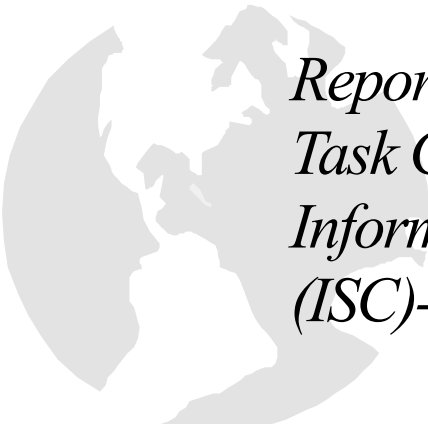

Campus Computing and the Environment



Report of the Green Computing Task Group to the Information Services Committee (ISC)- Final Report

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Campus Computing and the Environment

Report of the Green Computing Task Group to ISC

Executive Summary

In response to the release of the study [Environmental Impact of Computer Information Technology in an Institutional Setting: A Case Study at the University of Guelph](#) the ISC struck a Green Computing Task Group to review policies, guidelines and practices at the University of Guelph with respect to the purchase, use and disposal of computers¹, in order to make recommendations that would mitigate the environmental impacts of computing on campus.

Specific Objectives:

- identify green computing policies and best practices elsewhere and benchmark the University of Guelph against these practices
- recommend a campus awareness program
- identify energy conservation strategies and practices
- examine the need for and nature of computing procurement guidelines
- identify equipment disposal procedures

Task Group Conclusions:

When measured against the best practices in the environmental management of computers throughout the product life-cycle it is clear that the University of Guelph can improve its policies and practices. However, the university should take pride in its advanced E-Waste Disposal program and the high level of participation on campus. The well crafted Policy on Environmental Protection could be strengthened and enhanced by the further development of sustainability policies and possibly the establishment of a monitoring board. However, the top priorities identified by the task force involve education, assessment, and collaboration in the establishment of environmental awareness, policy and practice on campus with regards to “green computing”.

Top Priorities:

Campus Awareness Program – Raising awareness is the first step in changing practice and behaviours. To properly define and develop an effective campus awareness campaign regarding green computing principles and practices, the target audiences (IT staff, management, student/faculty/staff users) should be surveyed to determine current awareness of, participation in, and barriers to participation in current e-waste and energy reduction programs. The program will be lead by the Sustainability Coordinator but will require cross-campus collaboration with IT personnel, campus communications, purchasing agents, and physical resources. The campaign will employ social marketing theory based on persuasion

¹ *Computers* are defined as desktop units, which typically include: central processing unit, monitor, keyboard, mouse and external speakers; and laptop and notepad computers which include all of the above components in a single unit.

and motivation techniques to affect both short and long-term changes in behaviour and also to foster collaboration and participation in the program and development of new standards, policies and practices.

Energy Conservation Strategies and Practices – A campus energy conservation plan and strategy for computing needs to be developed in collaboration with university IT personnel and Physical Resources. Current power management configuration, departmental requirements, and energy utilization must be determined in order to set standards, benchmark progress and to ensure user needs are met while energy is conserved.

Computer Procurement – The establishment of a green procurement directive for computers would enable the creation of effective purchasing policies that ensure environmental criteria are applied to tenders and contracts regarding the assessment of manufacturers and vendors, service agreements, and end-of-life-cycle product management.

***For a summary of the specific recommendations jump to the report's conclusion or read the entire report for the complete analysis and detailed recommendations.**

Defining Green Computing

The definition of Green Computing used in this report is the positive (or least negative) relationship between the physical computer and its impact to the environments in which it moves through during its journey from cradle to grave. In this context the computer's impact to the various environments may be measured using any number of the following criteria;

From cradle: Materials from which components are manufactured (recycled or virgin materials, materials which can be recycled, least-toxic materials); effluents/by products produced in the manufacturing process (impact of effluents/by products on the environment); assembly methods (ease of disassembly at end of life); packaging materials used for components to facilitate storage and shipping (recycled or virgin materials, materials which can be recycled).

Operational use: Power consumption of each component; interface with user; life cycle (months/years before replacement is required); other consumables required to maintain.

End of use: Ability to reallocate if no longer required; supplier willing to take computer components back under recycling program.

