# Greening Canadian Hospitals

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## Community Research Connections

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With over 3000 hospitals, medical facilities and surgery centers found throughout Canada's many communities, they have tremendous impacts both on individual health and on the ecological, social and economic health of communities. Economically, the healthcare sector contributes approximately 10% of the nation's gross domestic product (GDP) making it a significant economic player in the Canadian economy (Canadian Association of Physicians for the Environment 2000). Ecologically, a hospital's energy consumption is particularly significant, contributing up to half of the total ecological footprint of the facility (Hancock 2001), while a hospital's waste production varies from relatively benign to toxic and potentially lethal environmental contaminates. It is clear that hospitals have a critical leadership role to play as their institutions move towards higher and more complex implementation of sustainable development. This leadership role extends beyond simply being model institutions for greening, to actively contributing to the communities in which they reside through the connections between individual, institutional and community health.

Many organizations make up Canada's medical community network such as the Association of Canadian Academic Healthcare Organizations, Canadian Association of Physicians for the Environment, The Canadian Coalition for Green Health Care, Canadian College of Health Service Executives, Canadian Healthcare Association, Canadian Healthcare Engineering Society, Canadian Medical Association, Canadian Nurses Association, Canadian Pharmacists Association, Canadian Public Health Association, National Specialty Society for Community Medicine and Health Care without Harm. These organizations have signalled the need for change by calling attention to the links between health and the environment and encouraging governments and health-care sector policy makers to adopt green policies.

The sector's unique requirements for health safety and security, and sterilization however, influence the decisions hospitals make regarding the energy they consume and the waste they generate. The purpose of this discussion paper is to highlight that, despite these unique operating constraints, there are important ways in which the healthcare sector could be leaders in implementing more sustainable ways of operating while at the same time

contributing to enhanced community development. This paper provides an overview of the environmental impacts of the sector (Appendix A) and of the Canadian medical community's recommendations for a green policy framework. It then provides an illustrative overview of best practices, a scan of four provinces, British Columbia, Ontario, Nova Scotia and Quebec, describing the policy initiatives each government has implemented, followed by some of the leading edge practices in the implementation of sustainability strategies and plans, both by individual hospital leaders and organizational innovation in each province.

The examples of sustainable hospitals in this discussion paper are by no means exhaustive and we encourage you to make this document a living document by contributing your initiatives and contact information to the working copy of this document found in Google Docs. Simple click here and make your contribution.

## Methodology

The information for this paper was obtained by first performing an internet scan of the various organizations that make up Canada's medical community, searching for policy recommendation and best practices for greening hospitals. Provincial ministries for environment, industry and health were also examined for legislation and policy documents that pertained to sustainable development, climate change and pollution prevention initiatives. A final internet scan of the numerous hospitals and health authorities found throughout British Columbia, Ontario, Nova Scotia and Quebec was performed to highlight and report on organizational leaders.

## Green Policy Framework

The green policy areas discussed below are a compilation of visions and strategies from many of the organizations in the sector, as well as key documents (CADDET 1997; Canadian Association of Physicians for the Environment 2000; Canadian Coalition for Green Health Care 2002; Hancock 2001; Health Care Without Harm n.d.; Joint Position Statement Feb 2009; Joint Position Statement Sept 2009; Waddington 2002; World Health Organization & Health Care Without Harm 2009). They represent a baseline for potential leadership by the healthcare sector in the implementation of sustainable development strategies, while at the same time reducing their operating costs and improving the quality of healthcare services they deliver.

### Energy Consumption/Resource Conservation

Since hospitals are required to heat, cool and power their facilities 24 hours a day, 7 days a week, 365 days a year, energy consumption makes up a significant portion of a hospital's footprint. This, however, does provide an opportunity for hospitals to make major reductions to their environmental impact by changing operating practices. Strategies for reducing the impact of a hospital's operation include:

- retrofitting existing facilities to function more efficiently;
- implementing energy conservation strategies;
- converting to cleaner, renewable energy sources;
- buying green power;
- incorporating Green Building Principles such as LEED, and
- considering overall transportation impacts of facility location.

### Waste

Hospitals consume considerable amounts of energy, water and other renewable and non-renewable resources. Inevitably this consumption produces a wide variety of waste ranging from the comparatively benign outputs such as glass, cardboard and food wastes to the extremely hazardous persistent organic pollutants, heavy metals, radioactive materials and cytotoxic drugs. These wastes are disposed of in a number of ways. The majority of a hospital's liquid waste is discharged as waste water effluent, while liquid containing toxic materials, such as cyanide, chromic acid, phenolic compounds, solvents and mercury need to be collected and processed as hazardous waste (Hancock 2001). Most solids go to landfills accounting for approximately 1 percent of Canada's solid waste. A large portion of this waste is also incinerated. Only 1 to 2 percent of medical waste actually needs to be incinerated making room for large improvements in waste management (Hancock 2001).

A hospital's interior environment is also subjected to harsh chemicals which pose health risks to staff and patients. Many of the disinfectants and cleaning agents that are used to sanitize and sterilize the hospital environment usually contain harsh chemicals. This ubiquitous exposure to toxic chemicals on a daily basis is being increasingly linked to high rates of asthma, dermatitis and allergic reactions (Canadian Nurses Association

2008; Hancock 2001). Food waste is also a major contributor to a hospital's waste stream. According to the Ontario Ministry of the Environment, Ontario hospitals discarded an average of 0.22 to 0.67 kg of food and packaging waste per meal served (Aramark Healthcare 2009).

Consequently, an important strategy for reducing a hospital's waste production and therefore its environmental impact is to reduce the amount and toxicity of material that enters the hospital in the first place. Any sustainable development strategies for the sector should:

- implement waste diversion initiatives to minimize the amount destined for disposal (i.e. waste reduction, material reuse and recycling all eligible materials including electronics);
- create combustion control strategies to improve the performance of existing incinerators;
- use alternative disposal or treatment technologies such as anaerobic digestion of wastes, with recovery of materials and combustion of biogas;
- segregate medical waste to divert materials from the incinerator;
- purchase reusable products instead of the disposable when available;
- audit waste streams to assess the degree of conformity with regards to regulatory compliance, evaluate or demonstrate due diligence, and possible performance improvements;
- minimize radioactive diagnostic and therapeutic materials, and
- prevent and compost food service waste.

### Green Procurement

An important strategy for reducing a hospital's waste production and therefore its environmental impact is to reduce the amount of material that enters the hospital in the first place. A green procurement policy would alter the purchasing practices of the hospital by giving preference to environmentally sustainable products where clinical performance and safety are equal or better (Hancock 2001). A green procurement policy needs to:

- include language about the packing material in your supplier specifications;
- reduce use of toxic materials;
- request rationalized packaging;
- buy in bulk to reduce packaging;
- ensure longevity of the product;
- buy local and seasonal food;
- procure organic food when possible;
- eliminate bottled water, and
- purchase the least toxic disinfectant and sanitization products available.

