectively.

BOX 5–2
Policy on Waste Minimization and Waste Management at University X

University X will establish a Waste Minimization and Waste Management Group (known as WMWM; given our knowledge of academia's infatuation with acronyms, this acronym will produce an appropriate sound for "getting things started" when spoken aloud). The group will be composed of members with expertise, important stakeholders, and those responsible for effective implementation.

WMWM will carry out a preliminary waste audit using campus resources where possible. Subgroups of WMWM will develop purchasing guidelines, review campus recycling and marketing of secondary materials, develop advertising, training and education campaigns and identify appropriate economic instruments for incentives and disincentives that apply to waste management.

Monitoring, Measuring and Accounting

Effective methods of keeping data related to solid waste practices and initiatives must be developed to obtain feedback on the viability and efficiency of initiatives. Currently assumptions and estimates are often the only information available. Accurate and comprehensive information about volumes, expenses and revenues is required for sound decision making. Records and files should be maintained, integrated and centralized to facilitate the gathering and calculating of accurate figures. This information can then be used to target initiatives with the most potential to reduce the volumes of waste generated and disposed of and to find the most cost-effective ones. The information can also be used to evaluate the effectiveness and efficiency of initiatives.

Yet, as previously mentioned in Chapter 3, the trade-offs between the costs of obtaining such detailed information and the benefits that could accrue must be considered. The cost-effectiveness of any potential initiative should be assessed before decisions are made. At some point the costs of getting more and more detail may start to exceed the benefits derived from the information. Altruism or love of the environment cannot be the only rationale for implementing initiatives; they must make economic sense.

External requirements and policies regarding waste minimization and source reduction should also be monitored so that a university can predict future requirements and prepare to meet them.

The 3Rs

Many universities are concentrating their efforts on recycling to the exclusion of other waste management strategies (Ching and Gogan 1992). While recycling programs are commendable, they are not optimal on their own. It is deceptive to think that recycling initiatives alone will be able to cope with the waste crisis. The Harmony Foundation's *Workplace Guide* (Harmony Foundation of Canada 1991, 49) explains:

"To prevent further degradation, govern-

ments are moving to mandate the '3Rs' – reduction, reuse and recycling – for waste generated in the commercial, institutional and industrial sectors. All three 'R' actions are important and can take place concurrently (rather than consecutively), but their order of priority must be clearly understood: First, reduce the quantities of materials used. Next, reuse existing materials as much as possible. Finally, recycle used materials to secondary markets wherever possible."

Universities can benefit by supporting research on waste minimization and recycling strategies and technology. Faculty and students have an opportunity to conduct practical research and the university itself can make use of the research findings.

Universities can also profit by cooperating with industry, such as recycling and waste disposal companies, to find ways to better manage recycling and solid waste disposal. These external companies have expertise that can help universities to use the three "R" actions to create an effective waste management program. Descriptions of each of the three "R" actions follow. Their division is not always distinct.

Waste disposal (hauling) contracts should be set up so that it is in the interest of the disposal contractor to support reduction, reuse and recycling rather than to maintain the weight or volume hauled away.

EXAMPLE

University of Calgary

The University of Calgary conducted a waste audit using outside consultants, faculty members with waste audit experience, staff members and graduate students carrying out a class project.

Garbage was identified by building and by activity (classrooms, washrooms, halls, offices, lounges, food services, etc.), sorted into 32 categories of material and then weighed. Lack of experience made identifying and remembering all 32 categories difficult.

Participants found that the sorting process was assisted by the following general categories:

- materials which should have been reused (reusable envelopes, file folders);
- materials which should have been recycled (beverage cans, large volumes of clean material);
- materials which could have been recycled using existing programs;
- materials which might be recycled if secondary materials markets develop;
- materials which could be composted; and
- materials which must be sent for disposal.

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Source Reduction

Source reduction is considered one of the most important and promising strategies for reducing the growing volume of solid waste in Canada. The National Round Table on the Environment and the Economy (1991) defines source reduction as the design, manufacture, purchase and use of products and materials in a manner that eliminates or minimizes the volume of waste requiring disposal. The basic premise of source reduction is that the less waste generated, the less waste requires disposal. Source reduction can result in cost savings by reducing the costs of collection, processing or disposal, as well as related capital, equipment and labour. Source reduction measures can also minimize the consumption of natural resources and reduce adverse environmental impacts through a reduction in manufacturing and disposal activities.

Generic source reduction measures can include (National Round Table on the Environment and the Economy 1991):

- reducing product volume;
- increasing product life;
- purchasing products selectively;
- promoting product reuse; and
- decreasing product consumption.

The following are examples of specific source reduction actions that can be taken at universities (National Round Table on the Environment and the Economy 1991; Ching and Gogan 1992; Westerman 1993):

- developing purchasing standards and guidelines that encourage reduced volume, durability and reuse of purchased products;
- favouring vendors who deliver their products with less packaging (or accept packaging back);
- implementing cooperative purchasing or materials exchange programs;
- converting to microscale laboratory techniques;
- reducing internal paper consumption;
- promoting double-sided copying and printing;
- promoting electronic mail and modem transmissions over hard copy;
- circulating and posting memos;

EXAMPLE

University of Toronto

The University of Toronto has implemented a waste reduction policy that encourages the entire university community (60,000 people) to work together to raise awareness and participation in a 4R program - Reduce, Reuse, Recycle and Rethink. This policy is reviewed at least every two years to assess its effectiveness.

The volume and weight of waste dumped in landfills from the University of Toronto decreased from 41,400 cubic yards and 1,470 tonnes in 1992, before program implementation, to 21,000 cubic yards and 870 tonnes in 1993/94 afterward – a 50% reduction in the volume of solid waste. A key element in this program was recruiting 270 volunteer environmental coordinators who serve as liaisons between the Waste Management Department and their respective faculties and student bodies.

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- sharing reports and periodicals;
- creating a central filing system; and
- using refillable and returnable containers.

Unfortunately, source reduction actions are not always straightforward (National Round Table on the Environment and the Economy 1991). Each source reduction action has specific advantages and disadvantages that must be assessed to determine its actual benefit. Sometimes reducing waste at the source may involve other economic or environmental costs. For example, choosing reusable products over disposable ones raises questions concerning the water and energy consumption properties of reusable products versus the hygienic properties or recyclability of disposable ones.

Two tools currently being developed that are likely to be important in resolving these uncertainties are life cycle assessment (Canadian Standards Association 1994) and life cycle costing, discussed in a later section of this chapter.

Purchasing

Purchasing guidelines and standards are a significant component of a university's source reduction strategy. Because of their sheer size, universities have tremendous power as consumers. Universities, like businesses and other institutions, consume a wide variety of products from large amounts of high-quality paper — the average university uses over one million sheets of bond and letterhead each month (Student Environmental Action Guide 1991) — to cleaners and paints, appliances and automobiles. The products that universities purchase can have a significant impact on the environment during their production, use and disposal (Smith et al. 1993). The products also determine the type and amount of waste generated by that university.

Some purchasing departments at universities and colleges across North America are beginning to develop environmental strategies for purchasing products (Association of Canadian Community Colleges 1992; Smith et al. 1993, 60–61). To encourage environmentally sound purchases, policies and guidelines can be established for the entire university, with clearly designated responsibility and accountability for purchasing decisions.

Some bureaucratic barriers may pose challenges to purchasing management programs. Firstly, there may be a lack of designated authority and accountability for purchasing choices. Secondly, there is often no feedback between departments to show the effects of changes in purchasing guidelines on disposal costs.

Education and awareness are key concerns. Effective communication channels for sharing information between purchasing and other departments on campus must be implemented. Education and training for university personnel and faculty can also be provided to make them aware of the importance of their buying decisions.

Purchasing personnel at universities should be informed of the latest innovations in products and services that meet environmental standards. However, environmental terms and claims can be confusing for the average person. It can be difficult to judge the environmental benefit of a product because of the many loopholes in the marketing claims of "green" products.

Consumer and Corporate Affairs Canada (CCAC, now Industry Canada) has written a

document entitled *Guiding Principles for Environmental Labelling and Advertising.* This document is an interpretation of Canadian law and is a guidance tool for regulatory compliance. The Canadian Standards Association has also published a *Guideline on Environmental Labelling (1993a).* It has been harmonized with the CCAC document and addresses all areas of labelling that apply to a broad range of environmental claims. Both of these documents may help consumers judge the meaning of environmental claims.

