EXECUTIVE SUMMARY

The purpose of the Roger Centre Design Charrette was to identify possible opportunities to improve the performance and reduce the costs of operating the facility. The Charrette format also demonstrated the value in examining energy use by teams of peers and professionals that, when given utility data, the opportunity to tour the facility and interview Rogers Centre staff, and to consider the operational and system issues collectively, could identify cost effective operating strategies and energy retrofit opportunities.

This Charrette demonstrated the value of this approach by attracting professionals having a wide variety of skills and experience. The discussion and exchange of views and information that resulted during the Charrette explored the full range of opportunities for the Rogers Centre to reduce electricity demand, and conserve electricity, natural gas and water, with a significant reduction in operating costs.

Rogers Centre has a total utility cost of $4,000,000 per year. The Design Charrette demonstrated that there is significant and sustainable cost saving opportunities. These opportunities exist in each of the utility areas; water, electricity and natural gas.

Roger Centre, as a landmark facility in Toronto and for the entire country, has the opportunity to demonstrate leadership in resource conservation through the implementation of cost effective efficiency measures.
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<td>4.0 Green Globes Final Report</td>
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<tr>
<td>5.0 List of Participants</td>
<td>59</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

On August 23-24, 2005, Sustainable Buildings Canada (SBC) organized a one-day Design Charrette to study conservation and efficiency for the Rogers Centre. Key funding support came from the Ontario Power Authority and Sanyo. The event was hosted by the Rogers Centre. The Charrette attracted 46 participants, representing architects, engineers, and a variety of technology specialists. Following an introduction to the facility, the group broke into 3 teams to consider methods to improve the energy and environmental performance. Each team consisted of approximately 14 core members, with a member of the Rogers Centre present and floating experts circulating among the teams. Alongside the technical teams' efforts, the Charrette also featured a communications team that examined ways that Rogers might best communicate its energy and resource efficiency improvements. With the assistance of communications experts from the Ministry of Energy, this team identified a number of potential strategies that Rogers will consider as the various retrofits are initiated.

Design Charrettes use the “integrated design process” (IDP) to create more environmentally friendly and efficient designs. The integrated design process is a method where designers collaborate in the initial design stages, rather than working in isolation. It challenges them to consider new strategies, systems and products that more appropriately support a sustainable design scheme.

An integrated team includes members with diverse expertise and experience to inform the process including property managers, energy simulators, costing experts, energy efficiency experts, envelope specialists, municipal engineers and planners and alternative energy specialists along with the design team members. These team members work together to achieve a higher performance, value-added building. This multi-disciplinary relationship should continue throughout the design and construction phases.

This report provides details on the activities and recommendations that were developed during the Charrette and as part of subsequent modeling and analysis. The 3 teams participating in this Charrette examined different features and opportunities for the building. Each was able to show how a number of energy and environmental improvements might be undertaken for the Rogers Centre that would address many of the issues related to energy and resource uses in the building. The Green Globes Assessment provided herein rolls together the various recommendations in a consistent reporting framework, demonstrating significant potential improvement over the existing building operating features.

Sustainable Buildings Canada is pleased to provide the following report and wishes to thank all those involved in making this important event happen, in particular the core funders identified above, staff of the Rogers Centre, the facilitators, modelers and experts and all the attendees. Thank you to all.
1.1 CONTEXT

The Rogers Centre was constructed in 1989 and is a landmark building on the Toronto skyline. It has the world’s first fully retractable roof on a domed stadium.

The building comprises over 2 million square feet which includes the stadium field and stands, restaurants, offices, a health club, conference and meeting areas and a hotel plus underground parking and significant storage spaces. There are 7 levels to the main structure, and the hotel has a total of 10 storeys. Stadium height is equivalent to a 31 story building.

The hotel is operated by Renaissance and is now a separate entity from the Rogers Centre. It does receive its services (chilled water & hot water) from the Rogers Centre plant and is on the Rogers Centre gas and electrical meters. There is submetering in the Rogers Centre and the hotel and other tenants are billed for electrical and gas usage.

1.1.1 Building Envelope

The Rogers Centre is largely comprised of thick uninsulated concrete walls and curtain wall systems. The stadium portion of the building has about 18% glazing while the hotel portion is at about 40% glazing to wall. Windows are clear double-glazed with thermally broken aluminum frames and aluminum spacers. The roof has a steel deck with 2-1/2 inches of polyiso insulation and a PVC membrane cover, giving an insulation value of about RSI-2.89 or R-16.4. There was a pneumatic air sealing system for the roof but it has failed and been replaced by rubber flaps. In the winter, when the roof is left closed, polystyrene foam inserts are installed in some of the roof gaps to reduce infiltration and heat loss.

1.1.2 Mechanical Systems

The Rogers Centre has twinned boiler and chiller plants on the east and west sides of the building. Two 500 horsepower and two 600 horsepower boilers provide hot water for hydronic heating to the building. The east and west boiler/chiller plants are interconnected allowing either to serve the whole complex, although distribution problems result in both plants operating all of the time. The hot water is used in fan coils and forced flow heaters throughout the complex. It is also used to heat ventilation air supplied to the building. The hot water system is a primary loop system where the boiler pumps provide the flow to the building.

There are four 1225 ton centrifugal chillers serving the building (two east and two west). One chiller on each side has been retrofitted with a variable speed drive for capacity control. The chillers have R-11 refrigerant so the Centre is currently contemplating a chiller retrofit to change out the refrigerant to meet provincial regulations.

Ventilation is provided by two sets of fan systems. The seating area fans provide air for conditioning the seating or “bowl” area of the building, delivering air at the 100 and 500 levels. There are 8 fan system (with 16 fans) capable of delivering 1 million cfm to the seating area. The air handling units are recirculating but are capable of 100% outdoor air. Typically one of the two fans per system is operated, delivering 500,000 cfm to the bowl. These are run to condition the playing area for event move-ins and move-outs, field conversions during indoor events, and games. When the roof is opened, the seating area fans are shut off and restarted...
when the roof is closed. The fans have cooling coils which have been retrofitted to a change-
over system to provide heating in winter and cooling in summer.

A second set of fans provide ventilation to the concourse area of the complex. There are seven
constant volume concourse area fans which provide air to a vertical “pie shaped” segments of
the building. Each fan delivers to levels 100, 200, 300, 400 & 500. Because of this design,
they must operate whenever there is an event to serve the 100, 200 & 500 levels, and whenever
the offices are occupied on the 300 & 400 levels. These fans provide 250,000 cfm for
ventilation and air conditioning. They are also recirculating with up to 100% outdoor air
capability, and have both heating and cooling coils.

Zonal fan coils provide local temperature conditioning to the SkyBoxes and the office areas of
the 300 & 400 levels. Other areas of the building have forced flow units for supplementary
heating.

Four make-up air units provide ventilation for the locker rooms and the Operations Centre on
the field level.

The loading dock area of the field level has forced flow heaters. There is a problem in this
area whenever there is a move-in in the winter time. Significant cold air blows into the
building, cooling the bowl area. This is especially problematic during the extended (5-day)
move-in for the Auto Show in February when the dock doors are open almost continuously
and the wind blows right through the field level.

Parking level has heating fans and dedicated exhausts fans which run continuously.

1.1.3 Existing Energy Use

Monthly utility (gas, electricity and water) data was analyzed for the Rogers Centre for the
period of January 2003 to December 2004. The building is using approximately $4 million
annually in utilities at present. The following summarizes the annual utility use:

<table>
<thead>
<tr>
<th>Rogers Centre Utility Use Summary</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>kWh</td>
<td>32,658,213</td>
</tr>
<tr>
<td></td>
<td>GJ</td>
<td>117,570</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>m3</td>
<td>2,469,789</td>
</tr>
<tr>
<td></td>
<td>GJ</td>
<td>93,358</td>
</tr>
<tr>
<td>Total</td>
<td>GJ</td>
<td>210,928</td>
</tr>
<tr>
<td>Water</td>
<td>m3</td>
<td>143,349</td>
</tr>
<tr>
<td>Electricity Cost</td>
<td>$2,941,390.44</td>
<td>$2,998,203.80</td>
</tr>
<tr>
<td>Natural Gas Cost</td>
<td>$896,563.60</td>
<td>$734,001.29</td>
</tr>
<tr>
<td>Water Cost</td>
<td>$169,920.81</td>
<td>$209,367.75</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$4,007,874.85</td>
<td>$3,941,572.84</td>
</tr>
</tbody>
</table>

Rogers Centre Charrette August 23/24 2005 Sustainable Buildings Canada
Rogers Centre - Energy Use by Source
(in Energy Units)

Natural Gas 44%
Electricity 56%

Rogers Centre Utility Cost Allocations

Natural Gas 19%
Water 5%
Electricity 76%

Average Daily Electrical Consumption

Month

W/h/day

2003 2004
Average Daily Natural Gas Consumption

Month
Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
- 20000
- 15000
- 10000
- 5000
0
Average Water Use

Month
Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec
-200
-100
0
100
200
300
400
500
600
700
800
900
1000
2003 2004
2003 2004
1.2 Summary of Green Globes Assessment

A Green Globes assessment was undertaken by ECD Energy & Environment Canada Ltd. The full assessment is included on Page 30. The key results are as follows:

**Green Globes**

*Energy performance targets*

![Energy performance chart](image)

**Rogers Centre - Green Globes Rating**

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>47%</td>
</tr>
<tr>
<td>Water</td>
<td>25%</td>
</tr>
<tr>
<td>Resources</td>
<td>65%</td>
</tr>
<tr>
<td>Emissions</td>
<td>57%</td>
</tr>
<tr>
<td>Indoor Environment</td>
<td>48%</td>
</tr>
<tr>
<td>EMS Documentation</td>
<td>30%</td>
</tr>
</tbody>
</table>
**Lighting**

T12 Fluorescent lighting and bulb exit lights in garages and service areas.