To grave: Effective recycling (ease of disassembly, recycle - ability of materials); CO2 travel points (number of miles travelled and fuel consumed to get all components to their final destination); and responsible and safe disposal of toxic components.

Campus Position and Policy

The University of Guelph currently has few policies on environmental sustainability. Environmental Health and Safety's *Safety Policy Manual* includes the [Policy on Health and Safety](#) (851.01.01) which contains a commitment by the University to environmental protection (Appendix A). It states a commitment to conservation and improvement of the environment by minimizing the impact arising from university activities. However, this commendable guiding statement is not well known throughout campus and there has not been

much in the way of further policy development beyond occupational health hazards. The *Safety Policy Manual* also contains a broad [Environmental Protection Act](#) policy (851.01.03) which is designed to provide due-diligence and guidelines for the prevention of environmental contamination. The [Non-Hazardous Waste Collection and Enhanced Recycling on Campus](#) policy (PR 14.0), published by Physical Resources, deals briefly with computer waste.

Best Practices

The International Institute for Sustainable Development hosts the [Sustainable Campus Policy Bank](#) from which one can draw best practices, and find solutions and guidelines most applicable to our situation at the University of Guelph.

A solid yet far-reaching policy does more than simply present a guiding principle or address specific legislation. The [Sustainable Development Policy for the Association of Canadian Community Colleges](#) is an excellent example of a policy which sets forth principles that are relevant across disciplines, and must be adhered to by all affected by the policy.

Other policies do not work so much from principle, but offer more targeted goals or guidelines which community members are expected to follow. The [Sustainability Mission Statement](#) for Northland College in the United States is a concise example of this (see Appendix B). The University of Hertfordshire, UK, [Sustainable Development Policy](#) is another example which sets forth specific guidelines.

Recommendation

The majority of universities whose green computing practices have been identified as “best practices” have well defined sustainability policies and green initiatives managed by environmental advisory boards, institutes or committees. This provides guidance and a recognized mandate for the development of campus awareness programs, environmental purchasing processes, and the establishment of appropriate energy consumption standards, and energy indicators from which one can benchmark progress. Although beyond the scope of this task group, it is recommended that the University revisit its policies and consider the creation of an institutional environmental mandate to build a strong foundation for green policies, initiatives and programs.

Campus Awareness Program

The general energy awareness program being coordinated by the Sustainability Coordinator covers some of the many ways individuals can affect their energy consumption, including some of the general computer energy saving tips, but there is no concerted campaign currently in place that focuses on the potential energy savings available through altering desktop computing practices and procedures. The other resource currently available that is specific to the University of Guelph is the sustainability program’s website which focuses on broader energy issues, although it does offer some basic computer-related advice.

The current e-waste management procedures are available on the sustainability website, are mentioned in PR 14.0, and have been circulated via email and presentations at meetings to ITSIG and key members of CCS. Tips have also appeared in the *At Guelph*, and currently a student group is planning on getting involved in an awareness campaign around the issue of e-waste disposal as a whole. The program has grown considerably since its inception in 2002, and currently enjoys a steady rate of participation. It seems that a significant portion of the campus population is currently motivated to recycle e-waste.

Best Practices

The most effective energy reduction campaigns have taken place at universities in the United States that have the capability to monitor and measure the electrical consumption of individual buildings or college units.

Campaigns offering incentives for energy consumption reduction have proven quite successful, although current research around social marketing suggests that in order for long-term behaviour change to be durable, it must be accompanied by the establishment of a permanent motivation behind that behaviour. Successful behaviour change strategies require an understanding of the individual and situational factors that motivate and/or constrain behaviour. The University of Toronto Sustainability Office has recently launched an energy reduction program based on the principles of persuasion and the community-based social marketing approach. (See Appendix C)

Recommendations

- 1) Conduct a survey of the different target audiences on campus to:
 - a) Gauge awareness of and participation in current energy reduction practices and e-waste management practices.
 - b) Identify barriers to participation in the above practices.
- 2) Develop campaign based on social marketing theory, moving beyond information provision to motivation and persuasion techniques, identifying effective short-term incentives and long-term behaviour modification strategies.
 - a) Develop a media strategy in conjunction with IT and Communications & Public Affairs (to be performed by Sustainability Coordinator).
 - b) Ensure campaign informs campus IT professionals of the support and services available through the Sustainability Coordinator and Purchasing in implementation of green computing solutions.
- 3) Measure and evaluate the success of the awareness program and the adoption of conservation or procurement practices by developing indicators and publicize the results.