Life Cycle Assessments

To make sound decisions regarding which product is more cost-effective in both the long- and short-term and which is more environmentally responsible, information from life cycle assessment and life cycle costing is needed. Life cycle assessment is a systematic assessment of the environmental impact and resource consumption of products, buildings and technologies, from the extraction of raw materials to the final disposal, including all energy consumed, transportation impact and waste generated.

The Canadian Standards Association has published two documents that deal with life cycle assessments. The first, *Life Cycle Assessment* (1994a), provides technical guidance on an acceptable method for conducting life cycle assessment and reporting assessment results. The second document, *User's Guide to Life Cycle Assessment: Conceptual LCA in Practice* (1994b), is of a more practical nature. Although these documents may give purchasing personnel an understanding of what life

EXAMPLE

University of British Columbia

The University of British Columbia Waste Reduction Program has a mandate to instigate, coordinate and promote waste reduction, reuse and recycling activities on campus. The ultimate goal is to achieve a 50% per capita reduction in landfilled waste by the year 2000. The Waste Reduction Program currently runs a campus-wide paper and cardboard recycling operation and provides information and advice on waste reduction. Recently an "Eco-Depot" multi-material recycling program was established in student residences.

The university is currently moving from a sorted paper recycling system to a mixed paper system. This action supports the "Waste Free UBC" program which aims to increase paper recycling on campus by 50%. University office staff are given a deskside recycling box and a mini desktop garbage can. Garbage and recyclables are taken by the staff to central waste stations, eliminating deskside garbage collection. Pilot programs in several departments have proven successful. Campus-wide implementation of the program is expected to take between 18 and 24 months.

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cycle assessments are all about, someone with expertise will be required to conduct such a study. Life cycle assessments are still difficult, expensive and controversial. This is one area where it might be wise to use qualified academics, if they are available.

Life cycle costing is another important tool in choosing products. The aim is to assess the costs and benefits (capital, operation and maintenance, and non-quantifiable aspects) of purchasing, using or making a product, building or technology for its full lifetime. The process can determine whether the purchase of an environmentally sound product is economically feasible or even practical.

Reuse

Typical options for reuse at universities include rebuilding or reusing pallets, refilling laser cartridges, re-circulating and refinishing used furniture, and reusing foam polystyrene packing peanuts (Ching and Gogan 1992). Renting or borrowing items that are rarely used can also be an effective reuse strategy (Westerman 1993).

Economic instruments can be applied to encourage reuse. The hot and cold reusable beverage containers carried by individuals at many universities and colleges is an example. Food services departments can either charge for disposable cups, or give a discount to the users of reusable cups, or both. Often this practice is not adequately promoted or advertised.

Partnerships offer many opportunities to divert all kinds of materials away from the waste stream. Material exchange networks match organizations and businesses offering used materials with those that want them. These networks can be operated internally within the university or externally with other organizations. External networks are becoming more common. The networks can deal with different types of materials including industrial, construction and hazardous materials. Optimal use of exchange networks may require the development of software or other systems to keep track of materials.

Product suppliers can be requested to assist with a university's reuse initiatives. One university thought that the packaging in which it received experimental enzymes should be reused. Its suppliers now include return shipping labels and pay the return postage for the packaging which is then reused to ship more enzymes (Westerman 1993). Gas cylinders, used to supply gases to laboratories, are another example of items that can be requested to be taken back for reuse.

Recycling

When waste cannot be avoided, after reuse initiatives have already been employed, recycling is the waste management option of choice. The environmental benefits of recycling are clear (Ching and Gogan 1992; Student Environmental Action Coalition 1991). However, recycling is not a panacea for waste management problems. It can also create adverse impacts on the environment. Although it is true that manufacturing from virgin materials may carry a higher environmental price tag, manufacturing from recycled materials is not totally benign (Ching and Gogan 1992).

Only a few mandatory recycling laws have been established in Canada so far. Metro Toronto has "banned from its landfills primary (sic) loads of cardboard, fine paper, recyclable wood waste, scrap metal, drywall, tires,

white goods (refrigerators and stoves) and clean demolition rubble" (Harmony Foundation of Canada 1991, 49). This type of legislation may become more common in Canada in the near future. The Canadian Council of Ministers of the Environment has set a nation-wide goal of a 50% reduction in garbage sent for disposal from the 1988 rate by the year 2000. Most provinces have committed to this goal (Government of Canada 1991).

There are four key considerations in implementing a recycling program at universities: institutionalization, increased workload for caretaking staff, health and safety, and scope of the recycling program. They are discussed in the following four sections. A brief discussion of plastic recycling and composting completes this chapter.

Institutionalization

A university recycling program must be institutionalized. University administration should take responsibility for the program. It should be a recognized and mandatory part of the day-to-day university business activities, not just a voluntary or optional activity. Establishing markets for recyclable materials and arranging sales contracts are business decisions, not necessarily charitable options. Recycling should be cost-effective and revenue for recyclable materials should be sought. At the very least, recycling should cost the campus no more than it would to dispose of the same amount of trash. However, in the short term, start-up costs will likely be more than the immediate savings in operating costs (hence the importance of life cycle costing).

Markets for recyclable materials should be monitored regularly, so the best possible recycling contracts can be negotiated. Universities can help develop recycling markets by creating demand for recycled products through their purchasing policies and practices.

Universities should work with waste disposal and recycling companies to find ways to optimize their recycling programs. To ensure the best financial arrangements are made, contracts for recycling should be evaluated and awarded separately from regular waste removal contracts.

The recycling program should be centralized and consistent across campus for maximum effectiveness. Members of campus communities respond better to programs in which every building offers the same rules, container colours, and range of commodities recycled (Ching and Gogan 1992). Companies that collect recyclable materials and manufacturers of recycling containers usually offer discounts for large contracts.

Most universities eventually commit paid staff to recycling. This happens for a number of reasons (Ching and Gogan 1992):

- grass-roots programs often suffer from volunteer burnout;
- the transient nature of student populations, including departures during vacation periods;
- accumulations of recyclables can overflow in campus buildings if pick-ups are missed; and
- institutionalization of the program can lead to better participation (i.e., the program is more visible and the service is reliable).

Increased Workload for Caretaking Staff

Ching and Gogan (1992) raise the issue of custodial work in recycling programs. They

explain that (122–123):

> *"if custodians are to be the chief agents in emptying bins and centralizing recyclables within buildings – which is the case in most institutionalized campus programs – issues related to custodial time and job definition must be addressed.... Campus programs that have failed to elicit custodian input have faltered in their recycling programs ... custodians are typically the principal enforcers of the quality of the recyclable materials.... Recycling adds to the workday and job responsibilities ... but most campuses find that recycling does not take a significant amount of time.... At many institutions, custodians compensate for the added duties by collecting office trash less often, sometimes only three nights per week, leaving the alternate nights for recyclables."*

Health and Safety

There are several safety issues which must be considered when implementing a recycling program. Paper and cardboard are invariably the first materials to be targeted in a recycling program. Storing such combustible materials has an associated fire risk. Unless proper planning accompanies the introduction of these programs, institutions may face action by fire prevention officers or even dire consequences. In the same vein, paper recycling efforts often involve locating collection barrels in hallways, a practice that is particularly dangerous for building occupants.

Composting food waste can result similarly in longer-term storage than would have been the practice formerly. With this storage, there is an associated increase in concern about odours, vermin and so forth. Even glass and aluminum recycling can generate problems from spilled fluids accumulating in the bottom of collection drums.

Scope of Recycling Program

Potentially recyclable materials are numerous. There are five major recyclable waste streams (adapted from National Round Table on the Environment and the Economy 1991; Harmony Foundation of Canada 1991):

- dry recyclable materials (e.g., paper, glass);
- yard waste (e.g., leaves, grass clippings, prunings, yard and garden organic matter);
- food waste (e.g., food services' food discards);
- heavy materials (e.g., pallets, wood discards); and
- hazardous and liquid wastes (e.g., lab chemicals, lead acid batteries, used motor oil).

A recycling program should initially target the most economically attractive items (Westerman 1993). At universities these items will probably be aluminum beverage containers, paper and cardboard. Then the program can progress to items that may be more difficult to collect, sort and transport or for which the recycling market is not as favourable.