**Lighting & Controls**

Lighting zones are too big and can not be isolated. Lights are kept on in daylit areas.

**Water**

Potential for water conservation in washrooms and through improved washing procedures.

**Recycling & Waste Reduction**

Opportunities for waste reduction through coordination and consistent signage for different recycling facilities and through communication program to the users.
1.3 Building Energy Simulation

A building energy performance simulation model of the existing building was developed in order to evaluate the current energy utilization and to quantify the energy savings of the potential energy retrofits.

The eQUEST software was used to develop the energy model. eQUEST is an hourly building energy simulation tool, and uses the DOE-2.2 calculation engine. DOE-2 is a widely used and accepted building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, usage, conditioning systems (lighting, HVAC, etc.) and utility rates, along with hourly weather data, to perform an hourly energy simulation of the building and to estimate utility bills. DOE-2 was developed in a collaborative effort between Lawrence Berkeley National Laboratory (LBNL) and James J. Hirsch & Associates, with major support from the U.S. Department of Energy and the Electric Power Research Institute (EPRI). Further details on the eQUEST software are available at www.doe2.com.

A three-dimensional model of the building is generated, comprised of all exterior surfaces and internal energy loads. For each hour of the year and for each space in the building, the simulation calculates internal heat gains, solar loads and building envelope loads. It then calculates the energy required to condition the building to the required setpoints and to provide required ventilation. The hourly values are totaled up to give monthly and annual utility use projections.

The weather used for the simulation is the Canadian Weather for Energy Calculations (CWEC) for Toronto, Ontario. This is a compiled hourly weather set from Environment Canada that uses the most typical values for a number of weather parameters including temperature, humidity, solar radiation and wind speed and direction, based upon a thirty year sample set. This provides the “most average” weather patterns upon which to predict energy savings.
The following shows the summarized output of the energy model of the buildings. Lighting and ventilation (fan energy) make up the largest portions of the electrical energy consumption. Space cooling is also a significant portion of the electrical consumption. The natural gas use is almost entirely for space heating. There is some small summer gas use for the kitchen cooking. Domestic hot water (DHW) is electrically heated except for the hotel area.

In order to examine the validity of the model, the energy use for Jan to Dec, 2004, was superimposed over the model energy use. The following graphs show this comparison. The lines are the actual use while the bar graphs are the model's predicted energy utilization.
There is a good correlation of electrical demand between the model and the actual building demand and between the model and actual gas use. The modeled electrical consumption is a little low suggesting there are more hours of operation for building electrical systems (such as lighting or fans) than currently in the model. This model was deliberately simplified to allow for more rapid calculations during the building workshop. A more detailed model (especially in the building operations schedules) would further improve the correlation with actual building energy use patterns.
Run 1 -- Baseline Design
Run 2 = Run 1 + Lighting retrofit plus Occupancy Sensors
Run 3 = Run 2 + Gas fired hot water
Run 4 = Run 3 + HVAC dampers and variable speed drives
Run 5 = Run 4 + High efficiency fan and pump motors
Run 6 = Run 5 + Boiler optimization
Run 7 = Run 6 + Chiller retrofit
2.0 Building Energy Retrofits

This model was used with the Team Y break-out group in the Charrette.

The group developed numerous energy conservation strategies. Several of these strategies were modeled during the workshop to evaluate their energy impact on the building.

Energy Conservation Measure 1 – retrofitting fluorescent lights in the office areas and parking areas from T12 to T8 lighting technology and adding occupancy sensors to lower energy use in unoccupied spaces.

Energy Conservation Measure 2 – installation of a complementary lighting system for the seating and bowl area to be used for cleaning and move-ins and conversions – not simulated this run.

Energy Conservation Measure 3 – installation of gas fired domestic hot water heaters for the locker rooms and a hot water loop for the SkyBoxes, restaurants and concessions.

Energy Conservation Measure 4 – installation of block dampers to restrict flow of the concourse fans to 100 and 500 level except during events with variable speed drives installed on the supply fans to reduce the airflow volume while still providing ventilation to the office areas.

Energy Conservation Measure 5 – replacement of the fan and pump motors in the facility with high efficiency motors.

Energy Conservation Measure 6 – optimization of the boiler burners to be fully modulating with excess air trim (O\textsubscript{2} trim), burner management controls and possibly a flue gas economizer to recover heat from the stack gases (need a heat sink – such as DHW preheat).

Energy Conservation Measure 7 – chiller replacement with a high efficiency (0.55kW/TR) chiller. Note that this could be achieved with the replacement of 2 of the four chillers in the plant while the remaining two chillers (likely the chillers with VSDs) are retrofitted to a new refrigerant.

The following table indicates the level of energy savings that is achievable from these energy savings retrofits. This is only a sample of the energy savings potential of the building and represents measures which could be quickly simulated for the purposes of the Charrette. Further evaluation of the viability of the measures and the assumptions behind the energy savings is required.
<table>
<thead>
<tr>
<th></th>
<th>Annual Energy Use</th>
<th>Annual Utility Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elect kWh</td>
<td>Nat Gas Thems</td>
</tr>
<tr>
<td>Base Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0+Lighting retrofit &amp; occ sensors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>27,313,594</td>
<td>733,559</td>
</tr>
<tr>
<td>3+VAV for concourse fans</td>
<td>23,594,380</td>
<td>894,325</td>
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<tr>
<td>4+High efficiency motor</td>
<td>22,674,760</td>
<td>902,727</td>
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<tr>
<td>6+Boiler burner opt</td>
<td>22,674,760</td>
<td>864,733</td>
</tr>
<tr>
<td>6+Chiller Retrofit</td>
<td>21,527,534</td>
<td>864,733</td>
</tr>
</tbody>
</table>

**Incremental Energy Savings - savings by measure**

<table>
<thead>
<tr>
<th></th>
<th>Electric kWh</th>
<th>Nat Gas Thems</th>
<th>Electric Total($)</th>
<th>Nat Gas Total($)</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+Lighting retrofit &amp; occ sensors</td>
<td>1,639,886 (6%)</td>
<td>-14,010 (-2%)</td>
<td>$150,462</td>
<td>-$14,760</td>
<td>$135,702</td>
</tr>
<tr>
<td>3+VAV for concourse fans</td>
<td>1,182,618 (4%)</td>
<td>-49,584 (-7%)</td>
<td>$98,251</td>
<td>-$51,864</td>
<td>$46,387</td>
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<tr>
<td>4+High efficiency motor</td>
<td>919,620 (3%)</td>
<td>-8,402 (-1%)</td>
<td>$91,297</td>
<td>-$8,700</td>
<td>$82,597</td>
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<tr>
<td>6+Boiler burner opt</td>
<td>0 (0%)</td>
<td>37,994 (5%)</td>
<td>$0</td>
<td>$39,977</td>
<td>$39,977</td>
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<tr>
<td>6+Chiller Retrofit</td>
<td>1,147,226 (4%)</td>
<td>0 (0%)</td>
<td>$183,729</td>
<td>$0</td>
<td>$183,729</td>
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</tbody>
</table>

**Cumulative Energy Savings - savings including all previous measures**

<table>
<thead>
<tr>
<th></th>
<th>Electric kWh</th>
<th>Nat Gas Thems</th>
<th>Electric Total($)</th>
<th>Nat Gas Total($)</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+Lighting retrofit &amp; occ sensors</td>
<td>1,639,886 (6%)</td>
<td>-14,010 (-2%)</td>
<td>$150,462</td>
<td>-$14,760</td>
<td>$135,702</td>
</tr>
<tr>
<td>3+VAV for concourse fans</td>
<td>5,359,100 (19%)</td>
<td>-174,776 (-24%)</td>
<td>$493,104</td>
<td>-$181,028</td>
<td>$312,076</td>
</tr>
<tr>
<td>4+High efficiency motor</td>
<td>6,278,720 (22%)</td>
<td>-183,178 (-25%)</td>
<td>$584,401</td>
<td>-$189,728</td>
<td>$394,673</td>
</tr>
<tr>
<td>6+Boiler burner opt</td>
<td>6,278,720 (22%)</td>
<td>-145,184 (-20%)</td>
<td>$584,401</td>
<td>-$149,751</td>
<td>$434,650</td>
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<tr>
<td>6+Chiller Retrofit</td>
<td>7,425,946 (26%)</td>
<td>-145,184 (-20%)</td>
<td>$768,130</td>
<td>-$149,751</td>
<td>$618,379</td>
</tr>
</tbody>
</table>