Energy Conservation Strategies and Practices

Energy conservation strategies specific to the management of desktop and laptop computing at the University of Guelph have, to date, been up to the discretion of individuals, or individual IT managers and employees. Although the Sustainability Coordinator has initiated dialogue with some IT departments, a concrete, attainable plan and program has not been placed into effect.

Approximately 15 % of the University of Guelph's electrical consumption comes from the "plug load", while the remainder is taken up by mechanical uses (such as ventilation towers) and lighting. While the case study of the University of Guelph attempts to quantify what percentage of the plug load can be attributed to the various components of the desktop computing environment, the exact contribution is unknown, but has undoubtedly been a significant factor in the load creep that the University has experienced over the past several years.

Currently, campus electrical metering is in place for buildings across campus, with some exceptions. In addition, smaller buildings are often clustered together and read through one meter. The system connecting the meters to a central "front-end" data analysis software program is incomplete, and as such, regular data is not collected or monitored for individual

buildings. Physical Resources collects annual aggregate data for the entire University campus, including statistics on how much electricity the campus consumes.

Best Practices

Typically, computer-related energy reduction efforts at campuses across North America have focused on encouraging individuals to alter their behaviour patterns in regard to 3 areas:

- 1) implementing power management options on their machines
- 2) reducing the overall “on” time of the system as a whole
- 3) reducing the overall “on” time of the monitor in particular

In order to measure the success of energy consumption reduction it is important for any institution to have the ability to measure and compare consumption rates. Carnegie Mellon University has developed a set of [energy indicators](#) that could be applied to computer use, but would also be very useful in a broader conservation strategy.

Recommendations

Recommendations for this section focus on strategies for promoting energy management practices and behaviour by the Sustainability Coordinator (recommendations regarding energy-efficient hardware can be found in the next section on procurement):

- 1) Survey current power management policies and practices across campus.
- 2) Develop a plan, with IT personnel, to reduce energy consumption across campus.
- 3) Identify standard practices for implementing an energy reduction plan.
- 4) Coordinate participation of IT in an energy reduction plan with campus environmental policies and campus awareness programs.
- 5) Work with Physical Resources on the development of an energy consumption measurement program and energy indicators that break down energy consumption in a way that is easily communicable and relevant to the campus. To achieve this end Physical Resources could make metering a construction requirement for new buildings. However, the task group recognizes that the age and design of existing campus buildings makes this a challenging proposition that could take years to implement, if it proves feasible.

Computer Procurement

Computer Procurement at the University of Guelph is typically based on three main selection criteria: a) functionality and specifications required by the user; b) commercial aspects that offer best value (best combination of functionality, price and other desired criteria) and c) compatibility with existing equipment and use. Environmental impact or life cycle cost analysis criteria have not typically been utilized in procurement decisions.

The daily activities of computer procurement are primarily a decentralized function, managed centrally by Purchasing Services. Five supply contracts, including major computer manufacturers such as Dell and Apple are used by departments to purchase the computing equipment needed for their operations. Purchasing Services negotiates the pricing formulas, terms and conditions of sale and through user groups on campus sets general specifications that vary based on system use. Additionally, departments may purchase outside of these contracts if the value of the computer is less than \$1,500. In both of the above methods Purchasing Services has the ability to monitor and influence these transactions.

Best Practices

In search of best practices we found that while purchasing environmentally friendly green goods and services was espoused at the university board or committee level, there were only a handful of university green initiatives reflected in their Purchasing department through procurement policy and procedures. Our search looked for purchasing direction to include green criteria in their procurement decision making process. Trent University's [Environmental Procurement Policy](#) and McMaster University's [Socially Responsible Purchasing: Responsible Purchasing Statement/Commitment to Safety and the Environment](#) (see Appendix D) represent well-defined purchasing policies complete with purpose, scope and procedures.

The above policy and statement reflect a desire on behalf of each university to give consideration to those companies that address the environmental impacts through production, sale, recycling / disposal of the goods and services provided. The consideration is manifested in each university's procurement processes through their policy and statement. Even though each university's approach may differ, the outcomes of environmental awareness and consideration are present.