The opportunity to expand recycling programs and target further materials such as metals, plastics, commercial sector food waste, drywall, construction and demolition waste, automobile tires and white goods (used appliances) should be explored. Plastic and organic materials are typically two significant elements in a campus waste stream. They are briefly discussed in the next two sections.

Plastic Recycling

New techniques are being developed that make plastic recycling programs increasingly

attractive and feasible. However, recycling plastic is more complex than recycling other materials, such as paper and cardboard. Plastics can be recycled when large sources of the same type are available and in close proximity to a recycling facility to make transportation economically feasible (Environmentally Sound Packaging Coalition of Canada 1994).

The first step in designing a program is to find out if there are local recycling companies that take plastic material. These companies should be consulted to determine what material they can use and in what form they will accept it. There is little use collecting material if there is no market for it.

The wide variety of plastic currently in use makes recycling a challenge. Ensuring that only clean material is collected is another challenge. Currently, there are two options to recycle plastic. The first is to collect clean waste plastic and sort it by type, grade and additives present. This clean, sorted plastic can then be recycled into plastics that have properties approaching those of virgin plastics. If sorting, cleaning and transportation costs can be kept under control, this option may bring in the most revenue. However, it is often difficult to keep these costs under control.

Another option is to use unsorted (commingled) but still clean plastic material for applications such as plastic lumber. However, recycling mixed plastics is difficult because mixing polymers, additives and other contaminants produces a low grade material with unpredictable and variable properties.

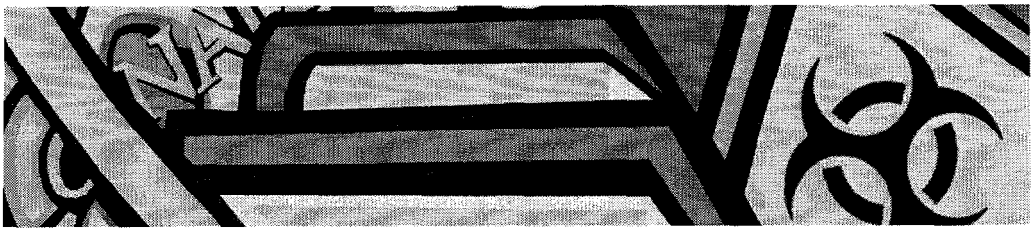
For plastic material such as foamed polystyrene or highly contaminated plastics, the most cost-effective options are utilizing it as fuel for heat recovery, or reducing it to synthetic crude or disposing of it in a landfill. This type of plastic material cannot be recycled. Despite the negative image of landfills, most plastics help stabilize landfills and do not create any environmental hazards (Henselwood 1994).

Composting Organic Material

Composting, another method of recycling, seems to be growing rapidly in all provinces (Hazardous Materials Management 1994). Composting is the biological degradation of organic matter so that it can be utilized as a soil amendment. Many different materials can be composted — from plant waste to wood waste to food waste. Typical institutional food items that cannot be composted include meat, dairy products, fat and oil. However, grease from food can be reprocessed by industry and used to produce feed for animals.

Composting is difficult in the climatic conditions that prevail in most of Canada, but research and development programs are rapidly making year-round composting technically feasible. The economic feasibility is also improving as disposal costs increase and compost materials displace the need for purchasing soil amendments.

Although composting has not yet become required by law in Canada, it may in the future. In the United States, compostable materials must be separated from the rest of the waste in more than 30 states (Westerman 1993). Proactively implementing composting programs has immediate benefits and would stand the university in good stead should composting become mandatory.



6. Hazardous Materials

Universities are not large generators of hazardous waste compared to many industrial facilities (Ashbrook and Reinhardt 1985; Allen and Neuse 1990). Accordingly, universities have been largely ignored by environmental regulators in the past. The absence of external monitoring has meant that educational institutions themselves have often turned a blind eye to environmental regulations (Sanders 1986). These regulations, often designed with industry in mind, can be unusually burdensome for academic institutions (Brink et al. 1989).

Although universities are not large producers of hazardous waste, they do produce an exceptionally wide variety of wastes, much more heterogeneous than in most industrial facilities (Smith et al. 1993; Sanders 1986; Ashbrook and Reinhardt 1985). Not only is the waste varied, but its composition continually changes as new research projects are started and older projects are terminated. (Ashbrook and Reinhardt 1985; Sanders 1986).

The multitude of chemicals used at universities includes not just specialized compounds used in experiments and research, but "everyday" chemicals used in everyday products. These chemicals help a university to achieve its varied goals, from education to good housekeeping, but they can also pose risks to the environment, health and safety (Smith et al. 1993). The management of these chemicals before they become waste is essential in any hazardous materials management effort. It will assist in reducing the amount of waste requiring recycling or disposal. Hence the term hazardous materials management is preferable to hazardous waste management.

The potentially adverse environmental impact from hazardous waste generation at universities and colleges is not insignificant. In the past, hazardous waste has been improperly disposed of by many academic laboratories; it has been poured down drains, tossed into garbage bins, or just dumped on the ground (Sanders 1986).

Federal and provincial regulations

regarding hazardous waste are being continually tightened. Enforcement of regulations through external monitoring is being intensified. Tightening chemical and biohazardous waste regulations mean that it is imperative that universities begin preparing now for these regulations, to avoid being caught off-guard, by developing and implementing management systems for these types of hazardous materials. This is especially important if universities want to avoid the bureaucracy, accompanied by increased paperwork and cost, involved in external monitoring. If universities can conduct their operations so that they meet these requirements without external monitoring, then much time, cost and outside interference may be avoided. Reducing reliance on hazardous materials in university activities will reduce exposure to regulations.

An effective hazardous materials management system demonstrates "good faith" to regulatory agencies and shows regulators that self-regulation can be effective. Such a system can decrease overall disposal costs, minimize the exposure of personnel to chemicals, and promote a reduction and minimization ethic through the conservation of material and energy resources utilized in the production and disposal of hazardous materials (Matteson and Hadley 1991). A hazardous materials management system can also provide a solid foundation for a declaration of environmental stewardship and promote a favourable public perception of a university.

Other forces motivating better management of hazardous materials at universities include risk of liability, financial considerations, insurance availability and cost, pressure from university associations, and concern by both university communities and the general public.

Universities must understand that unless faculty, students and employees are properly informed and trained in accordance with an adequate hazardous materials management policy, the administration may be held accountable in the event of an environmental incident. In addition, faculty members, as well as graduate students and employees, should understand that they, personally, may be legally responsible for making sure that their own hazardous materials collection and disposal actions are environmentally sound.

Another driving force is unique to educational institutions. Universities have a responsibility to educate their students to be environmentally responsible employees and citizens. The implementation of an effective hazardous materials management program would set an appropriate example for students. Universities must practise what they preach and students must learn the practices that they will have to use when they are employed.

Hazardous Materials Management

An important step in the development and operation of a hazardous materials management program is to determine which materials fall within the scope of the program. There are a number of regulations concerning hazardous materials and hazardous waste, each with its own definition of what constitutes a hazardous material. Some of these regulations are the Workplace Hazardous Materials Information System (WHMIS), *Transportation of Dangerous Goods Act* (TDG), *Canadian Environmental Protection Act* (CEPA) and provincial hazardous waste disposal regula-

EXAMPLE

University of Alberta

The University of Alberta 's Chemical Exchange Program began in 1985 as a pilot project. The program, now university-wide, collects chemicals from staff who no longer have a use for them; enters information about the chemicals (name, manufacturer, quantity and whether the container has been opened) on a computerized data base; distributes the list of available chemicals to users across campus; and responds to requests for the chemicals.

The program is based upon chemical exchange programs at the universities of Illinois and Wisconsin (see Korenaga et al. 1993). The Universities of Saskatchewan and British Columbia have examined the program and will set up their own versions and The University of Calgary is considering a similar initiative.

When the chemicals are received, they are sorted, labelled, catalogued and added to the computer list of available chemicals. Over 300 university staff receive information about the program twice a year. In addition, all universities and colleges in Alberta, high schools in the Edmonton area, and some government facilities receive announcements about the program.

Since the program began, about 26,000 chemical containers with a value of over $2 million (based on costs that would be charged to the chemistry department and are often discounted appreciably from catalogue prices) have been distributed to campus researchers. Chemicals worth about $200,000 per year are being reused. Recipients include staff in 12 of the 16 faculties on campus, the university library, physical plant and occupational health and safety.

The cost of operating the program is approximately $40,000 per year which includes the salary of the technician responsible for the program. The avoided disposal costs are more difficult to estimate.