### Transportation

The healthcare sector is a transportation intensive industry. Hospitals rely heavily on transportation systems to move patients, workers, supplies and waste. To reduce the environmental impacts from these systems strategies need to focus on reducing both the total travel required and the intensity of the emissions by using higher efficiency vehicles, alternative fuels or alternate modes of transportation. Both Sweden and the United Kingdom have shown signification emission reductions by incorporating transportation policies into the operations of their hospitals. In Stockholm, for example, the ambulance operator AISAB has reduced ambulance fuel consumption by as much as 10% after implementing an eco-driving program that trained drivers in a manner that reduced fuel consumption. The Addenbrooke's Hospital in Cambridge, United Kingdom has successfully promoted alternative modes of transportation reducing the numbers of cars used on the hospital grounds by 16% and staff car usage by 22% (HCWH 2008). Canadian hospitals need to evaluate the cost/benefits of reducing fleet emissions to determine the best options available to their operation. Sustainable transportation initiatives would:

- operate high fuel efficient or hybrid vehicles;
- provide eco-driver training;
- use fuels that have minimal ecological impact;
- support mass transit, carpooling, car sharing, telecommuting and biking initiatives;
- support suppliers with efficiency/alternate fuel standards;
- support local suppliers;
- purchase for energy efficient shipping, and
- dispose of waste locally reducing energy and greenhouse gas emissions produced in transporting waste.

### Green Teams

The establishment of 'green teams' or environmental management teams are one way to ensure the implementation of the above strategies for reducing the ecological footprints of Canadian hospitals. Green teams play an important role in monitoring and reporting on environmental performance while prioritizing goals and actions plans. The formation of green teams and their inherent management and reporting systems can also contribute to a hospital's successful application for accreditation from Accreditation Canada and ISO14001 certification. Accreditation and certification help to guide hospital organizations to continuously improve management practices while achieving:

- awareness of their impact on the environment;
- acceptance of responsibility for those impacts;
- the expectation that harmful impacts will be reduced or eliminated, and
- the placement of responsibility for environmental impacts upon all members of the community (Hancock 2001; Waddington 2002).

This compilation represents a key baseline for what needs to be done in order to move to greening the healthcare sector, but this is only the first step in a continuum for change, moving from green to the implementation of sustainable development strategies in all hospitals, to leaders for regeneration. This continuum for change and decision-making is illustrated in Figure 1.

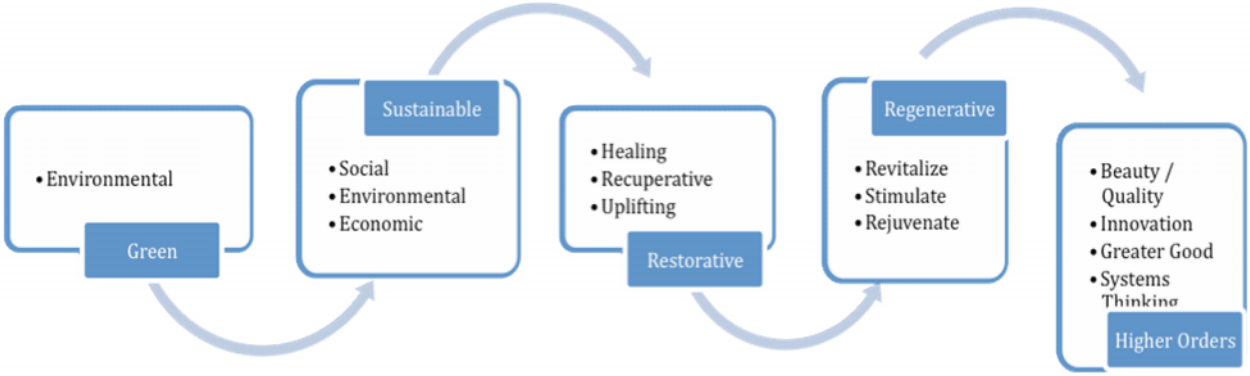


Figure 1. Decision-Making Continuum[1]

Recommendations for actions to move the sector along this continuum are contained at the end of this document.

## Best Practices

Just recently, a new journal called the Canadian Journal of Green Health Care was launched, to be published tri-annually by the Canadian Coalition for Green Health Care, http://www.nxtbook.com/dawson/marketzone/ghc_201009

## Provincial Policy Scan

A scan of British Columbia (B.C.), Ontario, Quebec and Nova Scotia's government agencies has revealed various levels of commitment and implementation for reducing their environmental impacts. Included in this section are hospital leaders and organizational innovations that have been employed to comply with these regulatory standards.

### British Columbia

B.C., through the 2007 Greenhouse Gas Reduction Targets Act has committed all public-sector organizations to being carbon neutral by 2010 and is supporting this initiative with their Public Sector Energy Conservation Agreement (PSECA). Created as a partnership between BC Hydro and the Government of B.C. this agreement has helped public sector organizations in the province achieve annual energy cost savings of close to $7.4 million, GHG reductions of over 18,700 tonnes and conservation of 38.6 Gigawatt Hours (GWh) of electricity since its inception.

[1] Algonquin College, Draft Sustainability Strategy, 2010.

*Provincial Legislation and policy documents*

- Bill 44 – 2007 Greenhouse Gas Reduction Targets Act
- BC Air Action Plan
- The BC Energy Plan
- Green Building Code
- Public Sector Energy Conservation Agreement
- BC Energy Efficiency Act

### Ontario

Ontario is dedicated to reducing their greenhouse gas emissions to 6 per cent below 1990 levels by 2014, 15 per cent by 2020 and 80 per cent by 2050. The province's Green Energy Act (2009) is one of the key policies public agencies will be required to use for achieving this goal. Since this a relatively new initiative no results have been made available for measuring the effects of the Act at this time.

*Provincial Legislation and policy documents*

- Ontario Environmental Protection Act
- Green Energy Act
- Energy Conservation Responsibility Act
- Waste Diversion Act
- Safe Drinking Water Act
- Water Resources Act
- Toxics Reduction Act

### Nova Scotia

Nova Scotia's commitment, through the Environmental Goals and Sustainable Prosperity Act and Climate Change Action Plan, is to reduce the province's greenhouse gas emissions to at least 10% below 1990 levels by 2020. To help achieve this goal Nova Scotia administers the $42.5 million ecoNova Scotia for Clean Air and Climate Change fund that currently supports 89 projects and programs to improve environmental quality while supporting sustainable economic development. As of November 2009 these funded projects will result in a reduction of 172,000 tonnes of GHG each year, a reduction of 294,000 kg/year of sulphur oxide and a reduction of 231,000 kg/year of nitrogen oxides, while creating 55 full time green jobs.