Combined, their directions seek to allow recognition of suppliers whose cradle-to-grave environmental efforts are rewarded, thereby creating a best practice model as follows:

Cradle Criteria: Consider companies which manufacture and operate in environmentally sensitive ways, i.e., use raw materials for manufacturing that meet a maximum post-consumer reusable waste targets; use raw materials that are recyclable at the equipments' end-of-use stage; use packaging concepts that are environmentally friendly or recyclable.

Operational Use Criteria: Consider companies which manufacture: to Energy Star electrical efficiency standards; products which are environmentally sensitive in daily operations; and research new equipment / improve equipment in an effort to consume less resources or consume recyclable resources through-out its useful life.

End-of-Use Criteria: Include and conduct life cycle analysis when evaluating equipment, goods or services.

To Grave Criteria: Consider companies which manufacture using raw materials that are recyclable at the end-of-use / disposal stage.

The interest of university Purchasing departments to address green procurement initiatives was solicited at the 2005 Fall Conference of the Ontario University Purchasing Managers Association [OUPMA]. The results of this solicitation reflected a good level of interest on behalf of Ontario university Purchasing departments. An OUPMA sub committee for Socially Responsible Purchasing was formed with the following objectives:

- Committee to find accurate information on green purchasing and disseminate the information to the rest of the group.
- OUPMA to become more actively involved in green purchasing.

OUPMA committee members were drawn from the University of Guelph, University of Waterloo & McMaster University.

Recommendations

Subject to approval and direction through appropriate channels, the following procurement initiatives could be adopted:

- 1) Establish standards and benchmarks with which to define a green purchasing policy for computers.
 - a) Determine environmental evaluation criteria to compare technologies and components, utilizing reliable third party monitoring and testing organizations independent of suppliers.
 - b) Use existing computer templates from systems contracting tenders as benchmarked specifications for comparative purposes.
- 2) Define Purchasing policy complete with purpose, scope and procedures.
 - a) Use the Trent and McMaster examples as source documents for developing a green procurement directive.
 - b) Construct terms and conditions for future tenders and contracts. However the user departments would have to accept these terms *and* be willing to incorporate eco-labels and other environmentally friendly functionality into their specifications.
 - c) Adopt standards issued by ecological standards associations and identify their labeling programs, i.e., Energy Star, EnerGuide, Green Seal, etc. to incorporate into procurement practices.
Note: Acceptable standards and their eco-label would be determined by Physical Resources and the Sustainability Coordinator.
 - d) Communicate procurement information resources within the University community via Purchasing Service's website and provide resource links as appropriate. Incorporate training and education of new environmental criteria and processes into existing client training program.
- 3) Report / update purchase activity in support of green initiatives, including progress to date to Sustainability Coordinator for incorporation into campus awareness program.

Computer Equipment Disposal Procedures

The University of Guelph deals with our electronic waste through a growing e-waste recycling program that was initiated in 2002. Under this program e-waste is divided into two separate streams, CRT monitors and all other electronic equipment. Electronic equipment encompasses computer towers, keyboards, mice, printers, scanners, photocopiers, fax machines, and a number of other electronic office and lab equipment types. This type of equipment was designated under the Waste Diversion Act by the Ontario Minister of the Environment in December 2004, and the province is still in the process of developing a diversion program for e-waste.

Our general e-waste is sent via University staff to a community living group in Fergus which has formed a worker co-operative called Production Works. Here, employees with intellectual disabilities dismantle all equipment down to base component parts and sell the metals, etc. to scrap companies and recyclers for a small profit.

Due to the fact that Production Works will not accept monitors for safety reasons, another route for the proper disposal of monitors had been under investigation for a number of years. In summer 2005, a Toronto-based company was chosen due to their lower costs and commitment to environmental sustainability.

Please see the Appendix E for the specific procedures.

Best Practices

Many universities have a strict paperwork based approach based out of their asset disposition procedures which regulates the flow of their electronic waste. Due to being handled through this formal procedure, there are steps within which dictate reuse as an option above recycling. An example is the University of Alberta's [Surplus Assets Disposal Procedure](#). [Carnegie Mellon University](#) presents another similar procedure. Both universities have, in addition to their computer recycling program, a statement within the policy advocating or explicitly recommending reuse before recycling.