During the first five years of the program, chemicals were distributed free to those who could use them. Since 1991, a flat fee of $2 per container and $10 per order has been charged to help offset administration costs.

In conjunction with the chemical exchange program, used solvents are distilled for reuse. Equipment for this purpose has been donated by Parkes Scientific Ltd. of Edmonton. Currently dichloromethane, methanol, acetone and isopropanol from the departments of Chemistry and Soil Science are being recovered and reused. There is a large potential for expansion of the solvent recovery program.

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tions. Even within the WHMIS program, no uniform guidelines or standards have been set yet for material safety data sheets (MSDS).

The lack of harmony between these sets of regulations may create some difficulty for the development and implementation of a university hazardous materials management program, since a university must abide by and ensure that it is in compliance with all of the regulations that cover its operations. Until harmony is achieved, it is up to the university to organize its management system to handle the lack of concordance. An effective strategy should be on the lookout for proposed changes in legislation and regulations and prepare in advance. This is important because the laws on hazardous materials are evolving constantly. The management program must be flexible to respond to these changes. Up-to-date copies of all applicable hazardous materials regulations and guidelines and the university's own policy can be set up and maintained in a centralized format and location so that they are easily accessible.

There are five essential objectives that a hazardous materials management system must strive to meet if it is to be efficient and effective. The first objective is the development and implementation of a hazardous waste minimization program. Waste minimization involves efforts to reduce the amount of materials that are part of the recycling stream or waste stream. Waste minimization is sometimes called source reduction and is described in Chapter 5, Solid Waste.

The second and third objectives are the implementation of campus-wide hazardous materials reuse and recycling programs. A fourth objective is the sound and cost-effective disposal of the remaining hazardous material. Sometimes the first four objectives are encapsulated under the same policy. However, their different priorities may be overlooked when they are lumped together. Differentiating the objectives through separate policies emphasizes that it is always better to minimize waste.

A fifth objective is to put an effective education and training component into operation. Training and education should be geared to all sectors of a university community involved with hazardous materials, from lab chemicals and art supplies to everyday housekeeping and office products.

These five objectives can be achieved by developing and implementing hazardous material cradle-to-grave management systems (i.e., from their production or purchase to their ultimate disposal) that meet current and future compliance and conformance requirements. The elements listed in Box 6–1 can help create an effective management system.

Hazardous materials management requires properly designed facilities if the work is to be done safely. As with recycling, a university cannot simply decide to begin managing its hazardous materials without dealing with the need for proper facilities. Effective hazardous materials management also requires that the staffing implications be considered.

The remainder of this chapter focuses on the five objectives that a hazardous materials management system must meet: hazardous waste minimization, including a discussion of microscale chemistry, purchasing and inventory; hazardous materials reuse and recycling, including chemical exchange programs and solvent recycling; hazardous waste treatment; and education and training. Potential obstacles to the implementation of an effective haz-

BOX 6-1
Key Elements of a Hazardous Materials Management System

- hazardous materials policy statement
- designated organizational structure
- risk assessment
- environmental input to strategic planning
- training and education
- resources and facilities available to meet objectives
- information management
- monitoring, measuring and auditing
- communication and reporting
- continuous improvement

ardous materials management system have been described in the literature. This chapter ends with an outline of some of these obstacles.

Hazardous Waste Minimization

Waste minimization is a significant component of any hazardous materials management program. The United States Environmental Protection Agency developed a Hazardous Waste Management Hierarchy as shown in Figure 6–1. Reduction or elimination of the hazardous waste generated is considered the most desirable option, while straight waste disposal is the least desirable option (Brink et al. 1989, 155).

Waste minimization is the most effective solution for reducing the cost and liability of hazardous material handling and disposal. Waste minimization, reuse and recycling strategies are significantly distinct from disposal strategies, such as landfilling and incineration. Changes in packing liquid hazardous waste to reduce volume and therefore disposal costs is a waste disposal strategy, not waste minimization, because the amount of hazardous waste being generated or sent for disposal has not been reduced.

A campus-wide waste minimization program should be tailored to both the volume and diversity of a university's waste stream and its available resources (Matteson and Hadley 1991). Waste management techniques for research and educational institutions are discussed in publications such as the American Chemical Society pamphlet *Less is Better* (1985, cited in Brink et al. 1989, 158) and the California Department of Health Services report, *Waste Audit Study – Research and Educational Institutions* (1988, cited in Brink et al. 1989, 158). Suggestions in these publica-

tions and by Matteson and Hadley (1991) for minimizing hazardous waste include:

- purchasing chemicals in smaller quantities, where appropriate, to avoid having to dispose of any excess;
- substituting less hazardous chemicals for more hazardous ones that result in more expensive, difficult to dispose of waste;
- dispensing only the amount of chemical required in an experiment;
- conducting experiments on a smaller scale, thus reducing both the quantity of chemi-

Figure 6-1
Hazardous Waste Management Hierarchy

(Adapted from: U.S. Environmental Protection Agency 1986; cited in Brink et al. 1989, 156)

cals required and the quantity of waste generated; and
- implementing an exchange program for surplus chemicals so that instead of being discarded, unwanted excess material may be used by other researchers.

Ashbrook and Reinhardt (1985) agree that two basic options for waste minimization are the purchase and use of smaller quantities of chemicals and the substitution of less hazardous chemicals in laboratory work. Both of these approaches are safe, economical, no-regrets approaches. They concede, however, that constraints on the purchase of certain chemicals can be expensive to administer and may be seen as a burden by teachers and researchers. Also, the use of less hazardous material does not necessarily reduce the amount of waste, although it might simplify waste handling and thereby reduce cost.

Although the use of hazardous materials should be decreased whenever possible, caution should be taken when attempting to switch less hazardous products for products presently used. The true environmental impacts and cost-effectiveness of a new product may not be known until life cycle assessment and life cycle costing are undertaken, as described in Chapter 5, Solid Waste.

Waste Minimization Through Microscale Chemistry

Microscale experiments are miniaturized versions of standard laboratory experiments, using quantities of chemicals a hundred to a thousand times smaller (Smith et al. 1993). Microscale techniques are currently being used at more than 400 colleges and universities in the United States and are now being implemented at universities in Canada (Smith et al. 1993). Microscale experiments lower the cost of laboratory teaching and promote environmental stewardship by decreasing the amount of chemicals purchased and the amount of hazardous waste requiring disposal (Brink et al. 1989).

Microscale techniques are not appropriate for all experiments. Microscale is not "the same but smaller" as may be commonly thought; total restructuring may be involved. It is often necessary to plan different experiments using different instruments and different chemicals.

The purchase of new sets of glassware in large quantities contributes to the high initial cost associated with implementing microscale experiments. However, these costs will probably be offset by savings from reduced chemical purchase and disposal in the first few years. The new smaller glassware used in microscale experiments is also robust and more difficult to break, which can result in reduced replacement costs.

Purchasing

Purchasing is an essential part of a cradle-to-grave management strategy. The products a university buys determine what the university will have to dispose of. See Chapter 5 for a discussion of environmentally sound purchasing guidelines. The volume of a university's purchases can be used as leverage to negotiate chemical procurement contracts that serve the university's waste minimization agenda (Matteson and Hadley 1991). For example, to support waste minimization, gas bought in cylinders can be ordered from those suppliers that take the empty cylinders back for reuse.

The discounts offered by suppliers for

purchasing large volumes of chemicals can be a challenge to waste minimization. These bulk discounts encourage researchers to buy more of a chemical than is actually required. The excess is often stored for long periods of time and eventually disposed of.

Collective purchasing between researchers and charging disposal fees are two potential solutions to this challenge. Some universities purchase chemicals, often solvents, in bulk and dispense smaller quantities to laboratories as required. This reduces the overall inventory of chemicals stored in individual laboratories and often provides significant cost reduction. The staff and facility implications of this option need consideration (Louch 1994). Methods of applying overhead charges or the direct cost of hazardous waste disposal to the waste generators as an incentive to minimize waste still require further investigation.

EXAMPLE

University of British Columbia

The University of British Columbia (UBC) has created a Hazardous Materials Management Team to increase awareness on campus of the appropriate handling, storage and disposal practices for hazardous materials, with an emphasis on minimization.