**Table of Potential Energy Savings**
Run 1 -- Baseline Design
Run 2 = Run 1 + Lighting retrofit plus Occupancy Sensors
Run 3 = Run 2 + Gas fired hot water
Run 4 = Run 3 + HVAC dampers and variable speed drives
Run 5 = Run 4 + High efficiency fan and pump motors
Run 6 = Run 5 + Boiler optimization
Run 7 = Run 6 + Chiller retrofit
3.0 Team Notes

3.1 TEAM Z

Green Globes based analysis

A Need for Vision:
- Develop a coherent, integrated long-range plan combining retrofits, green operations, training, marketing- approach from several angles but with a common vision
- Leverage Success e.g., LED Signage

Key Recommendations:
Monitor and Target
- “Walk the talk…”
- Explore Demand Reduction and Distributed Generation

Encourage Integration of divergent Operations
- Example: Power washing (consider impacts on concrete)
  Impacts:
  - power
  - water
  - concrete degradation / maintenance / leakage and mold

Education
- Knowledgeable staff, tenants, and public (Handbook)
- Education and public awareness

Leverage Leadership to Achieve Future Goals

Leadership

Need to Explore partnership potential: Eg. Better Building Partnership

Develop and Maintain Performance Metrics
- $$/Sq. Ft
- $ / Energy as a % of Revenue
- GJ/SqM
- i.e., those that are ‘real’ for Rogers

Need to fully define metrics based on key data inputs

Test Assumptions
- Weather
- Events
- Attendance

Future Retrofits – based on long range vision and life-cycle costing. No separation of capital and operations budgets
Site

Exterior Lighting Review
- minimize exterior lighting where possible
- Reduce ‘night glow’ and ‘light pollution’
- Re-Use water (grey water and rain water)

Energy Efficiency

Chiller Retrofit / Replacement
- Current change from R-11 to R-123 in progress
- Deep water Chilling (corporate leadership)
- Potential of Geothermal to cover both heating and cooling needs

Lighting
- Better controls
- audit

Replace Water Heaters
- Remove individual Skybox water heaters
- Replace electric domestic water heating with natural gas

Boilers
- Economizer
- Explore heat recovery opportunities

Water

Meter Water Use
- Night and Day use
Specific applications

Toilet Flush Valve Retrofit:
   Plus: Minimal cost, ability to maintain existing ‘china’

Uriminals - Ultra-low Flush (1 litre):
   - suggestion not to use waterless as more maintenance may be necessary

Harvesting of Water:
   - Grey water systems
   - Waste water heat recovery
   - Use water for heat sink potential

Check Compressors and Water Cooled Equipment
   - Eliminate once through cooling
   - Utilize return for boiler make-up

Emissions

- NPR Reporting: Good News Story
- Future: Level of Assurances
   - Province: NOx / Sox
   - Federal: GHG

1) Implementation of Energy Efficiency and Water Efficiency measure will continue to improve the favorable emission profile of the Rogers Centre.

2) Great means to scorekeep success

Indoor Environment

- Re-balance of ventilation Controls
- Demand based ventilation
- Variable speed drives
- Tennant Survey of Ventilation Satisfaction
- Control input of fresh air
- CO2 Monitors
- Coordinate Mechanical Systems

Unresolved Issues
   Split Hotel and Stadium Functions
3.2 Team Y

**Tracking and Automation**

**Tracking**
- Expand submetering & calibrate existing meters
- Better tracking & reporting of energy use – tie into operations
- Improve energy use reporting to tenants
- Energy & demand monitoring
- Water metering of tenants (separate meter for hotel?)
- Profiling & benchmarking

**Building Automation System**
- Current system is old and not expandable
- Replace with current system to control all existing and new systems

**Lighting and Electrical**

**Lighting Retrofit Measures**
- Lighting retrofits – T8 or T5 for parkade, offices & ramps
- Alternate lighting source for field lighting during cleaning / move-in – 750 MH pulse start - longer lamp life, energy savings, better zoning, economy
- Pulse start HID or fluorescent for concourses (lighting levels too low) – reflectors for improving lighting
- Daylighting for ramps – paint with high reflective paint – other areas?
- EXIT signs – LED or photo-luminescence (PLM)

**Lighting Controls & Operations**
- Occupancy sensors for washrooms, storage areas
- Re-circuiting for controlling lighting (& TV’s & other systems) for building zones to match occupancy patterns
- Expand central lighting control.
- Implement daylighting for offices on exterior walls.
- Rogers staff to maintain tenant area lighting
- Comprehensive lighting audit recommended.

**Electrical**
- High efficiency motor replacement
- Power Factor correction - .88 to .91
HVAC and Hot Water

**Boilers**
- Burner optimization
- Boiler burner control improvement – O2 trim
- Operation strategies – part load and scheduling of multiple boilers
- Enbridge boiler audit

**Cooling**
- Expand capacity of one water economizer
- Install second water economizer on other side of buildings
- R-11 conversion envisioned for chillers Replace 2 chillers with high efficiency chillers (reduce from 0.8 to 0.55 kW/TR).
- Thermal cold storage – remove one chiller from each side and replace with ice storage bank to handle peaks and benefit from peak electricity costs

**Ventilation**
- Concourse ventilation serves multiple areas – recommend either new HVAC for offices separate from concourse systems, or zone dampers to permit separation of systems.
- Secondary option of block damper arrangement to deliver office ventilation without supplying (minimizing) concourse supply

**Loading Dock Area**
- Why wind tunnel effect – where is air going? – Roof?
- Infra-red heating in dock area
- Limit dock loading door opening heights (for vertical doors)
- Quick operating doors with sensors and smart controls

**DHW heating**
- Consider tankless heaters (to reduce standby losses due to prolonged periods of non-use), or
- Install controls on Skybox DHW heating to turn off when not required

**HVAC**
- Insulation audit of mechanical systems (air & water).
- Better thermostat control – integrate into BAS
Cogeneration and Energy Harvesting

Cogeneration Economics

- Annual power consumption: 33,000,000 kWh
- Annual power cost: $3,200,000
- Cost/kWh: $0.097 kWh
- Annual gas consumption: 2,460,000 m³/yr
- Gas cost: $0.30/m³
- Initial cogen size: 2.4 MW (based on current load profile)
Cogen Economics for 2.4 MW System

**Savings:**

Generator avoided energy charge ($): 1,929,289
Generator avoided demand charge ($): 0
Boiler avoided fuel cost ($): 675,783
Total annual savings: 2,605,073

**Costs:**

Engine gas consumption ($): 1,582,969
Engine maintenance costs ($): 248,620
Total annual costs: 1,831,589
Net savings: 773,484
Optimization through Absorption Cooling

Additional Cogeneration Considerations
- Increase power generation capacity to power entire Rogers Centre
- Utilize excess capacity for peak shaving
- Incorporate absorption cooling to utilize recovered heat during Summer months
- Incorporate thermal storage to optimize power plant operation

Energy Harvesting
- Solar shading on south side, or window film
- Improving daylighting with light shelves to push light into office areas
- Solar heat harvesting on ramp concrete structures
- Solar collectors on spandrel between two ramps on south side
- Ventilation for exterior rooms using dedicated air systems with heat recovery

<table>
<thead>
<tr>
<th>Incremental Energy Savings</th>
<th>Total Electricity kWh</th>
<th>Total Nat Gas Therms</th>
<th>Elect total $</th>
<th>Nat Gas total $</th>
<th>Total $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting retrofit &amp; occ sensors</td>
<td>1,399,010 5%</td>
<td>-14,828 -2%</td>
<td>$128,412</td>
<td>$(15,624)</td>
<td>$112,788</td>
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<td>Concourse fan control</td>
<td>461,625 2%</td>
<td>6,245</td>
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<td></td>
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<tr>
<td>High efficiency motor</td>
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<td>$103,421</td>
<td>$(12,068)</td>
<td>$91,353</td>
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<tr>
<td>Boiler burner opt</td>
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<td>34,652 5%</td>
<td>$ -</td>
<td>$36,461</td>
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<td>Chiller Retrofit &amp; free clg expansion</td>
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<td>0 0%</td>
<td>$182,122</td>
<td>1</td>
<td>$182,123</td>
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</table>

| Total                                      | 4,088,925             | 14,485               | $309,937      | 13%             | 8%      |

Rogers Centre Charrette August 23/24 2005 Sustainable Buildings Canada
3.3 Team X

1. Renewable Energy Strategies
2. Water Consumption
3. Waste Management

Guiding Principles

- Leadership from the top
- Clear published corporate policy
- Importance of education
- Setting realistic, measurable targets and monitoring progress
- Systems thinking: integrated design even at retrofit/renovation phases

1. Renewable Energy Strategies

The group listed all of the renewable energy options that might be applicable to the Rogers Centre, discussed how they might be applied, and evaluated them according to four criteria:

a) Technically feasible
b) Innovative (would this be breaking new ground for use of this technology, either in this region or in this type of facility?)
c) Educational (would it be highly visible and/or lend itself to being highlighted as part of an educational program for visitors and the community?)
d) Economically viable (a return on investment of under 5 years)

The options considered were as follows:

i. Free air cooling during winter

The building could make use of heat exchange by ventilation and recovering energy and conditioning inside air.