The Basel Action Network is an organization founded after the Basel Convention, a multilateral environmental agreement, which in 1994 passed a landmark decision to ban the export of hazardous waste for any reason from rich to poorer countries. Since computers and other electronic waste often comprise a large portion of this waste stream, BAN created a Recycler's Pledge of True Stewardship for industry to sign to signify their efforts to avoid perpetuating these human and environmental inequities.

Our equipment disposal procedures could probably be counted among the best practices across the nation. However we do not have an official position or preference for reuse or reallocation of computers before recycling and disposal.

Recommendations

- 1) Maintain current program, with the additional recommendations below:
 - a) Obtain suitable space for storage of e-waste and monitors.
 - b) Develop and implement methodology for tracking tonnage diverted from landfill.
- 2) Outsource recycling to companies who conform to as many of the standards listed under the [Electronics Recycler's Pledge of True Stewardship](#) as reasonably possible.
- 3) Formalize reuse and reallocation procedures and policies in conjunction with Physical Resources furniture disposition policy and in consultation CCS and other departmental IT managers.

Conclusion

The University of Guelph should take pride in its advanced E-Waste Disposal program and the high level of participation on campus. The well crafted Policy on Environmental Protection could be strengthened and enhanced by the further development of sustainability policies and possibly the establishment of a monitoring board. However, the top priorities identified by the task force involve education, assessment, and collaboration in the establishment of environmental awareness and practice on campus with regards to "green computing" throughout the entire lifecycle of the products.

Summary of Recommendations:

Campus Position and Policy

The majority of universities whose green computing practices have been identified as "best practices" have well defined sustainability policies and green initiatives managed by environmental advisory boards, institutes or committees. This provides guidance and a recognized mandate for the development of campus awareness programs, environmental purchasing processes, and the establishment of appropriate energy consumption standards, and energy indicators from which one can benchmark progress. Although beyond the scope

of this task group, it is recommended that the University revisit its policies and consider the creation of an institutional environmental mandate to build a strong foundation for green policies, initiatives and programs.

Campus Awareness Program

- 1) Conduct a survey of the different target audiences on campus to:
 - a) Gauge awareness of and participation in current energy reduction practices and e-waste management practices.
 - b) Identify barriers to participation in the above practices.
- 2) Develop campaign based on social marketing theory, moving beyond information provision to motivation and persuasion techniques, identifying effective short-term incentives and long-term behaviour modification strategies.
 - a) Develop a media strategy in conjunction with IT and Communications & Public Affairs (to be developed by Sustainability Coordinator).
 - b) Ensure campaign informs campus IT professionals of the support and services available through the Sustainability Coordinator and Purchasing in implementation of green computing solutions.
- 3) Measure and evaluate the success of the awareness program and the adoption of conservation or procurement practices by developing indicators and publicize the results.

Energy Conservation Strategies and Practices

- 1) Survey current power management policies and practices across campus.
- 2) Develop a plan, with IT personnel, to reduce the energy consumption of computers across campus.
- 3) Identify standard practices for implementing an energy reduction plan.
- 4) Coordinate participation of IT in an energy reduction plan with campus environmental policies and campus awareness programs.
- 5) Work with Physical Resources on the development of an energy consumption measurement program and energy indicators that break down energy consumption in a way that is easily communicable and relevant to the campus. To achieve this end Physical Resources could make metering a construction requirement for new buildings. However, the task group recognizes that the age and design of existing campus buildings makes this a challenging proposition that could take years to implement, if it proves feasible.

Computer Procurement

- 1) Establish standards and benchmarks with which to define a green purchasing policy for computers.
- 2) Define Purchasing policy complete with purpose, scope and procedures.
 - a) Developing a green procurement directive.
 - b) Construct terms and conditions for future tenders and contracts.
 - c) Incorporate labeling programs into a university green computing procurement initiative. Adopt standards issued by ecological standards associations and identify their labeling programs, i.e., Energy Star, EnerGuide, Green Seal, etc.
 - d) Communicate procurement information resources within the University community via Purchasing Service's website and provide resource links as appropriate. Incorporate training and education of new environmental criteria and processes into existing client training program.
- 3) Report / update purchase activity in support of green initiatives, including progress to date to Sustainability Coordinator for incorporation into campus awareness program.