UBC is also developing solvent recovery, photographic waste treatment and chemical exchange programs. The objective of the solvent recovery program is to implement procedures for the daily segregation, collection and recovery of laboratory solvents for reuse on campus. The solvent redistillation system redistills used solvents of large volume and known composition (i.e., contaminants are known). The project is currently recovering ethanol and xylene from histology labs and methanol from botany. In 1994 the program was awarded contracts to supply xylene to hospital and research histology labs. Common solvents targeted for future recovery include methanol, acetone and methylene chloride. The program aims to recover 15,000 litres annually after three years by 1997, at which point it should be running on a cost-recovery basis.

Hazardous waste disposal at UBC is currently funded through the central operating budget. Alternatives, which could distribute disposal costs more fairly and provide incentives to reduce the generation of hazardous waste, are currently being evaluated.

UBC is also developing a hazardous materials tracking and inventory system which will help the university comply with regulation regarding handling, storage, use and disposal of hazardous materials. The inventory will also assist in identifying potential areas for further environmental initiatives. The hazardous waste tracking system should be fully implemented by the end of 1995.

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Another option is the implementation of a computerized purchasing system that could make it possible to know how frequently a chemical is being ordered, in what quantities, how much is being stored on campus and where it is located.

Inventory

Both the American Chemical Society (1985) and the California Department of Health Services (1988) publications (cited in Brink et al. 1989) advocate a comprehensive inventory system for tracking chemicals from purchase and receipt to disposal. It may be possible to use a bar code and computer system to track, from cradle to grave, all hazardous materials used on campuses.

An inventory system can prevent over-ordering a chemical that may already be on hand, or detect excessive disposal of a particular material. It can aid safety planning by providing information about the quantities and locations of hazardous materials (Brink et al. 1989, 184). It could also improve the ability to understand and summarize the significant characteristics of a university's waste stream and readily provide information in the case of emergency.

Hazardous Materials Reuse and Recycling

In two recent Canadian court cases, described in Saxe (1993), courts adopted the view that recycling is an alternative to waste management and that materials designated for recycling have commercial value and, therefore, are not considered waste. A material is not regarded as waste if the possessor of the material intends to use it for a legitimate and appropriate business purpose. In terms of liability, this means that chemicals designated by a university for exchange or recycling purposes may not fall under the hazardous waste regulations. Consequently, universities may face less onerous regulations and paperwork, and fewer legal liabilities.

Chemical Exchange Programs

Chemical exchange programs, which transfer chemicals from people who no longer need them to people who do, can reduce the volume of hazardous waste (Sanders 1986). At one university nearly 30% of the waste chemicals collected for disposal from laboratories were still in the original containers — material that could be a resource for someone else (Allen and Neuse 1990). Although the task of organizing an exchange program may be challenging, the potential benefits are numerous. Such a program would decrease liability for chemicals stored for long periods of time, avoid new purchase costs and decrease disposal costs. Chemical exchange programs can include art materials and other non-laboratory chemicals.

A potential challenge to chemical exchange programs may be that some researchers may only want to use freshly bought chemicals of unquestioned purity (Sanders 1986). However, most chemicals, including exchange chemicals, are purified before they are used by researchers. In any event, chemicals of questionable purity can still be used as technical grade material. One university has found that the greatest use of surplus chemicals was by senior students who required only a small amount of an infrequently used material (Brink et al. 1989, 188).

Solvent Recycling

The recycling of solvents will help reduce disposal costs and purchase costs of new solvents. The initial cost of a distillation system can be recovered through cost savings within a short period of time (Aston 1993).

Hazardous Waste Treatment

Ashbrook and Reinhardt (1985) propose a number of steps that can be taken to reduce the volume of hazardous waste requiring disposal. To do this properly, the wastes should be segregated at source according to their properties. After segregation, the appropriate treatment method can be employed: neutralization of acid and bases, reclamation or distillation of chemicals for reuse, and evaporation of dilute solutions.

Education and Training

Given the number and variety of people handling hazardous materials and the multitude of substances used, education and training must be significant constituents of any university's hazardous material management system.

Education and training should be an integral part of the hazardous materials policy to ensure that it takes place and is formally presented in both safety courses and university curricula. All university sectors that deal with hazardous waste should be involved. The education program should target different audiences: staff, students, instructors, researchers and administrators. Each of these groups has different roles and responsibilities and, accordingly, will require information and instruction specific to its activities. WHMIS (Workplace Hazardous Materials Information

EXAMPLE

Dalhousie University

Dalhousie University initiated a chemical exchange program, ChemEx, in 1990 and expanded it in 1992. ChemEx offers surplus lab chemicals to about 20 institutions in Atlantic Canada, including universities, hospitals, research institutions, school boards and private companies. A list of surplus chemicals is updated regularly and sent out four times a year. Off-campus organizations are responsible for making their own arrangements for shipping requested materials.

Each surplus chemical is kept for a year. If not requested in that year, it is disposed. By the end of 1994, the avoided purchase cost of the exchanged chemicals was estimated to be $80,000. The avoided disposal cost was difficult to estimate.

Dalhousie is presently working to resolve some problems connected to the ChemEx Program, such as storage and the improvement of packaging and transportation. Some receiving laboratories have difficulty getting material safety data sheets for the surplus chemicals.

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System), the transportation of dangerous goods and hazardous waste handling and disposal should all be discussed.

Matteson and Hadley (1991, 44) describe the necessity for such a training program in university laboratories:

> *"a portion of the chemical waste produced by most laboratories simply results from careless and wasteful procedures employed by workers or students. This waste production can be minimized by raising the consciousness of laboratory personnel as to the expense, environmental impact, and potential risk posed by excessive hazardous waste disposal. Researchers and laboratory students must be given instruction in waste-minimizing procedures and techniques."*

University staff handle many hazardous materials throughout campus operations. These staff must understand their responsibilities, the concepts of waste minimization and recycling and how these concepts relate to their jobs, and they must be aware of appropriate disposal methods. Training courses can be adapted for unskilled staff and for departments without labs, such as art and education.

To date, it has not often been the case that the curriculum in any course that uses hazardous material and generates hazardous waste teaches students about hazardous waste, associated problems and alternatives. In a society concerned about sustainable development, this approach is no longer acceptable.

Many universities are now recognizing that training in environmental management is an essential part of a student's education (Sanders 1986; Ashbrook and Reinhardt 1985). Components on hazardous materials and hazardous waste can be included in course curricula for both undergraduate and graduate students. Hazardous materials should be addressed directly, to emphasize the importance of the topic, as an explicit part of any course that uses hazardous materials and generates hazardous waste. To underscore this training, the university must set an example by practising what it preaches.

Waste minimization should be an integral part of every hazardous materials education program. Some points which can be covered are outlined by Matteson and Hadley (1991, 45):

- pre-determining what chemical wastes will be produced when planning an experiment;
- choosing reactants and solvents that result in non-hazardous chemical waste wherever possible;
- performing experiments on the smallest scale feasible;
- determining the needed amount of each reagent before obtaining it; and
- consulting reuse and laboratory inventories before purchasing chemicals.

Potential Obstacles to an Effective Hazardous Materials Management System

Some common obstacles to setting up effective hazardous materials management systems at universities have been well documented. These obstacles can be divided into five different categories.

a) Habit and Lack of Awareness

Some faculty members may not be amenable to change because they do not see any reason to disrupt the way things have worked to date. Other professors may be so absorbed in research and teaching that, if the importance

of hazardous materials management is not stressed from top management, they give it very low priority (Sanders 1986). If internal policies and requirements are not enforceable and there is no cost to the generators of hazardous waste, compliance is not likely.

b) Lack of Accountability

Still other faculty members may take a cavalier attitude toward the matter. Environmental issues may be seen to interfere with their academic freedom. Sanders (1986) found that many academic research groups regard themselves as autonomous and operate with relatively little outside supervision. As a result, they may not pay attention to instructions from senior administrators. Industrial scientists are much more likely to pay attention to similar instructions because they are accountable for their actions; people who disobey safety rules are disciplined (Sanders 1986).

c) Misunderstanding

Other researchers or staff may not realize that the substances they work with are hazardous, could be minimized or recycled, or that these substances are easily rendered non-hazardous before being discarded. Some people may also mistakenly believe that they, themselves, have the expertise to do this disposal properly (Ashbrook and Reinhardt 1985; Sanders 1986). Improper disposal is also likely to be more common in departments where work has not generally been perceived to be hazardous and, accordingly, fewer resources are devoted to hazardous materials management.