*Provincial Legislation and policy documents*

- Environment Act
- Environmental Goals and Sustainable Prosperity Act
- Pollution Prevention Implementation Plan
- Climate Change Action Plan
- Voluntary Carbon Emissions Offset Fund Act
- ecoNova Scotia for Clean Air and Climate Change fund

### Quebec

Quebec aims to reduce their GHG emissions to 20% below 1990 levels by 2020 with the guidance of their Sustainability Development Act and the 2006–2012 Climate Change Action Plan. The establishment of the Sustainability Development Act has allowed the province to legally establish an accountability framework for sustainable development through which individual efforts can be channelled, contributing to the province's climate change goals. Already completing the fourth year of their plan, Quebec has committed more than $ 660 million for over 1200 projects under the 19 programs found throughout the Action Plan. The results of this action so far has been a reduction of almost 1% of Quebec's GHG emission from 1990 to 2008.

*Provincial Legislation and policy documents*

- Sustainable Development Act
- Environment Quality Act
- Climate Change Action Plan 2006-2012

## Hospital and Organizational Leaders

*BC Interior Health Authority*

The Interior Health Authority (IHA) is responsible for ensuring publicly funded health services are provided to the people of the Southern Interior of British Columbia. Covering an area of almost 215 thousand square kilometres the IHA serves a population of 732,000 with 18,523 employees throughout 22 hospitals. In order for the IHA to minimize its ecological footprint and improve the health of the community and environment the IHA has established an Environmental Sustainability Department, community-based Green Teams, and a centralized Senior Environmental Advisory Committee (SEAC). Through these initiatives an environmental sustainability policy document was drafted. With the guidance of these policies, the following initiatives have been implemented.

- Kelowna General Hospital has made use of Okanagan Lake water for cooling, increasing the energy efficiency of the facility
- Hillside Centre in Kamloops has been designated LEED gold by incorporating dual flush toilets, low flow faucets, lighting controlled through occupancy sensors, and flooring containing recycled material
- Shuswap Lake Hospital has included geothermal heating and cooling, high efficiency mechanical units, low flow toilets and LED indirect lights in the recent expansion project
- switched from diesel to biodiesel fuel produced from locally grown crops in 4 of 6 Logistics delivery trucks
- mercury thermometers and toxic cleaning products are being phased out while reduced paper and increased recycling is saving thousands of dollars in landfill costs (Interior Health Authority; Mazurkewich, Houghton & Hancock 2004).

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*BC Vancouver Island Health Authority*

British Columbia's Vancouver Island Health Authority (VIHA) operates 150 facilities, employing more than 17,000 employees who provide health care to over 750,000 people on Vancouver Island, on the islands of the Georgia Strait, and in the mainland communities between Powell River and Rivers Inlet. With a focus on improving the health of VIHA's residents while minimizing the environmental and human health impacts of Canada's health care system VIHA is actively pursuing the following green initiatives.

- Royal Jubilee Hospital site in 2011, aims to be the first acute care facility in Canada – and the largest health care building - to achieve gold status under the Leadership in Energy and Environmental Design (LEED) program.
- In partnership with BC Hydro, through the BC Hydro Power Smart Partners Program, energy conservation initiatives from improving hot water/boiler systems; reclaiming heat from waste laundry water; retrofitting lights to low mercury/high efficiency and replacing windows are being performed.
- Through regular waste audits the health authority is able to creatively recycles as much as possible, i.e. printer cartridges, cooking oil, mercury from fluorescent tubing and even used linens that we donate to developing countries.
- Regularly composting of all lawn and garden waste
- Kitchen wastes are composted in Nanaimo, Port Alberni, Duncan, Parksville, Qualicum and Victoria. Grease traps have been installed in all South Island food preparation kitchens.
- Promotion of "travel smart" options such as walking, bicycling, using transit, ride sharing and carpools for staff (Vancouver Island Health Authority 2008; Vancouver Island Health Authority 2009).

*BC Provincial Health Services Authority*
The Provincial Health Services Authority (PHSA) is one of six health authorities located within the province of British Columbia. The PHSA's primary role is to guarantee access to a coordinated network of specialized health care services while operating provincial agencies that include the BC Children's Hospital and BC Transplant.

In order to reduce its environmental footprint and meet the BC provincial government's requirements to become carbon neutral by 2010 the PHSA has introduced sustainability efforts into areas of operation that include: reducing waste, alternatives to driving, energy improvements, green building standards, sustainable purchasing and green leadership programs. Through these efforts:

- Vancouver's BC Cancer Agency Research Centre and the BC Cancer Agency Abbotsford Centre have achieved LEED gold,
- The BC Cancer Agency Centre for the North in Prince George is a LEED gold facility currently under construction,
- The Mental Health Building at the BC Children's Hospital and Women's Health Centre site in Vancouver on Oak Street is currently pending LEED certification
- Green+Leaders program has been created consisting of staff volunteers who help foster sustainable behaviours in their departments by acting as early sustainability adopters, modeling new behaviours, providing colleagues with sustainability information, and helping individuals identify alternatives,
- Creation of waste audit toolkits,
- Envisioning a sustainable purchasing best practices, and
- Developed Green Commuters Program for promoting alternative transportation options (Provincial Health Services Authority; Provincial Health Services Authority).

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*Cambridge Memorial Hospital*
Cambridge Memorial Hospital (CMH) is a 277-bed community hospital staffed by 1,100 employees and in 2000 it became the first hospital in North America to receive ISO 14001 certification for its environmental management system (EMS). The implementation of the EMS has fostered leadership within the hospital and a commitment to sustainable development principles. Through this commitment the hospital has:

- Developed an environmental management system (EMS) and achieved ISO 14001 certification,
- Joined with two other hospitals to collectively manage the recyclable waste stream,
- Diverted 60 tonnes of white paper and 40 tonnes of corrugated cardboard from disposal in one year,
- Increased the recyclable content of its waste by 40 percent in one year,
- IV bag recycling program has diverted 8.6 tonnes of PVC and 2.7 tonnes of HDPE since 1996,
- Achieved a 20% reduction in the amount of biomedical waste,
- Returned corrugated containers and print toner cartridges to their suppliers,
- Diverted 5 kilograms of nickel-cadmium batters from landfills through the Nickel-Cadmium Battery Recycling program,
- Implemented mercury audits, education and awareness programs as part of the mercury-free medicine campaign to phase out mercury-containing products, and
- Established a hospital wide green team to implement and monitor the EMS (Hancock 2001; Hancock, Whate, Wolnik & Matto 2001).

These efforts have also improved the image of the hospital within the community. This has created opportunities for staff to communicate the link between health and the environment through special environmental days such as Health Living, Green Transportation and Garbage Free Lunch (Hancock, Whate, Wolnik & Matto 2001).