Computer Equipment Disposal Procedures

- 1) Maintain current program, with the additional recommendations below:
 - a) Obtain suitable space for storage of e-waste and monitors.
 - b) Develop and implement methodology for tracking tonnage diverted from landfill.
- 2) Outsource recycling to companies who conform to as many of the standards listed under the [Electronics Recycler's Pledge of True Stewardship](#) as reasonably possible.
- 3) Formalize reuse and reallocation procedures and policies in conjunction with Physical Resources furniture disposition policy and in consultation CCS and other departmental IT managers.

Cited Resources

Executive Summary

Environmental Impact of Computer Information Technology in an Institutional Setting: A Case Study at the University of Guelph:

http://www.uoguelph.ca/isc/documents/050602environs_000.pdf

Electronics Recycler's Pledge of True Stewardship

http://www.ban.org/pledge/electronics_recycler_pledge.pdf

Campus Position and Policy

University of Guelph - Policy on Health and Safety (851.01.01):

<http://www.uoguelph.ca/ehs/policies/01-01.pdf>

University of Guelph - Environmental Protection Act (851.01.03):

<http://www.uoguelph.ca/ehs/policies/01-03.pdf>

University of Guelph - Non-Hazardous Waste Collection and Enhanced Recycling on Campus policy (PR 14.0):

<http://www.pr.uoguelph.ca/pr/policies.htm>

International Institute for Sustainable Development – Sustainable Campus Policy Bank

<http://www.iisd.org/educate/policybank.asp>

Energy Conservation Strategies and Practices

Carnegie Mellon University - Environmental Indicators:

http://www.cmu.edu/greenpractices/campus_assessment/IR_2004/Energy_Management.pdf

Computer Procurement

Trent University - Environmental Procurement Policy:

http://www.trentu.ca/financialservices/purchasing/policies/PUR_3_environmental_procurement.pdf

Computer Equipment Disposal Procedures

University of Alberta's Surplus Assets Disposal Procedure

https://www.conman.ualberta.ca/stellent/groups/public/@finance/documents/procedure/pp_cmp_057477.hcsp

Carnegie Mellon University - Environmental Health and Safety Recycling Procedures

http://www.cmu.edu/ehs/Waste_and_Recycling_Programs/recycling.htm#Computer

Other Resources

Eco-Efficiency: Good Business Sense website:

<http://www.ec.gc.ca/cppic/En/refView.cfm?refId=1529>

Electronics Stewardship Canada website:

<http://www.epsc.ca/>

Environmental Indicators for Carnegie Mellon University – Baseline Assessment
http://www.cmu.edu/greenpractices//campus_assessment/IR_2004/Energy_Management.pdf

Green Procurement w/ Eco Label links:
<http://www.solutions.ca/GreenProcurementOnline/Links.asp>

Hewlett Packard - Suppliers who show environmental responsibility:
<http://www.hp.ca/corporate/philanthropy/environment.php>

Product Stewardship Institute c/o University of Massachusetts; Purchasing Environmentally
Preferable Computers: A Guide for Procurement Officials:
<http://www.productstewardship.us/supportingdocs/epp.pdf>

Appendix A: University of Guelph Policy on Environmental Protection

From: University of Guelph - Environmental Health and Safety's *Policy on Health and Safety* 851.01.01

<http://www.uoguelph.ca/ehs/policies/01-01.pdf>

Appendix B: Northland College Sustainability Mission Statement

Northland College appreciates and respects the interdependence of complex human and ecological systems and is committed to maintaining and improving their health, wholeness, balance and diversity.

As a leader in the environmental field, the College will support programs and policies which reduce the demands upon the environment to a point below the earth's regeneration rate and actively pursue the ultimate goal of a sustainable campus.

Northland College will implement programs and policies which:

- Exceed the highest energy efficiency standards/codes currently enforce
- Develop independence from commercial energy by use of alternative energy sources
- Through purchasing practices, help create commercial markets for products and services that contribute to sustainability
- Select products, materials and resources which are environmentally safe, sustainable, non-toxic and preferably of local origin
- Emphasize reducing and reusing, then recycling of waste
- Exploring alternative waste disposal systems including onsite and regional options
- Restore indigenous natural ecosystems as part of the campus aesthetic
- Promote a sense of community through cooperation of students, faculty and staff regarding all aspects of campus development
- Aim for zero discharge of all toxic waste and materials
- Increase the value of long-range paybacks and incorporate full cost accounting into economic decision making including spiritual, aesthetic, and quality of life values
- Create a campus aesthetic indigenous to the north country and mindful of local cultures and ecosystems
- Advance sustainable food production
- Conduct a regular environmental audit

Northland College and the Northland College community will strive to be a leader in the continuous pursuit of sustainability by experimentation, monitoring, education and outreach.