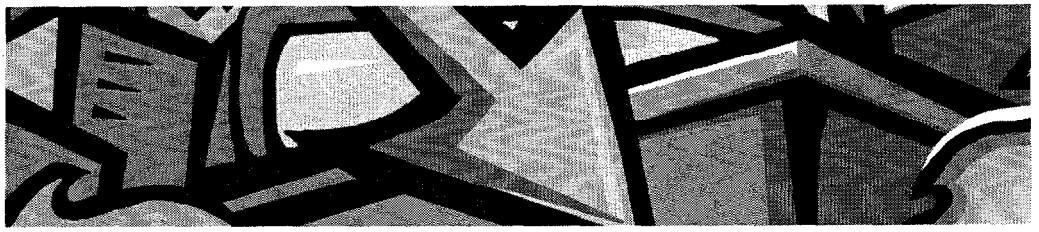
d) Transient Population

Another impediment is the transient nature of the student population. Training and supervision must be provided continually to accommodate all students handling hazardous materials and generating hazardous wastes.

e) Difficulty in Restricting Visitor Population Access

Another unusual feature of academia is that educational facilities are accessible to the public, and so it is difficult to restrict access to areas in which hazardous materials are kept (Ashbrook and Reinhardt 1985).

Developing and implementing the elements of an environmental management system can help to overcome these obstacles, if they occur, and create an effective and efficient hazardous materials management system.



7. Transportation

[Much of the information in this chapter was obtained from Madhav Badami's (1994) Master's Degree Project (thesis), "The Transportation Audit as an Environmental Management Tool," at the Faculty of Environmental Design, University of Calgary.]

Transportation has significant and wide-ranging energy, environmental, economic and social impacts associated with vehicle manufacture and petroleum production at one end, through infrastructure construction and maintenance, to vehicle operation, servicing and disposal at the other. Individual motorists contribute to these impacts. However institutions, such as universities, also play a role through their policies and practices in areas such as vehicle purchase and disposal, fleet operation and maintenance, employee commuting and business travel, and handling and disposal of transportation wastes.

A university's transportation practices are dictated by external factors, such as government policies on fuel prices, fuel efficiency and emission standards, vehicle manufacturers' business plans, and urban land-use and development laws. Yet, there is considerable scope for action by universities to improve their transportation policies and practices. They can enhance their own productivity while helping to conserve raw materials and energy and reduce environmental degradation. Institutions are uniquely positioned to take action due to their capabilities in planning, implementation and control, and the economies of scale that they can achieve. The actions of institutions can also influence those of employees, customers and suppliers.

Transportation Management

A transportation management strategy must address two distinct aspects: on-campus and off-campus transportation. University transportation not only encompasses on-campus pathways, roads, parking lots and university-owned vehicles, but also local systems used to commute to and from the campus. A transportation management system can be set up using elements listed in Box 7-1.

The focus of a transportation management program will vary according to three factors. The first is the relative number of students who reside on the university campus

BOX 7–1
Key Elements of a Transportation Management System

- transportation management policy statements
- designated organizational structure
- risk assessment
- transportation management considerations integrated into strategic planning
- training and education
- resources and facilities available to meet objectives
- information management
- measuring, monitoring and auditing (including management system audits)
- communication and reporting
- continuous improvement of all components of the transportation management system

versus the number of students who commute. Second is the convenience of public transit, walking and cycling facilities versus the convenience of commuting by automobile. The third factor is the size of the university's vehicle fleet. Only the size of the vehicle fleet is under the direct control of the university. Each university will tailor its transportation program accordingly. If a university does not have a vehicle fleet, it will focus the program entirely on commuting and parking issues.

Organizational structure, transportation audits and transportation policies are discussed in the following section. The focus then moves to considerations of daily commuting, automobile selection, operation, servicing and maintenance, waste management, education and training and, finally, the use of university community expertise.

Organizational Structure

The transportation management system should be able to negotiate, integrate and coordinate the missions and actions of separate university departments. For example, class scheduling can affect campus transportation. If many large classes are scheduled for the same time, campus parking lot capacity can be overtaxed. To minimize the need for new roads and parking lots, classes could be scheduled to make optimal use of current facilities. Trade-offs, in terms of the costs and benefits of such an initiative, require further consideration.

Another example of the need for coordination between departments is the cooperation required between campus grounds-keeping, traffic and safety departments. Grounds departments may plant shrubs and trees around a campus to make it more aesthetically

pleasing. While this action can enhance attractiveness, it can also create traffic hazards by obstructing views.

Transportation Audit

To improve transportation policies and practices within universities, first evaluate existing policies and practices to identify problem areas and opportunities. A transportation audit, similar to the environmental audit described in Chapter 2, can be conducted regularly to find areas requiring action.

A whole range of issues requires assessment, including vehicle fleet management, employee commuting, physical design and land use, management of transportation wastes, and personnel policies regarding housing, commuting, parking and business travel. The entire range of policies and practices, including such areas as purchasing, that affect and are affected by the organization's transportation policies and practices also requires evaluation. Compliance with regulatory requirements (as in the case of vehicle fleet management and transportation wastes) and conformance with government, industry and organizational standards, policies, codes of conduct and guidelines require evaluation.

This evaluation should be conducted within the context of material and energy conservation, emissions reduction, waste minimization, safety, and cost-effectiveness and productivity. Finally, an action plan with clear-cut objectives, roles and responsibilities based on the findings of the evaluation should be developed and implemented.

The essential attributes and methodology for a generic transportation audit are outlined by Badami (1994). Issues to be evaluated in a generic transportation audit include:

- coordination and management, including transportation policy;
- vehicle purchase and disposal;
- vehicle fueling, including underground storage tanks;
- alternative fuels;
- vehicle operation, maintenance and fleet management;
- waste minimization;
- recycling;
- waste disposal;
- commuting and business travel;
- car parking;
- cycling;
- pedestrians;
- land use;
- safety and security; and
- education and training.

The first priority is to do the audit. However, it is possible to implement basic no-regrets measures (low-cost or no-cost measures) before knowing the results of the audit. These measures can be quite effective while costing the university very little and involving minimal risk. Accommodating and encouraging alternate modes of transport, such as walking, biking and public transport, by increasing convenience and safety is an example.

Transportation Policies

Three separate elements must be addressed in campus transportation policies: pedestrians, cycles and vehicles. It is easy to focus on vehicles and exclude the other two elements, but to be most effective all three must be addressed. In addition, due to Canada's climate, transportation policies will need to consider both summer and winter conditions.

Universities should develop policies that

mandate consideration of material and energy conservation, low emissions, safety, long service life, waste minimization, recycling and waste disposal in vehicle selection, operation and maintenance, vehicle disposal and operator training.

A comprehensive commuting policy should cover parking demand management, schemes to discourage single-occupancy motorized vehicles and encourage non-motorized and high-occupancy motorized alternative commuting modes, pedestrian convenience and safety, cyclist convenience and safety; safety in parking lots, coordination within the organization and with external agencies and neighbouring communities, mechanisms for seeking input on commuting issues from employees, employee business travel, and programs to inform employees of the environmental impacts of individual commuting choices.

Since campus transportation policies and practices such as commuting are also influenced by those of the city where the university resides, coordination with external agencies, such as the municipality's transit and engineering departments, must be considered. The interface between a municipal government and a university on all transportation modes (vehicles, public transit, bicycles and walking) requires care and attention. Too often the focus is on public transit and vehicles, neglecting issues of safety and convenience for cyclists and pedestrians.

EXAMPLE

Université de Montréal

The Université de Montréal is proactively incorporating transportation issues into university planning. Accessibility to the campus is a major consideration in the university's urban master plan for campus physical development. Institutional parking policies, including parking rates, are being evaluated in light of their impact on the use of public transportation and on the use of land for parking lots.

A metro line has been established in the university area. Through agreements between the Université de Montréal, the municipality and the urban community about this new service, the metro station locations were selected and the areas surrounding the stations were linked with protected pedestrian zones, taxi stands, etc. The metro line reduces travel time for those members of the university community coming from other regions of the city.

Aside from interventions in physical development, operational methods of public transportation have been re-evaluated to ensure best customer service. The university is also reviewing the transit operating schedule, especially the frequency of trains during rush hour and the evening service, which directly influences accessibility to night classes.