*The Ottawa Hospital*
The Ottawa Hospital (TOH) is one of the largest healthcare organizations in Canada with more than 3.5 million square feet of space and an annual energy budget of approximately $14 million. In order to manage their

significant energy costs while improving building comfort, reducing their environmental impact and managing utility risks, TOH contracted Honeywell in 2004 to implement an energy conservation program. Through this program TOH was able to reduce the facilities utility consumption of natural gas by 40%, electricity by 18%, steam by 23% and water by 5% by:

- retrofitting lighting at all three campuses;
- upgrading lighting of two parking garages;
- installing new Building Automation System covering approximately 5,500 points of control for all three campuses;
- replacing of some chillers with more energy-efficient units and environmentally friendly "CFC free" chillers;
- installing high-efficiency hot water and heating boilers;
- replacing of existing motors with more efficient ones;
- sealing building envelops to reduce drafts and prevent energy leakage;
- installing water conserving fixtures and reducing process water usage, and
- implementing continuous awareness program to educate employees and surrounding community.

Due to the success of this program the hospital was able to reduce their greenhouse gas emissions by 11,833 tonnes annually (equivalent to the need of 39,132 trees) and their annual energy was reduced by 184,279 GJ or 0.62 GJ/m2 (Rashid 2006).

In addition to this work the TOH has received almost $1 million in incentives which have been applied to:

- capture the waste heat from their boilers using the flue ace system;
- convert city water cooled equipment to chilled water cooled;
- upgrade their boilers and chillers with new automated energy efficient plants;
- optimized design for HVAC systems;
- upgrade lighting, and
- perform steam traps annual surveys.

TOH is also one of the largest generators of biomedical waste in the country. In order to mange their waste output in an environmentally responsible way, they implemented a biomedical waste program that since 1994 has:

- eliminated the unnecessary on-site incineration of non-pathological biomedical waste;
- installed a state-of-the-art fluid management system;
- decommissioned its on-site incinerator, and
- installed two on-site "Hydroclave" alternative technology waste treatment systems (Hancock, Whate, Wolnik & Matto 2001).

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*Women's College Hospital*
The Women's College Hospital (WCH) is located in downtown Toronto and has a staff of 770 that serves over 270,000 ambulatory patients annually. In 1989 the WCH recognized the impacts hospital operations were having

on the environment. With this realization the WCH Green Team was formed to create green policies and lead the way to environmental sustainability. Since the formation of the group the WCH has been able to:

- Improve indoor air quality to decrease asthma triggers by implementing a fragrance-free initiative advocating for the use of scent free, eco-friendly cleaning products,
- Advocate for a mercury-free environment by replacing older thermometers and blood pressure cuffs with digital versions. Mercury switches in plant maintenance have also been eliminated,
- Apply an energy conservation strategy reducing energy consumption from electronics and lighting thereby reducing hospital greenhouse gas emission by approximately 925 tonnes,
- Gain energy efficiency by monitoring and adjusting the building's automated heating ventilating and air conditioning (HVAC) system while performing an annual steam trap survey to monitor upkeep,
- Replace old hot water tanks with instantaneous hot water exchange systems,
- Realize a diaper recycling program diverting them from landfills, and
- Replace PVC tubing currently used in the Neo-natal Intensive Care Unit NICU with neoprene tubing, as recommended by Health Canada.
- Engage, inspire and educate WCH staff and the community in green initiatives and values (Canadian Coalition for Green Health Care 2009; Canadian Nurses Association 2008).

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*County of Simcoe, Ontario*
The County of Simcoe is comprised of sixteen municipalities and is the second largest county in Ontario. Providing paramedic services for the County and the cities of Barrie and Orillia, ambulances need to cover an area of 4,800 square kilometres, travelling 2,600,000 kilometres per year. This translates to a significant amount of GHG emissions. In an effort to reduce their emissions, in December 2009 the County has partnered with Fleet Challenge Ontario, Simplicity Air and Demers Ambulance. The project consists of installing a Hybrid Idling Reduction System (HIRS) into police and EMS vehicles.

Currently EMS vehicle's idle 35 to 65 percent of their overall operating time to ensure sufficient power is available to operate emergency equipment and that the patient compartment is kept at room temperature. The benefit of the HIRS is that it maintains all the required onboard systems, and cab climate control as mandated by the Ministry of Health and Long Term Care, without the need for idling. By eliminating the need for idling a significant source of GHG emissions will be eliminated. Environmental testing will be conducted by the University of Windsor and is scheduled to be completed by December 2010 (County of Simcoe May 2010; Demers Ambulances 2010).

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*Cape Breton District Health Authority*
The Cape Breton District Health Authority provides hospital services for the communities located within Cape Breton County, Northern and Central Inverness County and Victoria County. The District is staffed by over 3,300 health care providers, working with 270 physicians, providing care to about 130,000 people. To identify

measureable and sustainable opportunities and strategies for reducing the environmental footprint of the hospitals in the district the Cape Breton District Health Authority has created a volunteer multidisciplinary team called 'Green today for a healthy tomorrow'. Since the incorporation of this team the District has:

- implemented an energy efficiency program to replace existing lighting and install motion sensor switches in washrooms and janitor closets;
- developed a compost program and re-educated staff on the recycling program, resulting in a 45% reduction in solid waste going to landfill;
- changed to cleaning products that both enhanced product quality and is environmental safe;
- applied a Micro-Fibre system of cleaning, this reduced chemical usage and enhanced water conservation while reducing cross-contamination, airborne microscopic dust particle irritants, dirt and bacteria;
- implemented reduce, reuse, recycle and recover methodology throughout the procurement life cycle;
- eliminated styrofoam throughout the District;
- improved segregation of biomedical waste diverting materials from the incinerator; and
- developed a Green Intranet Site to help communicate the goals and results of sustainability projects (Cape Breton District Health Authority 2008; Cape Breton District Health Authority 2010).

*Queen Elizabeth II Health Sciences Centre*
The Queen Elizabeth II (QEII) is located in Halifax, Nova Scotia and is the largest adult academic health sciences centre in Atlantic Canada. Consisting of 10 buildings located on two sites the QEII is a major energy consumer. In order to reduce their impacts on the environment two of its facilities will be converting to natural gas from heavy fuel oil for heating and hot water supply. This conversion includes the replacement of two large boilers, the modification of two others and the construction of a new emissions stack. The projected environmental benefits from this project are:

- a reduction of 15,000 tonnes of GHG emissions per year; and
- a reduction of 244,900 kg of air pollutants per year.

An extra benefit to this project is the extension of the distribution system for natural gas on the Halifax peninsula. This has allowed other consumers to convert from oil or electric heat to natural gas further reducing GHG emission and air pollutants in the area (Nova Scotia Department of Energy & Nova Scotia Environment 2009).

*McGill University Health Centre*
The McGill University Health Centre (MUHC), located in Montreal, Quebec, is a University Health Centre affiliated with McGill University, and consists of the Montreal Children's, Montreal General, Royal Victoria, Lachine and Montreal Neurological hospitals, as well as the Montreal Chest Institute. As the largest medical and life sciences research facility of its kind, MUHC has recognized that in order to heal people we also need to heal the environment. In committing to this philosophy MUHC drafted their Environmental Policy in 2006 and their Waste Management Policy in 2007. The Environmental Policy is the basis for the hospital's environmental programs and initiatives which include the following.