This option was graded as being technically possible and economically viable.

ii. Lake water cooling

Enwave supplies chilled water through underground pipes. This could be used for space cooling for this building. Metro Hall has already switched to this technology and it may be a simple matter of working out the economics and negotiating the details.

The existing chillers may left in place and used as a standby system.

This option was graded as being technically possible, innovative, somewhat educational and economically viable.
iii. Solar

a. **Photovoltaic (PV)**

PV panels could be installed on the walls and fixed portions of the roof. Semi translucent panels could be installed as the roofs for covered walkways, where they would also provide shade. In peak summer periods energy can be stored during day time and used as emergency lighting during night or can be fed into the grid, and “net metered”. Efficiency and cost would be issues to consider. At current prices, use of PV panels would be more for demonstration and education purposes than for cost savings. Case studies could be checked for details.

This option was graded as *educational, technically viable and innovative*.

b. **Natural Lighting**

A lot of metallic surfaces like metallic blinds, metallic decorative pieces could be used to reflect more daylight into the building. Sensors could be used with blinds so that as the natural light levels go down, the building light levels increase to avoid discomfort to the people working.

Some of the panels of the roof of the building might be changed to translucent panels in order to light up interior spaces.

This option was graded as *somewhat educational, economically viable, technically possible and innovative*.

c. **Domestic Water**

Some washrooms and all corporate suites in the building are using 3 kw heaters for their own hot water. Domestic hot water panels could installed, with the hot water fed to various quadrants around the building, including washrooms and suites. Gas boilers can be used as a stand by system.

This option was graded as *educational, technically possible and economically viable*.

d. **Passive Solar Heating**

Heat energy entering the building either through an open roof or through a passive “solarwall” installation can be stored in a medium and used later on.

This option was graded as *somewhat economical, economically viable, technically possible and innovative*.

iv. **Geothermal**

Installing geothermal energy for heat exchange would involve drilling several hundred holes of around 6” diameter into the rock at a depth of around 300 m. Water is run through pipes in
these holes which becomes a source of heating in winter. The water going back to ground cools the water and this becomes a source of cooling in spring and summer.

The holes could be drilled in the parking lots around the building, and possibly under the field itself. The payback for this system is around seven years. Some back up capacity for heating or cooling would still be required.

This option was graded as *somewhat educational, economically viable, technically possible* and *somewhat innovative*.

**v. Wind**

Several wind turbines (vertical) could be designed for and installed outside the building. This would serve as a major educational opportunity with medium-term return on investment.

This option was graded as *educational, somewhat economically viable, technically possible* and *somewhat innovative*.

**2. Water Consumption**

The costs of energy and water consumption are closely linked. The cost of water is estimated to increase by around 6% in the next 5 years. The following steps can be taken to decrease the water consumption of the building:

i. Conduct a thorough independent audit of current water use practices, segregated by zones and types of use.

ii. New sensor-based products need to be installed in the bathroom facilities including toilets and urinals.

iii. Mechanical room has a lot of small leakages which need to be addressed.

iv. Metering and monitoring systems need to be installed. Each area should pay its own water bill.

v. Creative recycling needs to be explored (e.g. greywater re-use)

vi. Rain water harvesting can be done using overhead or underground storage. This water could be used for toilets, washing the stadium seats, washing of sidewalks, irrigation etc. This would require having two separate pipes, one for storm water and one for drinking water.

vii. Sub metering should be made manager’s responsibility.

viii. Educational programs for all the above should be worked on.
3. Waste Management

At present, the only thing being recycled in the building is paper and everything else is being sent to the landfill.

The following actions can be taken to improve the waste management of the building:

i. An independent waste audit is a must.
ii. Signage regarding waste disposal and recycling throughout the building needs improvement.
iii. Purchasing policies/contracts need to include clauses that restrict the number of materials brought into the building by all vendors, and need to specify a list of approved recyclable materials.
iv. Arrangements to be made for composting of organic disposals.
v. Restrictions to be enforced on what is to be brought into the building by spectators.
vi. The sorting system for recyclables should be/look the same as the city’s so that people do not get confused and can use the system easily.
vii. Training must be provided to all staff and responsibility appropriately assigned to all managers and staff.
viii. Target setting and monitoring the same is a must.
GREEN GLOBES

Industrial and sport occupancies
Rogers Charrette Report

Building: Rogers Centre
Owner: Rogers’s Communication
Date: August 19, 2005
Ref. No: 05-045

ECD Energy and Environment Canada Ltd.
Tel: 416 699 6671
Fax: 416 699 9250
E-mail: jiriskopek@sympatico.ca
Executive Summary

This Green Globes Report is a follow-up to the original report completed prior to the Sustainable Buildings Canada (SBC) Roger’s Centre Charrette held August 23, 2005. The initial assessment of the Roger’s Centre established current the level of sustainability based on the BOMA Go Green Comprehensive™ survey for existing buildings. The goal of Go Green is to assess individual building systems and management structures to showcase areas of environmental stewardship, and highlight areas where improvements to building systems or operations can result in a reduced ecological footprint and increased cost savings.

The initial assessment of the Roger’s Centre resulted in an overall rating of 47%. This is based on criteria which include; energy efficiency, water usage, resources consumption, levels of emissions, and quality of the indoor environment. Additionally, the report assessed existing corporate policy regarding environmental targets and goals.

As a result of the group presentations a revised Green Globes report was generated using the combined recommendations from all three groups. It is projected that if all of the recommendations were implemented the Rogers Centre would have an overall Green Globes rating of 74%. The recommendations are broadly based, reflecting the diversity of professional expertise of the participants, and include both capital intensive physical interventions as well as procedural changes that entail minimal initial capital investment.

The group presentations revealed a number of specific areas where all two or more groups were in agreement on particular recommendation. This report includes all of the recommendations provided by the participants, and provides more detailed information in areas where there are overlaps of recommendations within the groups.

The intent of this report is to inform, educate, and guide the Rogers Centre’s senior management of the Charrette’s recommendations. The goal is to make the recommendations clearly applicable to staff so that as progress moves towards implementation, managers are aware of the technology, requirements, and impacts of the various solutions.
INTRODUCTION

Rogers Centre is a 10 storey, 2,000,000 square foot building that was built in 1989 and is described as follows:

Rogers Centre is the world's first multi-purpose retractable domed stadium. The building area is approx 2 million SF; it is assumed that 1.2 million is heated. There are ten levels and height is equivalent to a 31 story building. The complex also includes a hotel which, prior to the sale of the stadium to the Rogers Communications, operated together with the stadium. Since the sale, the hotel is operated as a separate entity.

The building has a very high electrical base load and a significant weather sensitive (cooling) electrical load. Lighting is a large portion of the load (there are dozens of 4kW lamps in the dome area). The majority of fluorescent lighting is T12. The building mechanical systems consists of 4 large (2x500 & 2x600 bhp) modulating, natural gas fired hot water boilers for space heating and 4 x 1200TR R-11 chillers for cooling. There are constant volume fans for the seating area (these are off when dome open) and constant volume supply fans for concourse areas. There is a HVAC automation system (Johnson Controls) and lighting automation system (PDM). DHW heating is largely electric

There is no significant envelope insulation but a very high thermal mass. The dome opening involves much more of a heat gain than loss. It is only opened for baseball games and some football games in the summer/fall – and only just for game time (unless outdoor conditions are good for ambient cooling). It is not opened in the winter. There was a pneumatic sealing system for the roof but it has been abandoned due to operational problems and it is now sealed with rubber gaskets. Air sealing would be challenging. There is no sealing between the concourse and the seating area – probably not feasible. When the loading doors are open, that there is considerable air leakage into the dome area. This is especially problematic in the winter when there are long periods of open doors for show set-ups, particularly in February for the Car Show.
**Green Globe Rating Summary**

Original Percentage of points achieved by Rogers Centre for each module:

<table>
<thead>
<tr>
<th>Module</th>
<th>Original Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>47%</td>
</tr>
<tr>
<td>Water</td>
<td>25%</td>
</tr>
<tr>
<td>Resources</td>
<td>65%</td>
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<tr>
<td>Emissions</td>
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<tr>
<td>Indoor Environment</td>
<td>48%</td>
</tr>
<tr>
<td>EMS Documentation</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Rogers Centre achieved an overall rating of 47%.*

New score based on the Charrette recommendations:

<table>
<thead>
<tr>
<th>Module</th>
<th>New Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
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<tr>
<td>Water</td>
<td>85%</td>
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<tr>
<td>Resources</td>
<td>72%</td>
</tr>
<tr>
<td>Emissions</td>
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<td>Indoor Environment</td>
<td>65%</td>
</tr>
<tr>
<td>EMS Documentation</td>
<td>97%</td>
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</tbody>
</table>

*Rogers Centre achieved an overall rating of 74%.*
To find out how the performance of Rogers Centre compares to other buildings that have been assessed, and to obtain certification, the data must be verified by a licensed assessor who has undergone the Green Globe training and certification.