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Daily Commuting

Implementing a program that helps reduce the number of vehicles used in employee commute trips is an effective method to conserve energy and reduce adverse environmental impacts from vehicle use. Universities can consider the following steps (Harmony Foundation of Canada 1991, 86-87; Roseland 1992, 75-90; Gordon 1991; 125-171):

- appointing a transportation coordinator with clearly defined responsibilities (that may include building awareness among employees of the societal impacts of individual commuting choices and the benefits of non-car alternatives, conducting periodic commuting surveys to assess employees' commuting needs, achieving reduction in trips by single-car occupancy motorized vehicles and enhancing the use of non-car alternatives);
- increasing the use of telephone, facsimile, modems, electronic mail and tele-conferencing (moving information instead of people), thus reducing the need for long-distance travel that is typically performed by aircraft (on a passenger-kilometre basis, the aircraft is the most energy-inefficient form of travel);
- developing and implementing schemes to promote:
  - walking (through the increase of convenience and safety);
  - bicycle commuting (through provision of such things as pathways and secure lock-ups);
  - public transit use (through transit pass subsidization);
  - ride-sharing (through preferred parking rates for cars and vans with full passenger loads, and in-house van pool matching); the benefits of a well-run ride-sharing program are several, apart from conserving energy, reducing environmental pollution and easing pressure on limited parking space, it enhances corporate image and enables participants to relax on the way to and from work (on the days they do not drive) and to get to know each other better, thereby improving employee morale and productivity (Weber 1983);
- implementing flexible work schedules;
- working with municipal transportation planning and transit agencies to improve transit service, and facilities for pedestrians and for bicycle commuting.

EXAMPLE

University of Calgary

A transportation audit of The University of Calgary was conducted by a graduate student as part of his Master's thesis. This audit focused on the university's motor vehicle pool and critically evaluated the university's policies and practices in the following areas: vehicle purchase and disposal; vehicle fueling (underground storage tanks); vehicle operation, maintenance and fleet management; waste minimization, recycling and disposal; education and training on transportation issues; and coordination and management regarding access and mobility within, to and from the university.

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Automobiles

Selection

Fuel is often the single largest operating cost of a vehicle. This cost can be reduced significantly by careful vehicle selection, and in the process vehicle performance and emissions and the resale value can be enhanced as well (Alberta Energy 1988a, 2). Perhaps even more important than fuel economy are reliability, long and trouble-free service life, and ease of maintenance (it would be pointless to have a highly fuel-efficient vehicle that kept breaking down frequently or that required low-tolerance maintenance).

Green purchasing guidelines should be developed for vehicles and vehicle parts and fluids, in close coordination with a university's purchasing department. These guidelines should stress the importance of life cycle costing and of identifying products that are environmentally sound without compromising product quality, safety, warranty requirements and cost-effectiveness.

Operation

Vehicle speed is a critical factor influencing fuel economy. In Canada, it is also important to maintain and operate vehicles for optimum cold-weather performance. Since the first few kilometres of a vehicle's journey consume proportionately the most energy and produce the most emissions, improved dispatch management techniques such as route and schedule selection and trip consolidation (to minimize short trips with stop-and-go operation), and vehicle loading optimization (matching vehicles to loads and routes) along with the required record keeping to support these activities, can produce fuel cost savings with little additional investment cost.

Servicing and Maintenance

Preventive fleet maintenance is another significant factor in improving cost-effectiveness and reducing adverse environmental impacts. It can considerably reduce operating costs, in addition to enhancing reliability, making major breakdown repairs unnecessary, improving vehicle performance, and enhancing service life and driver and vehicle safety (Alberta Energy 1988b, 2). Fleet vehicle maintenance programs can also significantly improve fuel economy and reduce emissions.

An essential component of preventive fleet maintenance is the implementation of an information maintenance and evaluation system. Good records can help identify and prioritize problem areas, monitor and control costs, identify opportunities for cost saving, and measure performance and productivity.

EXAMPLE

University of British Columbia

The University of British Columbia, in conjunction with the Jack Bell Foundation, is providing car pool and van pool services for faculty and staff. The UBC Student Environmental Centre Transportation Group is working toward better campus access by bicycle and bus.

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The data can be used to monitor the progress of fleet management programs; specify replacement vehicles; improve maintenance, safety and reliability; and decide whether or not to convert to alternative fuels. The records can also be used to keep track of materials recycled and waste disposed.

Waste Management

Much waste is generated through vehicle operation and maintenance. A majority of these materials, such as lubricating oil and batteries, are classified as hazardous waste in regulations, if not saved for recycling. This classification has significant compliance implications for automobile-servicing facilities. Waste minimization is the most preferable and probably the most cost-effective method to meet these compliance requirements. If there is less waste to handle and dispose of, there is less chance of noncompliance or of an environmental incident occurring. As well, disposal costs are reduced. Recycling of waste is the next most preferable method. Two recent court decisions in Ontario have held that "recycling is an alternative to waste management, and that recyclable materials are not waste" (Saxe 1993, 26). This means that recyclable materials do not fall under the hazardous waste regulations. Proper handling and disposal procedures and strategies are the next step toward an environmentally sound transportation waste management program. Waste minimization, recycling and waste disposal are outlined in more detail in Chapter 5, Solid Waste, and in Chapter 6, Hazardous Materials.

Education and Training

Driver education programs can dramatically decrease fuel consumption, pollution levels, maintenance requirements and accident rates, which can lower insurance rates. Fleet operators should be trained in smooth driving, progressive shifting and idle control, in addition to driving safety.

Education programs that provide information on campus commuting issues should also be provided.

University Community Expertise

Utilizing in-house expertise to make transportation programs more effective can result in win-win situations. Students and faculty from teaching and research units (such as engineering, environmental science, and management) can collaborate with operational units (such as physical plant and ancillary services) in projects such as performance evaluation of re-refined products, development of cost-effective green purchasing guidelines, fleet energy management, transportation waste minimization, recycling, waste disposal, commuting surveys, parking demand management, and development of a comprehensive commuting policy. Apart from saving money on external consultants, students and faculty can tackle and solve real-life problems in their own backyard. Information can be exchanged, and mutual learning can be promoted, both in separate departments and for universities as a whole.

8. Conclusion

Anticipating and avoiding problems is preferred to reacting after problems have occurred. Prevention is generally less expensive than solving problems after they have developed. This proactive approach, and the rapid changes that are forcing universities to address environmental problems, require universities to become learning institutions. Not learning institutions in the sense that they are academic entities, but learning institutions in Senge's (1994) sense, that is, institutions that can learn to cope with the rapidly changing world.

One means of coping with rapid change and environmental demands is the continuous improvement model of the Global Environmental Management Initiative's (GEMI) (1994) total quality environmental management approach. This model applies well to consumer products but presents at least some minor difficulties when applied to educational institutions. Nevertheless, continuous improvement in quality and improvements in efficiency and productivity mean that there is less time required for mundane tasks and more time available for analysing and solving the real problems.

For both individuals and institutions, continuous improvement and learning require experience, knowledge, feedback and memory. For institutions with no learning, feedback or memory, the situation becomes similar to Alzheimer's disease — institutional Alzheimer's. The tools that we have urged universities to develop and apply allow them to become learning institutions by helping them to record their experience, acquire knowledge, feed it back into the system to assist both learning and management, and develop an institutional memory. Environmental management tools are a means of avoiding institutional Alzheimer's disease with respect to environmental issues.

Anticipating and avoiding problems also requires a systems approach. As pointed out in Chapter 1, this type of approach is necessary for those environmental problems which arise because of the size or complexity of the sys-

tem, or for similar problems that arise in different places in a large system, or which arise from or with respect to the system's own characteristics (i.e., they are not component problems). The complexity of campus systems (the complicated institutional structure, the number of different groups involved and the number of different activities) is one of the sources of the difficulty in effecting sound environmental management. Systems thinking is one way of managing these types of complex problems.

A systems approach can help to identify the major cause and effect relationships and to solve problems, not just shift them around. Three notable authors have strongly advocated a systems approach to problem solving. Beer (1972) advocates a cybernetics approach which uses an analogy to human body systems, where the organization observes the external environment and then selects those aspects that require attention. Meadows et al. (1992) use computer modelling to try to analyse global environmental problems using a systemic approach. Senge (1994) recommends the application of systems thinking to corporate design and development and to the individual and institutional learning that takes place within them. The tools presented here do not individually or collectively constitute systems thinking. But if a systems mindset is established, and a commitment made to use it, these tools will be essential.