- A thorough recycling effort during Montreal General Hospital's renovation project where an average of 84% of waste was diverted from landfill, 9% more than the target, and 100% of the windows were recycled and thus diverted from landfill,
- Implemented the following energy-efficiency projects:
    - The Montreal Children's Hospital installed high-efficiency centrifugal chillers, an innovative serpentine-type boiler that recovers heat from combustion gases before they're evacuated outdoors and variable speed drives, optimized the steam distribution network, and recovered heat from the medical air compressor room for an energy savings of 32,617 GJ/yr and a 2,417 tonnes/yr of CO2 emission.
    - The Royal Victoria Hospital installed 6 high-efficiency boilers, a heat recovery system on the boilers (hot gases), a centralized building control system, an electrical boiler, insulated pipe network, and applied a condensed steam heat recovery system for an energy savings of 57,188 GJ/yr and a 4,238 tonnes/yr of CO2 emission.
    - The Montreal Neurological Hospital converted their heating network, installed heat recovery system, replaced hot-water production system, installed a variable-speed drive system and

installed a centralized building control system for an energy savings of 32,697 GJ/yr and a 2,423 tonnes/yr of CO2 emission.
    - The Montreal General Hospital modernized their steam network, installed 2 off-peak-hour electrical boilers, converted to hot water heating from steam heating, replaced hot-water boilers and installed a heat recovery system for an energy savings of 110,788 GJ/yr and a 4,950 tonnes/yr of CO2 emission.
    - The Montreal Chest Institute converted the heating network in Pavilion J, optimized steam production and installed a heating plant and new windows in Pavilion D for an energy savings of 10,340 GJ/yr and a 666.4 tonnes/yr of CO2 emission (McGill University Health Centre n.d. a).
- Installed low-flow, water-saving faucets and foam-type hand-washing devices to promote infection control and less water consumption at the same time.
- Joined Approvisionnements Montréal's CAP Committee (Comité d'achats et de pratiques environnementales) and the internal Best Clinical Products Committee to increase awareness with suppliers for the need to reduce excess packaging and to ensure materials are recyclable, as well as in line with clinical needs.
- Joined the Allégo program encouraging employees to use alternative means of travel and operating a shuttle service between sites to facilitate intra-hospital travel and reduce greenhouse gas emissions (McGill University Health Centre n.d.b; McGill University Health Centre 2006; McGill University Health Centre 2007; McGill University Health Centre 2009).

*Charles LeMoyne Hospital*
Established in 1966, the Charles LeMoyne Hospital (HCLM) is the affiliated university hospital centre for the Montérégie region. The HCLM is one of the ten largest hospital centers in Quebec employing 2270 people that provide medical services to over 400,000 individuals.

As part of receiving accreditation from the Canadian Council on Health Services Accreditation (CCHSA) Charles LeMoyne Hospital created a strategic plan that incorporated an energy efficiency upgrade program. Launched in the early 90's the program has since yielded the HCLM annual energy savings of approximately $360,000 since performing the following upgrades.

- Replaced old conventional boilers with coil tube boilers that incorporated a new control system with continuous monitoring capability and low-nitrous-oxide burners reducing 1996-1997 natural gas consumption by more than 515,000 m3 and avoiding 952 tonnes of carbon dioxide (CO2), 3.68 tonnes of NOx and 0.44 tonne of methane (CH4) emissions.
- Installed a Direct-Contact Recuperator to recover latent, sensible energy from combustion gases in the boilers.
- Replaced existing motors with new high-efficiency motors.
- Upgraded existing lighting system reducing electricity consumption and increasing the useful life of equipment.
- Developed an awareness program for employees as well as building occupants allowing employees and occupants to exercise some control over energy use and making them aware of energy efficiency objectives (Natural Resources Canada 2003b).

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## Moving Towards an Integrative Health Care System

As seen in Figure 1, greening is only the beginning stage in the continuum in the implementation of sustainable development, ultimately moving to a restorative and regenerative health care system. Sustainable development can be defined as a process of reconciling three imperatives: (1) the environmental imperatives to live within global biophysical carrying capacity and maintain biodiversity; (2) the social imperative to ensure the development of democratic systems of governance in order to effectively propagate and sustain the values by which people wish to live; and, (3) the economic imperative to ensure that the basic needs are met worldwide. Equitable access to resources – ecological, economic and social – is fundamental to its implementation (Dale 2001; Robinson & Tinker 1997). Figure 2 illustrates the continuum for the sector to move towards a fully integrated sustainable health system.


Figure 2. Moving Towards a Sustainable Future[2]

The figure below shows the desired future state, in which the economy is embedded within a society or cultural sphere, which in turn, is embedded within the environment or ecosystem. The ecosystem is all encompassing, and human society is a subset. In turn, the economy is a subset of society, and sub-subset of the ecosystem.

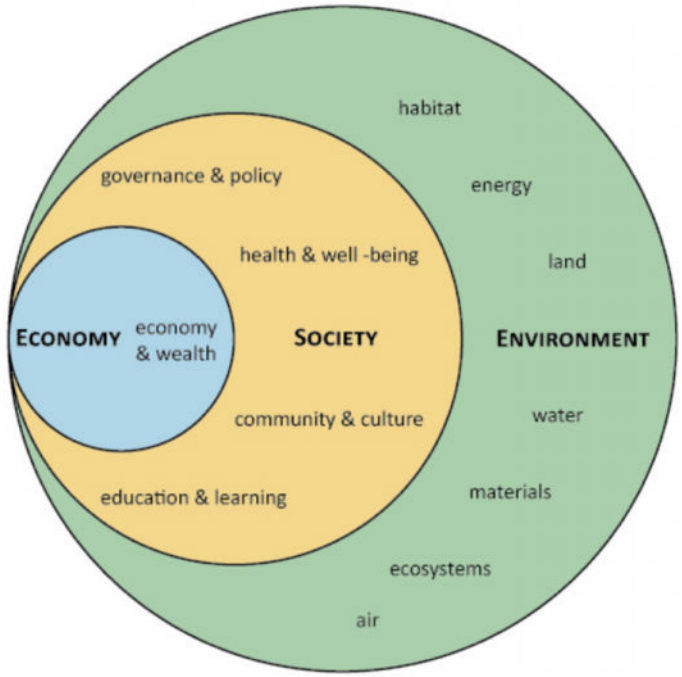


Figure 3. Desired Future Goal

[2] http://sustainableschools.org/discover/what.htm

## Recommendations for Future Action

**Management Systems**

Comprehensively and systematically manage environmental impacts by adopting a sustainability management system (SMS) through on-going data collection, documentation, planning and implementation of programs and policies throughout the hospital sector. Steps to achieve a SMS include:

1. Identify indicators that track performance.
2. Conduct a sustainability assessment.
3. Establish a baseline against which future performance can be assessed.
4. Identify environmental impacts including water, energy consumption, waste and air pollution.
5. Set targets for each of the indicators.
6. Develop and implement a sustainable development strategy.
7. Re-assess performance against the indicators.
8. Revise sustainability development strategy and implement.