<http://www.iisd.org/educate/policybank.asp?pid=61&detail=Yes>

Appendix C: Principles behind the University of Toronto's energy reduction plan

Community-Based Social Marketing – (founded by Dr. Doug McKenzie-Mohr):

1. Selecting a target behaviour.
2. Identifying the specific perceived barriers and benefit of the target audience to that behaviour (via, in order: literature research, observational studies, focus groups, and surveys)
3. Strategy formation (application of tools derived from psychological principles to the target barriers)
4. Pilot (evaluation and possible reformulation of strategies)
5. Broadscale implementation.

The CBSM approach also incorporates the following principles of persuasion - (compiled from Cialdini, R.B. and Schultz, W.):

1. Reciprocation - we should try to repay what another person has provided us
2. Commitment and consistency - we feel the need for our attitudes and behaviours to be consistent
3. Social proof - the tendency to see an action as more appropriate when others are doing it
4. Liking - we are more likely to comply with a request from someone we like (or know)
5. Authority and expertise - we are more likely to comply with the request of a perceived expert
6. Scarcity - psychological reactance: whenever our free choice is limited or threatened, the need to retain control leads us to reassert ourselves

Outline of the principles provided by Gillian Maurice, University of Guelph Sustainability Coordinator

RESPONSIBLE PURCHASING STATEMENT/COMMITMENT TO SAFETY AND THE ENVIRONMENT

In order to serve the best interests of the campus community and the various public partners, the Purchasing Resources Department commits that general safety and environmental criteria will be included with cost criteria in all significant purchasing decisions.

1. When electrical equipment is to be purchased, it will be CSA approved and a preference will be given brands that receive the Energy Star rating.
2. In all purchase decisions, the evaluation of products will include their recyclability and the recycled material content.
3. In the purchase of new passenger vehicles, preference will be given for purchase of those that meet Low Emission Vehicle (LEV) or Ultra Low Emission Vehicle (ULEV) standards.
4. When appropriate, due to operating costs, operator safety, disposal costs, etc., whole categories of purchase will meet campus safety or environmental goals. In such cases, purchase decision will be made on the basis of full-life cycle cost analysis including disposal costs when such data are available.
5. When appropriate and possible, the campus community is encouraged to reduce paper mass mailings by utilizing the Public Distribution e-mailing lists and/or utilizing the Daily News to convey a message. Electronic means of communicating important information should be the prime consideration for disseminating this information.
6. In order to help meet our recycled paper purchases, all printer and photocopier paper used at McMaster University will have at least 30% post-consumer recycled paper content and purchased from the negotiated source. Alternate suppliers of paper should not be used.
7. When suppliers deliver products in cardboard containers and with Styrofoam packaging, they will be required to remove their waste from all University sites at no extra cost to the University.

Appendix E:

University of Guelph E-Waste Disposal Procedures

General E-Waste

Collection methods:

- 1) Pick up through Physical Resources work order system, coordinated by Sustainability Coordinator, enacted by Transportation Services Material Handlers. Customer-initiated requests via phone, email, in person.
- 2) Drop off at MacNaughton loading dock. Customer must notify Sustainability Coordinator.

Onsite Storage:

- 1) Temporary situation: rental of 20 foot 'cargo container' stored in P30.
- 2) 033 MacNaughton. When full, emptied by Material Handlers at request of Sustainability Coordinator.

Final removal/disposal:

Onsite storage facilities are emptied by Material Handlers at the request of Sustainability Coordinator, and the equipment taken to Production Works Co-operative in Fergus, at no cost.

Monitors

Collection: identical to other e-waste

Onsite storage:

- 1) Temporary situation: rental of 20 foot 'cargo container' (separate from e-waste container) stored in P30.
- 2) 033 MacNaughton. When full, emptied by Material Handlers to P30 bin at request of Sustainability Coordinator

Final removal/disposal:

Container is emptied by Toronto Recycling Inc. at the request of the Sustainability Coordinator when notified by Material Handlers. Transportation charges and per unit disposal charges are levied, but a rebate based on revenues is also factored in to the final billing. Cost: \$6 per monitor, \$150.00 pick up charge.