---

**ENERGY**

Energy is an important operational cost as well as an environmental parameter because energy use relates directly to climate change and global warming as well as a variety of air emissions. These atmospheric emissions include hydrocarbons, CO$_2$, and airborne particles as well as sulphur dioxide and oxides of nitrogen which produce acid rain. From a cost perspective, there is a direct relationship between energy savings and cost savings.

*Rogers Centre received an initial score of 47% based on the assessment of best-case practices for energy efficiency in light industrial buildings. This score has been revised to 70% based on improvements in lighting systems, boiler efficiency, hot water systems, installing variable speed drives, and implementing a written energy management policy.*

---

**Energy Consumption**

Rogers Centre achieved a score of 80% for its energy consumption. Based on the reported consumption of 2,460,684 m$^3$ of gas and 33,020,034 kWh of electricity for the period of twelve months ending December 2004, the current energy performance of Rogers Centre for that period was 48.56 kWh/sf-yr. Carbon dioxide emissions were 14,917.91 tonnes/yr. Energy costs were $3,732,205. The initial assessment found that the annual savings potential was in the order of $825,600. The charrette participants identified and addressed over $420,000 in annual energy savings, however there is the additional potential of over $400,000 in energy savings if all of the energy saving measures listed below were implemented.

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**Energy Efficiency Features**

*HVAC systems, lighting and heating of water use large amounts of energy. Rogers Centre achieved an initial score of 24% based on a review of individual features of the building fabric and services that would be expected to affect the building's energy use and hence its carbon dioxide emissions. This score has been revised to 75% based on the charrette’s recommendations which include new water conserving features, elimination of once-through cooled equipment, and introducing graywater and rainwater collection systems to replace non-potable water applications.*

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Rogers Centre Charrette  August 23/24 2005  Sustainable Buildings Canada
HIGHLIGHTS

Rogers Centre has the following energy-efficiency features:

Lighting

Energy efficient lighting that includes:

- some compact fluorescents
- some light emitting diodes (LEDs) on exit signs
- high intensity discharge (HID) lamps
- provision of task-lighting at office workstations

High efficiency lighting accounts for less than 50% of the building’s lighting.

Boilers

The boilers are less than 20 years old.

Controls

Temperature setback and weather compensation are implemented.

There is a partial BAS (building automation system).

Hot Water

The building has aeration faucets, which serve as a hot-water saving devices.

Hot water is blended (hot and cold water are mixed) and maintained between 50-55°C

Envelope

A condition assessment of the building envelope has been carried out as a part of due diligence during the sale to Rogers Communications in 2004.
**SBC Charrette Recommendations**

The following recommendations were explored by the charrette participants as ways of improving the energy efficiency and reduce costs at the Rogers Centre. These solutions as well as the additional recommendations below are offered for consideration; however to ensure optimal results experts should be consulted.

**Lighting**

Replace the current T12 fluorescent lighting throughout both the building and parking areas. Re-lamping with energy efficient lighting is one of the most common building retrofits because it can produce significant savings. For example:

- Install T8 or T5 fluorescent lamps for general-purpose lighting
- Complete the conversion to LED exit lights throughout the building
- Install daylight sensors, or occupancy sensors in areas such as mechanical spaces, stairwells and storage rooms,
- Implement a timed automatic shut-off system for all non-essential lighting during unoccupied hours.

Fully implement a high efficiency lighting retrofit throughout 100% of the building

**Boilers**

Currently there are two 500 bhp and two 600 bhp boilers. As the boilers are approaching their life expectancy (currently boilers are 15 years old), consider either replacing the boilers with high-efficiency modulating or condensing boilers, or retrofit boilers and install heat recovery systems, automatic vent dampers to restrict heat loss up the chimney, or other higher efficiency systems.

**Controls**

The Rogers Centre current Johnson Controls HVAC system and PDM lighting control system are not upgradeable and lack detailed control. All three charrette groups agreed that it would be advisable to replace the current system with a computer controlled system that will allow for more control and monitoring of activities within the Rogers Centre.

**Hot Water**

Hot water was identified by all of the groups as an area that needs to be addressed as the building undergoes future retrofits. Participants suggested that the domestic hot water systems in the Skyboxes be replaced with a tankless (instantaneous) hot water heating unit as usage is

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**Informational Resources:**

1. Continental Automated Building Association  
   [http://www.caba.org/links/tour.html](http://www.caba.org/links/tour.html)
2. Building Automation Systems General Information  
   [http://www.advancedbuildings.org/main_t_load_build_automation_sys.htm](http://www.advancedbuildings.org/main_t_load_build_automation_sys.htm)
occasional and does not necessitate a hot water tank for each box. Consideration was also given to installation of a solar water heating system along the roofline of the building.

**Other Energy Efficient Features**

Include high efficiency features such as:

- Infrared heating was identified as an option to reduce heat loss in the loading dock areas and areas that are exposed to outdoor temperatures during event set up or take down.
- All of the groups agreed that energy efficient motors on fans, pumps, and variable speed drives could easily be connected to existing equipment and offer a simple cost effective method for reducing energy consumption.
- Waste Heat Recovery systems for domestic hot water were identified as a potential energy savings system that could be retrofitted to existing infrastructure.
- All of the groups discussed deep lake water cooling as a long-term replacement option for the existing chillers.

**Green Energy**

The ability to specify ‘Green Energy’ in energy contracts will soon be available in Ontario. Although there is a premium to supply this service it will have the beneficial effects of stimulating and further developing the green energy field in the Ontario and reducing future costs. It also has value as a public relations and marketing tool.

Development of on-site renewable energy sources including active solar, wind, photovoltaics, and ground source were identified as sources of future energy needs. The development of these resources would provide the public with a visual demonstration of the Rogers Centre’s commitment to renewable energy, and could also provide an educational opportunity for both the stadiums visitors and city residents. The renewable energy systems should account for more than 10% of total energy supply.


**Envelope**

Consider installing shading devices appropriate to the Rogers Centre. Exterior shading by sun screens, deciduous trees, awnings, solar blinds or low-e film over large glass areas can reduce solar heat gain by 55%. Overheating can be also reduced by green roofs and high-albedo (reflective) roof coatings.

Given the large energy peak associated with the delivery of cars for the Car Show in February, a number of measures that could decrease the heat loss in winter months and result in reduced heating costs. Consideration was given to building a vehicle entrance lobby within the building structure. This is the most effective solution, but it is also the most expensive.

Other options include:

- Fit motorized, insulated doors to loading doc entrances that are only used occasionally, complete with:
  - clear operating instructions;
  - an interlock to turn off the heating when the door is open;
  - an audible alarm, which triggers after the door has been open for a pre-set time.
- Insulate access doors. Standard U-value for vehicle access and similar large doors is 0.7 W/m²°C.
- Fit plastic strip curtains or fast-acting doors to regularly used goods entrances.
- Provide separate personnel access alongside goods doors.
- Provide pneumatic seals around vehicle loading bay doors.
- Pressurize the building using a make-up air heater.
- Heat the loading dock areas using gas-fired infrared heaters.

**OPPORTUNITIES FOR IMPROVEMENT**

Consider innovative energy efficiency measures, such as:

- a solar preheated ventilation air system (solarwall)
- thermal insulation coating
- other energy-saving systems, measures or technologies

**Envelope**

Given that the PVC roof membrane needs repairs, investigate the use of high albedo roof coating. As the building undergoes future retrofits, consider replacing existing doors and windows with high-efficiency units. Weather stripping and window film will increase the thermal performance of existing doors and windows.
The building's heating, cooling, ventilation, and lighting systems should be compartmentalized on an occupancy/zone basis. Ensure air-tightness between differing occupancies/zones.

Conduct air-sealing of the top part of the building, including mechanical penthouses.
Conduct air-sealing of the bottom part of the building, including parking areas and entrance doors.
Conduct air-sealing of the vertical shafts and elevators, if applicable.

Investigate the energy-saving potential of increasing the wall insulation based on the recommendations of the building condition report. Application of the insulation should be guided by the *Model National Energy Code for Buildings* (MNECB).

### Energy Management

*A comprehensive energy management program can contribute significant savings to the bottom line. Many energy management measures can be low cost or cost nothing at all. Rogers Centre achieved an initial score of 38% for energy management, if all of the charrette recommendations were implemented the energy management score would be 53%.*

#### HIGHLIGHTS

##### Energy Audit

An energy evaluation has been conducted as part of due diligence during the sale of the Centre to Roger's Communications.

##### Financial Resources

Since the sale to Roger’s Communications, there are financial resources available to improve the energy efficiency of the building.