**Buildings**

- Sector-wide implementation of LEED Gold, New Construction for all new hospital and medical facilities.
- Sector-wide implementation of LEED Gold, EB for all hospital and medical facilities.
- Sector-wide use of an Integrated Design Process (IDP) methodology for green building design.
- Sector-wide integration of gardens growing homeopathic medicines used for medicinal purposes.
- Sector-wide design of beautiful public spaces (inside and outside) of hospital buildings to be used by patients, visitors and staff.

**Energy and Climate Change**

- Sector-wide establishment of a baseline for measuring and improving GHG emission levels.
- GHG emissions targets established for health care sector on a provincial basis.

**Materials, Waste Management and Purchasing**

- Sector-wide medical waste recovery strategy targeting zero waste.
- Sector-wide sustainable purchasing policy.
- Sector-wide use of an Integrated Decision-Making Framework methodology for operational change.

**Food**

- Sector-wide prioritization of purchasing fair trade, local, and organic products.
- Sector-wide implementation of a sustainable food procurement policy.

**Transportation**

- Sector-wide transportation mode-shift targets and transportation demand management strategies.

**Water**

- Sector wide establishment of a baseline for measuring and improving water consumption.
- Water consumption targets established for health care sector on a provincial basis.

**Education**

- Sector-wide development of on-going experiential and inter-professional learning focusing on integrating sustainable development strategies across the health care sector.
- Integration of alternative medical practice into the health care sector (including homeopathy, acupuncture, midwifery, etc.)

**Budget**

- Development of funds for strategic sustainable initiatives by increasing operational efficiencies through continuous improvements in processes and developing partnerships.

**Accreditation and certification**

- Establish sustainable practices as fundamental elements of the accreditation and ISO certification processes, ensuring hospital organizations are continuously improving management practices that focus on a fully integrated sustainable health system.

## Appendix A – Environmental Impacts

### Energy Consumption/Resource Conservation

A 2003 survey performed by Natural Resources Canada shows that hospitals consumed nearly 52 million gigajoules (GJ) of energy to heat, cool, and power buildings, an amount equal to the average annual consumption of approximately 450 000 Canadian households. This fossil fuel consumption resulted in nearly 2.8 million tonnes of greenhouse gas emissions contributing approximately 2.1 percent of Canada's total greenhouse gas emissions. This is equivalent to the average annual emissions of approximately 814,000 compact cars or 533,000 sport utility vehicles (Hancock 2001).

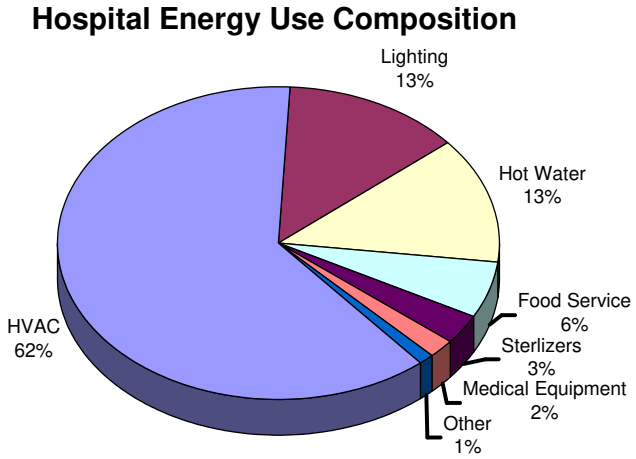


Figure 4. Hospital Energy Use Composition, Canadian Coalition for Green Health Care (2001)

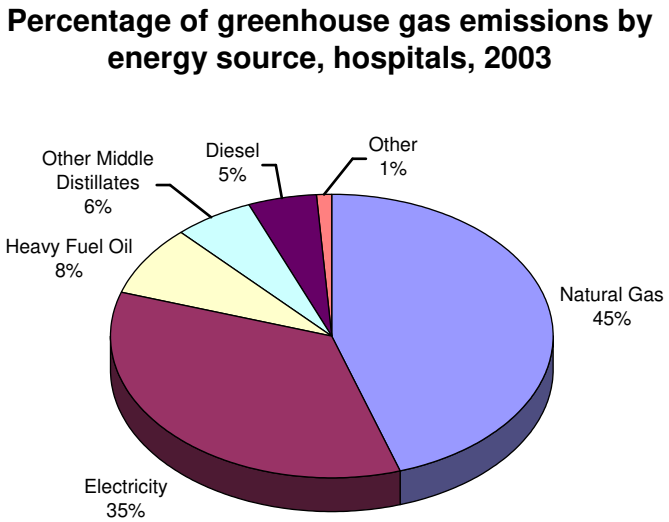

Figure 5. Percentage of greenhouse gas emissions by energy source, hospitals, Natural Resources Canada (2003a)

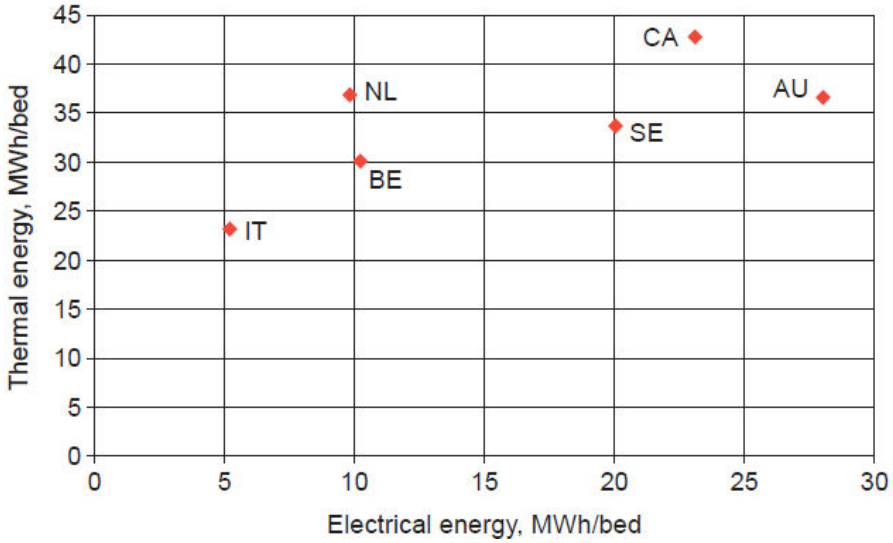


Figure 6. Average annual electrical and thermal energy consumption per bed, for typical hospital stock in six countries (Canada is indicated by CA). (CADDET 1997)