The integrated or systems approach must go beyond single sector management activities such as solid waste management, hazardous waste management, energy, and water conservation. An environmental management system must eventually become an integral part of everyday activities at one level and strategic planning at another, rather than an addition to an existing program. Systems thinking will not make environmental management on campuses easy, but systems thinking will facilitate it.

Sound environmental management will not solve the budget problems facing universities. However, sound environmental management can make a small contribution to solving the problems of tough budgets through savings from resource conservation, cost reductions and cost avoidance. There will be start-up costs and capital investments required. Outside help will likely be available for financing some of the initiatives.

In terms of the larger, global environmental problems such as ozone layer depletion, global warming, species extinction and accumulation of persistent toxic substances, the approaches to management that we have proposed are not to be seen as a substitute for larger changes that may be necessary. They are, however, a necessary, understandable and achievable step. Some other conclusions that arose from this project are itemized below.

1. On many campuses some of the easy, no-regrets initiatives will have already been taken or will be under way. We suspect, however, that the approach will be fragmented and that the accounting systems will not clearly show all costs incurred and benefits derived. This is frequently the case in industry. Efforts must be recognized, rewarded and formalized in a coherent system. Better accounting systems must be initiated. New systems of accounting are essential for management feedback, environmental reporting, education, some economic instruments (sharing of conservation benefits), and full cost accounting.

Currently, there appears to be a lack of description and documentation of the initiatives taken on campuses, the costs and benefits of the initiatives, the challenges encountered in implementation, and the measures taken to improve the situation. This hinders developing an understanding of the nation-wide status of campus environmental management. Gathering and providing such information for universities and colleges can help them develop and implement effective programs more quickly and cost-effectively.

2. With some exceptions, there seems to be widespread willingness to do something, but there is also a high level of frustration caused by at least four factors: initial costs for personnel and capital investments, institutional inertia, painfully slow and complex decision-making systems on campuses, and the fact that many of those whose involvement is important are already overworked and cannot take on a greater workload effectively. Information sharing between universities may help develop and implement initiatives (see item 12).

3. Decision-making systems concerning environmental issues are generally weak at universities. There is no system in place, that we know of, where there is a strong and effective management unit which can implement campus-wide environmental policies and initiatives. Structural changes within the university for effective decision making may be necessary. The strong, centralized environmental management structures implemented in the private sector cannot be readily transferred to the academic setting because of their segregated management structures.

   The first step in making structural change is a careful description of the current structure and decision-making system, identification of all significant actors on campus and off, and description of current relationships and reporting mechanisms (formal and informal). It is unlikely that many improvements can be made without some structural changes and there are some improvements that can only be accomplished with structural changes. Task forces may be used initially, but attention to efficient implementation of initiatives will also be required, which is something task forces cannot do.

4. There is need for buy-in by large, diverse groups with different interests: students, administrators, staff, faculty, civil servants, politicians, neighbours, funding agencies and donors and the private sector. Achieving this cooperation may be difficult and may slow things down but is essential for effective environmental management.

5. Coordination is required between the activities of administrative units that often act relatively independently. Purchasing, caretaking, accounting and the safety office are examples of departments that require coordination in terms of environmental management. However, environmental policies that guide activities must be approved, and regularly reviewed, by senior management.

6. The hiring of at least one well-qualified coordinator is probably unavoidable. Most university faculty and staff are already over-

worked and cannot effectively take on many more responsibilities and act on them efficiently. The coordinator would, however, likely be able to take advantage of on-campus expertise and the willingness of students and graduate students to work on such problems within courses or as extra-curricular efforts.

With budget cuts and layoffs, this proposal may not be popular. However, if there is a commitment to act, given the lack of time for the extra work on the part of qualified staff and the limited effectiveness of volunteerism, a coordinator position has proved necessary on campuses where significant changes and savings have been made. Such a person is potentially able to earn his or her keep out of the savings accrued within a very short period of time.

7. Each organization on campus (administrative units, faculty association, students union, etc.) can begin writing its own environmental policy statement. These preliminary policies can then be integrated into one overall policy. It will be a long-term, ongoing exercise. It is important to start, to gain knowledge of the process and the issues, and to become more experienced in environmental policy formulation.

   We recognize that part of the reason that none of the university environmental policies that we are aware of match the strength and commitment of policies in the private sector is because they are first efforts and the approval processes often result in revisions which weaken initial drafts. This makes it that much more important to review and revise these policies on a regular basis.

8. University personnel should be aware that conducting the first environmental audit will be challenging. It is usually more complex than follow-up audits because of the greater uncertainty surrounding the most appropriate processes and the greater difficulty in obtaining and organizing the required information. However, this should not delay the start of the environmental auditing process. Only through starting the process and gaining experience will the uncertainty surrounding the most appropriate audit processes and objectives be surmounted. Subsequent audits will be easier, faster, less expensive and less frustrating.

9. With respect to costs, external funding sources should be approached. Governments, utilities, energy service companies (ESCOs) and recycling companies might be persuaded to supply funding for start-up costs, if a university has a management plan that identifies the resources it requires and what savings will be accomplished. The approach of the private sector should be related to the goals of reducing energy and water consumption, reducing packaging and solid waste, providing larger sources of good material to recycling industries, and so forth.

10. There is a major need for a system to track hazardous materials, especially research chemicals, on campus from cradle to grave or cradle to cradle. Adaptation of a bar code system similar to those used in industry may be the best option. As each hazardous material is received by a university, for example, it would be assigned a bar code. Because of

the complexity of campuses and the number of different chemicals and chemical users, careful adaptation of the systems available in the private sector would be necessary.

If a bar code system based on the international chemical name were developed, it would have broad national and international applications. It may be worthwhile for the Canadian Association of University Business Officers (CAUBO) to work with the Canadian Standards Association (CSA) to develop and implement such a scheme.

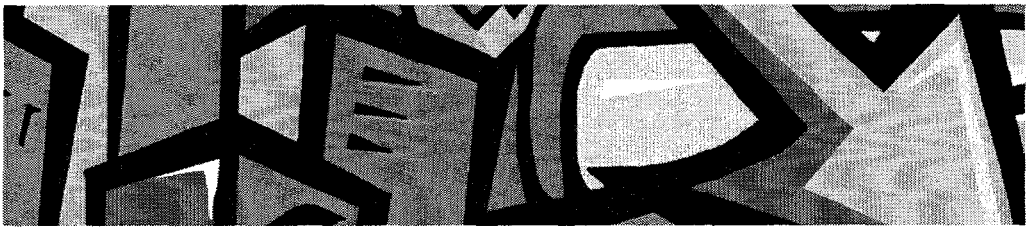
11. Education and curricula are driving forces for effective environmental management because it is very important that the educational setting reflect what is being taught (practise what you preach). It can also provide benefits where senior undergraduate students and graduate students from different faculties work on solving real-world problems on their campuses. These problems can be incorporated in courses which teach the principles, theory and practice in a rigorous and academically acceptable manner and use the campus as a case study and laboratory.

12. Specific mechanisms should be established through CAUBO, and others, to accommodate effective communication about environmental management on Canadian campuses. This could be done through e-mail and the internet, conferences and workshops.

    In periods of rapid change, frequent updates are needed. A conference, where all the major players describe the progress they have made toward solving environmental problems, should be held before the end of 1996. Three sections would likely be required: academic curricula and courses; research, development and technological solutions; and administrative systems. The published proceedings could provide a follow-up volume for this work.

One of the initial goals of this project was to identify and describe the best environmental initiatives that had been taken on Canadian campuses. It was not possible to do that. However, the examples provided in this book are useful in illustrating the actions being taken to solve specific problems on different campuses. It seems, as far as we know, that no university has solved or even started to attack all of its environmental problems yet.

Clearly there is much to be gained by sharing experiences. This will require careful documentation of project details and a thorough accounting of costs and benefits. When that information is available, it would seem desirable to form a network for sharing of information and experience through the CAUBO. The initial topics of concern to be handled by the network would include general administration and the use and development of the environmental management tools, academic curricula and courses, research and development and technology transfer, and information on the specific management areas (energy, water, solid waste, hazardous waste, and transportation). Electronic mail can be used to share this information. CAUBO could be a central force in the development of environmental codes and guidelines, similar to the industry guidelines, for Canadian universities and colleges. These guidelines could build upon the Halifax and Talloires Declarations.



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