##### Sub Metering

The building has Carma sub-metering to monitor 8 major tenants: e.g. Ticketmaster, Dome Productions, Fitness Centre, Hotel, Blue Jays etc.

##### Maintenance Schedules

There is a regular maintenance schedule for the mechanical systems and building envelope that includes:

- checks on the correct operation of the HVAC plant and air distribution system
- checking of temperature, humidity and fresh air controls to ensure they are set correctly and are responding as intended

There is a rudimentary preventive maintenance program for the building systems and envelope. The system does not include tracking when the repairs were carried out.
SBC Charrette Recommendations

Energy Policy

Develop and implement an energy policy for the building that expresses a commitment to establish targets, define responsibilities, monitor performance, conduct an annual review and report the results of the review.

Energy Management, Monitoring and Targeting

Monitor major energy uses of the building by using energy meters connected to a fully integrated Building Automation System.

Take steps to analyze and reduce peak energy demand by installing features such as thermal cold storage systems which would replace chillers with ice storage banks to handle cooling loads.

Energy Training

Ensure that building staff are sufficiently trained to design and implement an energy efficiency improvement programs, as this is a key factor to ongoing energy savings. Training needs are identified for each employee, and updates are provided regularly.

Sub Metering

Expanding the energy monitoring capacity of the Rogers Centre could help identify, isolate, and mitigate energy consuming systems.

Informational Resources:

1. Energy Submetering

Maintenance Schedules

Ensure that there is a regular maintenance schedule for the mechanical systems and building envelope that includes:

- checking of temperature, humidity and fresh air controls to ensure they are set correctly and are responding as intended

Develop a preventive maintenance program for the building systems and envelope.

Opportunities for Improvement

Consider the following best practices that could produce savings for Rogers Centre.

Energy Management, Monitoring and Targeting

Rogers Centre Charrette         August 23/24 2005         Sustainable Buildings Canada
Prepare an energy management (reduction) plan to address energy issues raised in the energy audit.

Setting realistic targets can serve as a basis for establishing benchmarks and comparing the energy performance over time.

**Operating Manual**

Provide an easy-to-follow manual that lists all the services contained within the building, with a description of function, operating instructions, standard control settings and basic troubleshooting.

**Maintenance Schedules**

Currently the building systems manuals are stored in the plan room. A systems maintenance schedule reduces energy consumption by improving the efficiency of the various systems. Consider as part of the regular maintenance schedule:

- measurement of boiler efficiency
- checks on the correct operation of ventilation and cooling controls
- identification and investigation of all occurrences of excess energy use
- checking of air-supply grilles to ensure that they are not blocked and are delivering fresh air as required
- checks for refrigerant leaks.

Set up a comprehensive preventive maintenance program for the building systems and envelope.

**Transportation**

_A daily journey totaling as little as 8 km by car can, over one year, emit as much CO₂ as that emitted to provide heat, light and power for a person in an office. Rogers Centre received a score of 69% for providing alternatives to automobile commuting._

**HIGHLIGHTS**

**Public Transportation**

There is access to public transport within 500 meters of the building.

There is service at least every 15 minutes during rush hour.

**Cycling Facilities**

There are changing facilities and showers for building tenants and staff.
Other Measures

There are measures to facilitate and promote public transport and carpooling. They have been described as: Proximity to transport nodes

OPPORTUNITIES FOR IMPROVEMENT

Cycling Facilities

Install bike racks for minimum 5% of staff and spectators. Ensure they are sheltered from rain.

Vehicle Fleet Management

While Roger’s Centre uses some electrical utility vehicles, the majority are gas or propane. This is because the electrical vehicles had a short operational capacity and needed frequent recharge. Investigate the possibility of purchasing alternative fuel vehicles. Consider installing alternative fuel re-fueling stations either on-site or within reasonable proximity.

Develop a policy that requires at least 50% of new cars, vans and light trucks purchased in the current fiscal year to use alternative fuels such as ethanol, methanol, propane, natural gas, hydrogen or electricity. The main advantage of electrical vehicles is that they do not pollute indoors and therefore result in reduced need for ventilation.

Water

This section assesses the water-conserving features of the building as well as its water management. A successful water management program begins with an understanding of how the facility and its spectators use and dispose of water. This makes it possible to plan effective measures to achieve reductions.

*Rogers Centre achieved an initial score of 25% for installing water-conserving features and implementing water-management best practices. Based on Charrette recommendations the Rogers Centre could achieve a score of 85%. The reported consumption of 159100 m³ for the period of twelve months ending December 2004, the water consumption of Rogers Centre is less than 2.0 m³/m²/year. Water costs were $209,368.*

HIGHLIGHTS

Water Conserving Features

The building uses the following water-conserving fixtures:

- low flow faucets (7.5 liters/min.)
Figure 1: Push-rod sink faucets and standard urinals in the washroom areas.

SBC Charrette Recommendations

Water conservation was identified early in the Charrette as an opportunity for major improvement.

Water Conserving Features

The once-through cooling systems used throughout the building should be removed and replaced with a circulating system that better manages water consumption.

Water fixtures are nearing the end of their lifespan. Replacement strategies can include:

- low flow toilets that use less than 6L/flush
- low flush urinals that use less than 3L/flush or waterless urinals
- full conversion to automatic valve controls and/or proximity detectors
- low flow showerheads (9.0 liters/min.)

Relevant Programs:
1. City of Toronto Toilet Replacement Program
   http://www.city.toronto.on.ca/watereff/multi_flush/index.htm

Informational Resources:
2. Water Conservation
   http://www.wbdg.org/design/water_conservation.php

The power washing of the spectator areas was a particular area of concern for both the long-term integrity of the concrete and the excessive water consumption. Although water-alternative solutions exist a water system remained the most viable. However a number of improvements were suggested including using rainwater cisterns or grey water systems. Employees should also have training regarding the washing and be instructed to only use as much water as is required. Other preventive measures could be used to reduce the water need for cleaning, such as communication and signage strategy aimed at spectators to reduce litter and through better organized recycling programs.
Figure 2: Stadium seating indicating an area where the cleaning water is collected and sucked out.

Collection of rainwater from the roof was seen as a viable non-potable water supply for cleaning and irrigation and could have a major impact on overall water conservation.

**Water Management**

Establish a written policy intended to minimize water use, and encourage water conservation which includes regular monitoring.

A comprehensive water audit should be undertaken to understand current consumption rates and illustrate areas where saving are achievable. Water audits should be done approximately every three years.

Establish and document water reduction targets.

Establish procedures to check for and fix leaks in the building’s plumbing system.

---

**RESOURCES**

Buildings consume many resources, including the land they are built on, the materials used in their construction, the products used for their maintenance, and the equipment and products used by the tenants. This section evaluates the waste generated by the building as well as site stewardship. The original building materials used in the construction of the building are not included in the assessment of existing buildings.

*Rogers Centre initially achieved 65% for managing resources through waste reduction and site stewardship. If all of the Charrette recommendations were implemented the centre would achieve a score of 72%.*

Rogers Centre Charrette August 23/24 2005 Sustainable Buildings Canada
Waste Reduction and Recycling

Buildings generate a large quantity of waste in addition to waste paper. Rogers Centre originally achieved 18% for implementing best practices for waste management. The charrette identified a number of areas where gains could be made which would improve the Rogers Centre score to 36%.

HIGHLIGHTS

Durability

There is suitable protection of exposed parts of the building from vehicles and weather.

SBC Charrette Recommendations

Waste Reduction Workplan

An independent waste audit should be completed outside of the report conducted by Turtle Island. It would give an unbiased opinion of current waste streams and areas of improvement.

Programs that reduce the volumes of waste generated (Reusable beverage containers, food trays, etc.) and reduced consumption of packaging and non-durable goods should be implemented. Recycling programs should strive to achieve high waste diversion rates. Establish waste-reduction targets.

As the main concourse will be undergoing renovations in the near future the feasibility of recycling construction, renovation and demolition waste should be considered. There should be a written policy that is intended to minimize the reduction of construction waste being sent to landfill.

Informational Resources:
1. Developing a Waste Reduction Workplan
   http://perc.ca/waste-line/rrr/wrap/develop.html
2. Implementing a Waste Reduction Workplan
   http://perc.ca/waste-line/rrr/wrap/implement.html

OPPORTUNITIES FOR IMPROVEMENT

Facilities for Storing and Handling Recyclable Materials

Set up a recycling and waste reduction program. Make provisions to store and handle recyclables such as office paper, newspaper cardboard, plastic, cans, and bottles, for both tenants and operations at the site. Ensure that the building's spectators are aware of the type of
products collected and of the name and contact information of the recycling company that removes them.

Set up a waste reduction communication program for the spectators.

Provide collection points for separating paper, glass, metal and plastic at or near the areas where waste is generated.

Provide facilities for the recycling of the following operational wastes:

- oils and lubricants (such as motor oil, and brake, power steering, transmission, and suspension fluids)
- oil containers
- anti-freeze
- coolants and refrigerants
- batteries
- paint thinner and other solvents

Establish a fluorescent and high-intensity discharge (HID) lamp recycling program.