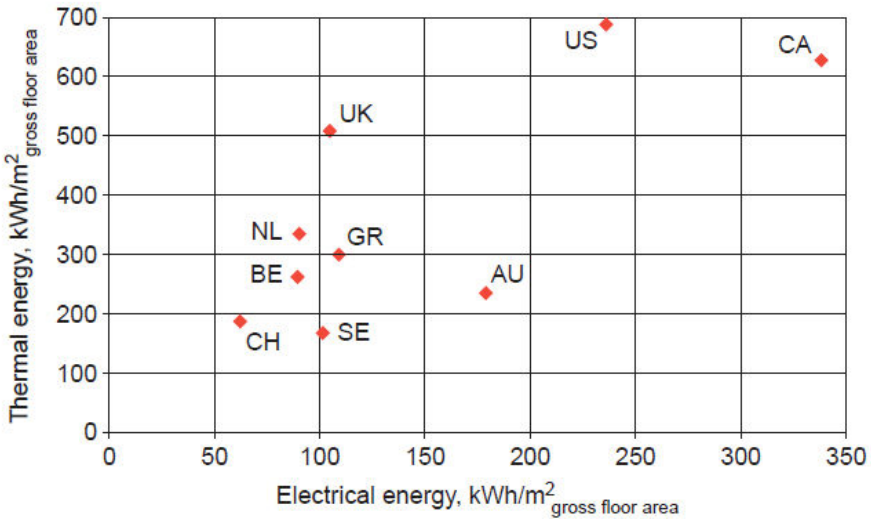


Figure 7. Average annual electrical and thermal energy consumption per gross floor area, for typical hospital stock in nine countries (Canada is indicated by CA). (CADDET 1997)

Consequently, hospitals have a high potential for energy savings. The Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET 1997) and others argue that hospitals can reduce their energy consumption by 20 to 45 percent by investing in the renewal of physical infrastructure by retrofitting existing facilities to function more efficiently, implementing energy conservation strategies, converting to cleaner, renewable energy sources, using local and regional building materials and native vegetation on site to reduce the buildings' cooling load and energy requirements (CADDET 1997; Canadian Association of Physicians for the Environment 2000; Hancock 2001; Canadian Coalition for Green Health Care 2002; Canadian Nurses Association & Canadian Medical Association. Feb 2009; Canadian Nurses Association & Canadian Medical Association. Sept 2009; Health Care Without Harm n.d.; World Health Organization & Health Care Without Harm 2009).

### Waste

There are two types of waste streams generated by hospitals. The first type is non-hazardous and makes up approximately 80-90% of hospital waste, consisting of food wastes, office materials, packaging, workshop residuals, non-infectious patient waste, disposable masks and gowns, plastic water bottles, etc. The remainder are hazardous in nature and consists of wastes that have are pathogenic, chemical, explosive, toxic or radioactive. In Canada these waste streams add up to 500 metric tons (MT) per day of medical waste that enters our environment. A large facility, such as the McGill University Health Centre, can generate up to 700 MT of waste per year (James 2009).

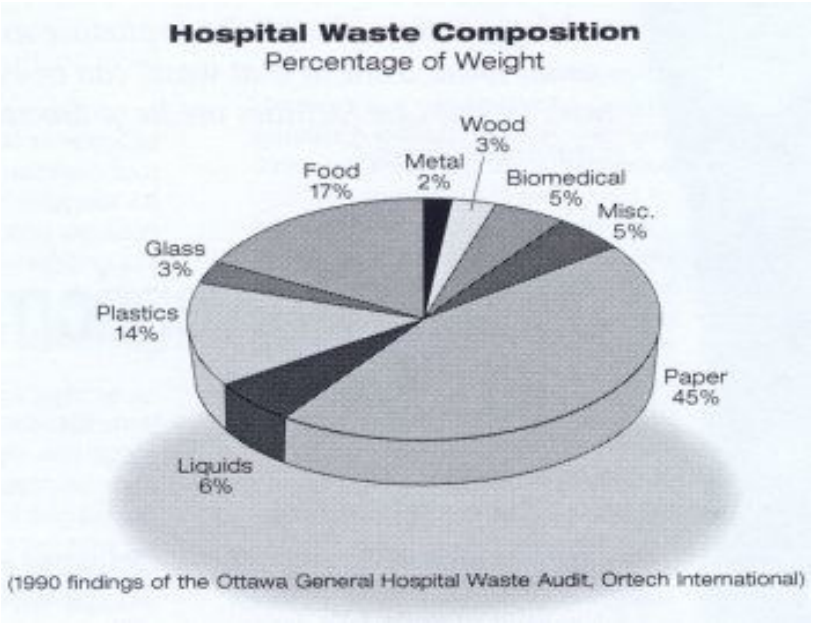


Figure 8. (Environment Canada n.d.)

Most solids go to landfills accounting for approximately 1 percent of Canada's solid waste. However a large portion of this waste is also incinerated. Incineration of biomedical waste emits $CO_2$ and $N_2O$ emissions, and according to Canadian Nurses Association (2008) is the largest source of dioxins and furans in the country. Dioxins and furans are persistent organic pollutants that are among the most toxic compounds in our environment. Dioxins are a recognized human carcinogen with human exposure almost exclusively through food. High levels of exposure are linked to cardiovascular disease, hypertension, miscarriage and infant death, birth defects, low birth weight, growth retardation and cancer (Canadian Nurses Association 2008; Hancock 2001; Hancock, Whate, Wolnik & Del Matto 2001; Health Care Without Harm 2002).

Incineration of biomedical waste also accounts for about 9% of the Canada's mercury emissions and the emission of other heavy metals (Canadian Association of Physicians for the Environment 2000; Hancock 2001; Rose & Bride 2009; Sibbald 2001). Mercury is a potent neurotoxin that affects humans most commonly through fish consumption. Once in the environment mercury is transformed by bacteria into methyl mercury that can readily affect brain, spinal cord, kidneys and liver functions (Canadian Nurses Association 2008; Health Care Without Harm 2002).

### Transportation

Burning gasoline and diesel fuels in our vehicles emits large amounts of CO2, methane (CH4) and nitrous oxide (N2O) into our environment. According to Environment Canada our vehicle emissions make up 27% of Canada's total greenhouse gas (GHG) emissions. Hospitals rely heavily on transportation systems to move patients, workers, supplies and waste. To reduce the environmental impacts from transportation, strategies need to focus on reducing both the total travel required and the intensity of the emissions by using higher efficiency vehicles, alternative fuels or alternate modes of transportation.

## Appendix B – Royal Roads University's Chemical-Free Cleaning System Case Study

### The University

Royal Roads University was founded in 1995 and currently has 1000 full-time students and offers 11 programs. Royal Roads operates year round and has several programs that are 12 months in duration, hence, there exists little fluctuation in operations and in the number of employees (which currently rests at 150 full-time and 90 part-time staff). The number of learners does vary during the year, but not significantly. Moreover, as learners and staff are present on campus year-round, all buildings are in operation for the entire year. The University has many students working at distance all around the world so it operates certain functions on a 24/7 system.

Royal Roads currently operates a single campus in Victoria, British Columbia. The Victoria campus has 9 major buildings the majority of which are over 25 years old. The total area within these buildings is almost 29,000 m2. The University has an operating budget of $32 million. Of that amount $840,000 is spent annually on custodial and housekeeping services.

### The Mission

Royal Roads University is one of the few post- secondary institutions in Canada to have sustainability as one of its founding principles. Royal Roads is committed to developing and maintaining high standards of environmental stewardship. The University's goal is to become a global leader in environmental sustainability through innovative strategies, which foster the protection and preservation of the environment. By implementing a virtually chemical-free cleaning system the University has practiced what it preaches by:

- Identifying the use of cleaning chemicals as a significant aspect and developing a plan to minimize their use;
- using less cleaning chemical;
- using less resources such as paper towels and rags;
- improving the health and well-being of not only custodial staff, but also the entire University community;
- increasing cleaning efficiency by decreasing time required to clean an area.

### Background

In April of 2000, Custodial /Housekeeping Services at Royal Roads University was approached by a representative from Faster Solutions Inc. in regards to implementing a chemical free cleaning system on campus. It was felt at the time that this system would fit well with the University's mandate of environmental sustainability. A four month trial period was initiated in the Grant building and upon its successful completion; the system was installed campus wide.

### How it Works

This cleaning system is based on micro-fibre technology originally developed for cleaning hospitals in Sweden. The micro-fibre is so fine that a 32cm x 32 cm (or 12"x12") cloth contains 1.2 million meters of micro-fibre thread. The fibre is woven into thousands of loops, which creates numerous microscopic pockets, which trap bacteria, dust, dirt and grease. Micro-fibre fabric is used to make a variety of cleaning implements such as multi-purpose cloths, window cloths and all-purpose dry and wet mops.

When the micro-fibre fabric is dry it cleans by static electricity and when used wet it cleans by capillary force. As static and capillary forces do most of the cleaning work, the use of chemicals is minimized. When the cloths and mops are dry they are primarily used for dusting, however, when wet they are more appropriate for cleaning. To wet a surface for cleaning a spray bottle is used to apply a fine mist of water. This system is very efficient as the cloths do most of the cleaning work as well as the fact that the set-up and cleanup time associated with this system are minimal.

It should be noted that these cloths don't disinfect the surfaces that they clean, rather they leave surface virtually free of any foreign material. The micro-fibre cloths and mops basically 'grabs' and 'holds' all foreign material until they are until they are washed with an enzyme cleaner.

After cleaning an area with micro-fibre cloths and mops, the mops and cloths are laundered with an enzyme cleaner. As the mops and cloths can be used wet, there is not need to mechanically dry them. By avoiding the use of commercial dryers, additional energy costs are avoided with this system.

### Lessons Learned

Although the micro-fibre cloths don't cross contaminate (e.g. bacteria being transferred from one surface to another), Royal Roads felt it necessary to purchase different colours of micro-fibre cloths. Each colour would represent a different function. As an example, Royal Roads Custodial team uses red micro- fibre cloths for the toilets and urinals, and blue cloths for all other surfaces.

In terms of "selling" the system to management and staff, demonstrations using black lights and different cleaning methodologies were a very visual method of proving the micro-fibre system's effectiveness.

In 2002, the University purchased a high efficiency washing machine that allows the cloths to be washed at a 205 degree temperature, all but ensuring the elimination of bacteria. Along with our annual laboratory testing of the cloths, we are assured that the cleaning techniques used here at Royal Roads, continues to provide the same results year after year.

The installation of the chemical free cleaning system was in part an investment in our environmental future, and with any investment you want to protect it. It would be advisable for security reasons, that a system to monitor these products be put in place.

One of the most important lessons that we learnt was education. It is extremely imperative that all persons using this system be educated on the proper use of micro-fibre and what it can do for any institution. Frequent training will allow your cleaning crew to become more cost effective and more efficient in their routines.

### Research

Studies done at an independent laboratory in the United States using the multi-purpose micro-fibre cloth show that the micro-fibre cloths are 99.94% effective at removing bacteria from smooth surface. In comparison, conventional cloths used with Lysol® or Bleach were, respectively, only 92.78% and 99.00% effective. Only surfaces saturated with 409® for a full 30 seconds were more effective (99.99%). Moreover, micro-fibre mops are significantly more effective than traditional cotton mops and chemical cleaners (99.62% versus 91.89% effectiveness).

A study completed at the University Hospital in Lund[1], Sweden rigorously assessed different cleaning methods, including a micro-fibre system. While the study attributes most of the differences in the level of cleaning by who actually does the cleaning, the traffic level and the quality of the floor finish, the new micro-fibre cloth were shown to have a greater ability to reduce bacteria on surfaces than conventional cloth. Moreover, the combination of mopping with a dry micro-fibre mop followed by a wet micro-fibre mop was more effective than traditional means. By virtue of the low profile and swivelling head of the mops, the study also revealed that a larger area (e.g. under furniture and equipment) could be cleaned with relative ease.

### Costs and Benefits

- Reduced environmental impact due to reduced resource (e.g. paper towels and rags) and chemical use;
- Saves time and money as cleaning with micro-fibre cloths/mops is more efficient than traditional means;
- Fewer allergic reactions chemicals as the system is virtually chemical free;
- Fewer incidences of back and shoulder problems in custodial staff as no heavy mops and buckets;
- Reduced chance of spills and chemical related accidents as system is virtually chemical free;
- Improved public safety as chance of slipping on wet floors is greatly reduced as wet mop leaves only a thin film of water that dries in a mere 20 seconds.
- Micro-fibre cloths can be reused at least 500 times;

[1] 1 Ekholm, Ann-Kristin. 1998. Cleaning Methods with Low Chemical Use: A Comparison of Cleaning Methods at the University Hospital in Lund. University Hospital in Lund. Sweden.

- Cloths and mops are light and can be laundered in great quantity;
- The cloths and mops take up less space and therefore reduces transport costs and required space for storage closets;
- Initial investment in the system is significant ($12,000), however, Royal Roads save $XXXX/year on chemicals and XX on labour costs, as the system is more efficient.

### Conclusion

The benefits of the chemical free cleaning system have dramatically outweighed the costs. Since the program inception in 2000, the system has paid for itself. When one considers the reduced impact on the environment, the reduced impact on the staff and learners, not to mention the reduction in accidents and injuries, this system has proved to be priceless. And when you look at what chemicals we do use here at Royal Roads, they are Green Seal Approved, or have been rated “Green” by the Environmental Choice Program. When it comes right down to it, “We Clean for Health”.

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