Where the facility involves processing or consumption of food consider providing composting, either on-site or centralized (off-site) for spectators' food scraps and any outdoor or indoor landscape waste.

**Site**

*Rogers Centre achieved 100% for measures to minimize the impact of the building on the site and/or to enhance the site.*

**HIGHLIGHTS**

**Site Pollution**

The site is known to be free of contamination. A document search has been conducted and there is no reason to suspect that the site is contaminated.

**EMISSIONS, EFFLUENTS AND POLLUTION CONTROLS**

For the purposes of this evaluation, pollutants include emissions from boilers, ozone-depleting substances found in refrigerants and fire-fighting equipment, asbestos, PCBs, radon, pesticides, and hazardous materials such as those found in cleaning products, lubricants, water treatment chemicals and fuels. Their environmental impacts relate to the degree of toxicity of each product and their release into the environment.
Rogers Centre achieved an initial total score of 57% for having in place emissions, effluents and pollution controls as well as good management practices for hazardous products and waste, health and safety, WHMIS, and for providing safe drinking water. The charrette explored a number of opportunities for improvement which would result in a new score of 72%.

### Air Emissions

Rogers Centre achieved an original score of 0% based on the emissions rate of its boilers and boiler maintenance. The post-charrette score is estimated at 71%.

**SBC Charrette Recommendations**

**Boiler Emissions**

As existing boilers reach the end of their useful life, consider replacing them with high-efficiency, low-emission boilers. High efficiency boilers not only reduce emissions - but also energy consumption by about 20%. The maintenance requirements of both conventional and low-NOx burners are minimal, comprising an annual check and cleaning. However, because low-NOx boilers require more burners, this may slightly increase maintenance costs.

**OPPORTUNITIES FOR IMPROVEMENT**

**Boiler Emissions**

Keep records of annual or six-monthly maintenance and monitoring of heating equipment i.e. cleaning of burners, monitoring of controls, and analysis of flue gas.

Where applicable, quantify and report air emissions and apply for Certificates of Approval for equipment releasing emissions to the environment.

Ensure that emissions from the facility are quantified and reported (in Ontario as per regulation 127/01).

**Vehicle Emissions**

Implement a policy of pre-trip checklists, regular tune-ups and regular inspection of the emissions control systems for all vehicles.

### Ozone Depletion

Rogers Centre achieved an initial score of 34% based on its use and management of refrigerants and fire-fighting systems. The charrette participants found a number of opportunities that would improve the score to 44%.

**HIGHLIGHTS**

**Refrigerants**

Rogers Centre Charrette August 23/24 2005 Sustainable Buildings Canada
Management of Ozone Depleting Substances

There is a maintenance contract with a certified contractor for the cooling system.

Halon

There are no halon-based fire protection systems within the building.

SBC Charrette Recommendations

Management of Ozone Depleting Substances

The conversion of the existing chillers to R11 should be expanded to a general phase-out of all ozone depleting coolants throughout all of the building as part of a larger upgrade of refrigeration units. Deep Lake Water Cooling should be investigated.

OPPORTUNITIES FOR IMPROVEMENT

Refrigerants

The building is cooled with R11 (CFC 11), which has an ozone-depleting potential (ODP) of 1.0 and a global warming potential (GWP) of 1500. Consider conversion to refrigerant with ODP=0 (e.g. R 123).

Install high efficiency purge.

Management of Ozone Depleting Refrigerants

Provide a management program for ozone-depleting substances (ODS) which includes:

- inventory of refrigerants and records
- maintenance reports, loss reports, and leak test results
- operational staff training
- periodic leak testing

Document a phase-out plan for ozone-depleting refrigerants, such as CFCs, that will result in the use of refrigerant with an ODP of zero. Note that under Canada's Strategy to Accelerate the Phasing-out of Uses of CFCs and Halons, there is a ban on refilling and topping up existing equipment using these substances.

Water Effluents

Rogers Centre achieved 40% based on best practices to manage liquid effluents.
HIGHLIGHTS

Waste Water Effluents

Roof drains are disconnected from sanitary or combined sewers.

Snow piles are located to minimize the effects of spring run-off on the environment (i.e. run-off is controlled and monitored).

The application of chemicals to control ice hazards is minimized, while still protecting the safety of personnel.

OPPORTUNITIES FOR IMPROVEMENT

Waste Water Effluents

Protect floor drains in areas where chemicals are stored. At a minimum, there should be containment of hazardous materials. This can consist of large secondary containers for storing the materials.

Waste Water Effluents Management

Consider reducing the amount of water that flows off the property, for example, by installing porous paving, increasing vegetation or installing rain-water catchments systems.

Consider on-site treatment of water run-off from hardscapes.

Establish and monitor the procedures for flushing cooling coils containing glycol to ensure that glycol losses to the drain are minimized or eliminated.

Hazardous Materials

Rogers Centre achieved 100% for avoiding hazardous materials that are inherent in many buildings and their systems and/or for implementing best practices with regards to their management as well as for providing safe drinking water.

HIGHLIGHTS

Asbestos

The building was constructed after 1981 and is free of asbestos.

Radon

The building is unlikely to have high-risk levels of radon.

Storage Tanks

There are two large underground storage tanks for emergency generator fuel.
The recent sale audit reviewed storage tanks for legal compliance and operation and maintenance procedures.

**Drinking Water (lead and bacteria)**

Safe drinking water is provided.

### Hazardous Products, WHMIS, Health & Safety

*Rogers Centre achieved 85% for applying best practices relating to the storage, usage and disposal of hazardous products by building maintenance staff and contractors, for implementing the Workplace Hazardous Materials Information System (WHMIS) and health & safety measures, and for applying integrated pest management methods.*

**HIGHLIGHTS**

**WHMIS Program**

There are the following safety features:

- MSDSs, spill clean-up kits and safety equipment such as eye-wash stations are kept near chemical storage areas.
- The MSDSs are less than 3 years old.
- WHMIS labels are present on regulated products.

**Health & Safety and Management of Hazardous Products**

Chemicals and hazardous materials are securely stored in externally ventilated spaces, under controlled temperature, with proper drainage protection, in areas with adequate shelf space, with proper caps to avoid spills and fumes, together with compatible chemicals only.

Education and training is provided for staff who are required to work with hazardous materials and wastes or transport them.

There is a designated person responsible for advising workers of potential and actual hazards, ensuring that workers use prescribed protective equipment devices and taking every reasonable precaution for the protection of workers.

There is a Health and Safety Committee that meets regularly and carries out regular inspections of the premises.

**Pesticides**

The pesticide contractor is licensed and employs integrated pest management methods. There are records of the type and frequency of pesticide use. Tenants are notified of pesticide applications in areas that they use.
Opportunities for Improvement

Health & Safety and Management of Hazardous Products

Keep a detailed and up-to-date inventory of hazardous materials produced by and used in the building. This inventory should include meticulous records of the hazardous waste in the facility and leaving the facility.

*INDOOR ENVIRONMENT*

Environmental management of a building needs to be done in a comprehensive way that also considers the health and comfort of spectators. Many environmental features actually enhance occupant well being. This section addresses issues such as indoor air quality, lighting and noise.

Rogers Centre received an initial score of 48% for having a healthy indoor environment. This score was revised to 65% based on the charrette’s recommendations.

Indoor Air Quality

There are many pollutants in the indoor air of most buildings. While IAQ may not be a significant issue in a facility such as Rogers Centre it may impact on athletic performance and user comfort. Satisfactory indoor air quality can be achieved by removing pollutants at source, diluting them with fresh air or doing both. Rogers Centre received an initial score of 48% for indoor air quality, which has been revised to 64%, based on the charrette recommendations.

HIGHLIGHTS

Ventilation System

Air intakes are far from sources of pollution such as parking areas, bus stops or stagnant water on the roof. This ensures that only clean air is circulated through the building's HVAC system.

Air intakes are at least 10 m apart from exhausts so as to avoid “re-entrainment” of exhaust air.

There is adequate ventilation of stadium areas, although there is no fine control based on the event occupancy. The constant volume supply fans are turn on during the events. When there are no events, only the office areas are supplied.

There is adequate ventilation of vehicle related spaces.

There are ventilation system controls.

The building has natural ventilation when the roof is open.
**Humidification System**

There is no humidification system.

**Parking and Receiving**

There is carbon monoxide monitoring.

**Control of Indoor Pollutants**

Areas with potentially high contaminant levels have effective local exhaust.

The cleaning contractors are aware of using environmentally preferable cleaning materials.

Smoking is permitted in designated smoking area that will prevent the spread of smoke to the rest of the building.

The building's water system avoids the occurrence of Legionella.

**IAQ Management**

The building monitors temperature.

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**SBC Charrette Recommendations**

**IAQ Management**

IAQ management is an excellent way of developing feedback loops between building tenants and management, ensuring that building systems are operating as designed. Providing complaint forms and incident logs, and addressing occupant concerns regarding indoor air quality will result in improving long-term IAQ levels.

A full building IAQ audit should be conducted to highlight problems and start addressing some of the issues of the existing ventilation infrastructure. Other areas of the audit should include:

- HVAC operations
- housekeeping procedures
- preventive maintenance
- procedures for unscheduled maintenance
- mould management

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**Informational Resources:**

1. IAQ Management

**OPPORTUNITIES FOR IMPROVEMENT**

**Ventilation System**

Ensure that grilles on outdoor air intakes are free of obstruction such as contamination from leaves, snow, insects and pigeon droppings and that outdoor air dampers are drawing properly.

Consider permanent carbon dioxide monitoring to control carbon dioxide levels and building ventilation rates in offices areas.

**Filtration System**

Provide air filtration with an efficiency rating of at least MERV 7 (Minimum Efficiency Reporting Value) or Average Atmospheric Dust Spot Efficiency of 25-30% according to ASHRAE Test Standard 52.1.-1992 in office areas.

**Parking and Receiving**

Ensure that precautions are taken to prevent intake of exhaust fumes at the loading dock.

**Control of Pollutants at Source**

Investigate the symptoms and eliminate the causes of mould and excess moisture due to minor leaks.

Where contaminant control ventilation systems are required, equip localized exhausts with airflow monitors and controls, and continuously regulate room pressure differentials.

Ensure that there are additional, documented, practices to reduce indoor pollution from potentially hazardous areas.

Consider a ban on smoking in the building.

Develop a checklist of items concerning IAQ issues that must be reviewed by architects, engineers, contractors, and other professionals prior to renovation and repairs.

**IAQ Management**

Provide continuous monitoring of humidity.

**Lighting**

*Lighting factors that affect visual comfort of spectators include visibility, glare, contrast ratio and colour rendition. Rogers Centre achieved an initial score of 31% for lighting. The charrette revealed a number of possible lighting improvements which has improved the Rogers Centre score to 56.*
HIGHLIGHTS

Lighting Features

The building employs natural daylighting through the use of large windows, or natural light when the dome is open. Suitable individually controlled task lighting in offices is generally provided.

SBC Charrette Recommendations

Lighting Management

It was recommended that frequency ballasts be fitted to luminaries as part of the larger lighting retrofit.

Informational Resources:
2. Energy Efficient Lighting
   http://www.eere.energy.gov/consumerinfo/factsheets/eelight.html
3. Energy Efficient Lighting Systems
   http://www.wbdg.org/design/efficientlighting.php

OPPORTUNITIES FOR IMPROVEMENT

Lighting Features

Consider installing controllable internal blinds or external shading devices to prevent glare at visual display terminals (VDTs). Ensure that lighting levels meet Canada Occupational Health and Safety Regulations.

Lighting Management

Implement a planned schedule of maintenance and cleaning of luminaires.

Noise

Noise is a frequent cause of complaints in industrial buildings and can be distracting. However in open plan areas, low noise levels can result in lack of acoustic privacy. Rogers Centre achieved a score of 100% for noise.

HIGHLIGHTS

The sound levels appear to be acceptable. It is easy, in open office areas, to engage in a conversation using a normal voice, understand a phone conversation, and have a private conversation using lowered voices.

There appears to be sufficient acoustic privacy in offices. Speech can be heard but not generally understood in adjacent work stations, and it is possible to have a private conversation using lowered voices. In enclosed offices, it is possible to maintain confidentiality using normal voice levels.

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* ENVIRONMENTAL MANAGEMENT SYSTEM *

This section evaluates the likelihood that the building will achieve continuous improvement thanks to its management system. Although a building's management may have an unwritten culture of strategic planning, as well as a commitment to conform to regulations and achieve energy efficiency through stringent operations and maintenance, these efforts can be greatly enhanced by a more formal documented approach.

*Rogers Centre achieved an initial score of 30% for its documentation, and its environmental purchasing practices as well as for its environmental emergency response plans and communications with tenants. The charrette revealed a number of improvements in environmental management that would improve the overall score to 97%.

Environmental Management System (EMS) Documentation

*Rogers Centre achieved an initial score of 0% for documenting its environmental policy, goals, targets and action plans. This score has been adjusted to 100% based on the charrette recommendations.*

SBC Charrette Recommendations

EMS documentation is a simple way of improving the environmental management within the Rogers Centre. Ideally a good environmental policy is easily accessible to staff and tenants, expresses a commitment to compliance with relevant laws, and an emphasis on continuous improvement. It should be signed by senior management.

The stated goals should include:

- energy conservation
- water conservation
- waste reduction and recycling
- environmental purchasing
- reduction in use and proper handling of hazardous products
- training and education

Documented action plans should be developed to improve the environmental performance of the building that includes strategies, time frames, training needs and budgets.

Environmental Purchasing

Eco-purchasing is a procurement strategy that reduces the volume and toxicity of wastes. It is based on the premise that all the environmental resources and costs of materials,
manufacturing, labour, transportation, packaging, merchandising, storage and disposal are wasted when a product is discarded.

Rogers Centre achieved an initial score of 52% for its environmental purchasing plan. This has been revised to 100% based on the recommendations of the charrette participants.

**HIGHLIGHTS**

Staff has a list of feasible environmentally friendly substitutes and their suppliers. The property manager consults with the cleaning contractor Hallmark and sources appropriate environmental products from APEX.

Staff who purchase hazardous products provide and review material safety data sheets (MSDS).

**SBC Charrette Recommendations**

Expand the environmental purchasing plan to the catering and concession areas in order to achieve continued improvement in products used by staff, cleaning contractors; and tenants.

The purchasing policy should also include a requirement for purchasing energy-saving equipment.

**Emergency Response**

The purpose of an environmental emergency response program is to limit the adverse effects of any man-made or natural disaster on the spectators and the environment.

Rogers Centre achieved 85% for its emergency response program.

**HIGHLIGHTS**

There are detailed procedures for an evacuation and quick, effective action in the event of an environmental emergency and threats such as: bomb threat, power outage, fire or structural failure. They include up-to-date contacts to obtain assistance promptly and to report the emergency. There is also a protocol to assess the risks of re-occupying the building in the case of evacuation.

The environmental emergency response plans refer to local, municipal, provincial and federal applicable legislation with respect to emergency procedures, reporting and record-keeping.

There is equipment on-site such as spill control kits, absorbents, and personal protection equipment for quick and easy access.

There are contingency plans for both short-term and long-term power failures that address the following elements: communication to tenants; security; provision of emergency power and water; and, if necessary, evacuation.

**OPPORTUNITIES FOR IMPROVEMENT**

A site map showing the location of environmentally significant features and equipment can help to plan emergency response. This is helpful for emergency crews.
Occupant Awareness

Communication with tenants serves to inform them of environmental initiatives in the building, increase their environmental awareness and motivate them to implement measures of their own.

*Rogers Centre achieved an initial score of 0% for tenant environmental awareness. Based on the recommendations from the charrette this score has been revised to 100%.*

**SBC Charrette Recommendations**

Development of a communications strategy with tenants regarding environmental initiatives and practices.

Information should be available to tenants on the environmental measures that they can implement in the workplace to contribute to:
- energy and water conservation and efficient use
- waste reduction and recycling
- the proper handling, storage and disposal of toxic products.

Spectators should be provided with information and should have a forum or hotline to discuss the environmental concerns and to coordinate their activities.

Building management must have in place a well-understood system for communicating with tenants/spectators on environmental issues specific to the building. Provide tenants and spectators with communications on ways they can contribute to:

- energy and water conservation
- waste reduction and recycling. This is particularly important in view of the cleaning costs and the water use associated with cleaning.
- proper handling, storage and disposal of toxic products

**Informational Resources:**

1. Sustainable O&M Practices
Basis of the Assessment and Disclaimer

This assessment is based on information received at a meeting held with Kelly Keyes, Property Manager, Rogers centre on Thursday, August 18, 2005.

Those who attended the assessment meeting and survey should check that the descriptions contained in this report are an accurate reflection of the information that was provided, and should inform the assessor if they are aware of any inaccuracies or additional information that would affect the assessors’ decision to award or withhold a rating.

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### PARTICIPANTS

<table>
<thead>
<tr>
<th>Emile Saulnier</th>
<th>Ainsworth Inc.</th>
<th><a href="mailto:emile_saulnier@ainsworth.com">emile_saulnier@ainsworth.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Phil Fung</td>
<td>SRS</td>
<td><a href="mailto:philfung@srsca.com">philfung@srsca.com</a></td>
</tr>
<tr>
<td>Jan Buijk</td>
<td>DDA Canada East / GE</td>
<td><a href="mailto:buijkjan@ddace.com">buijkjan@ddace.com</a></td>
</tr>
<tr>
<td>Rick Williams</td>
<td>Jenbacher</td>
<td><a href="mailto:rwilliams@carmaindustries.com">rwilliams@carmaindustries.com</a></td>
</tr>
<tr>
<td>Eleanor McAteer</td>
<td>Carma Industries Inc</td>
<td><a href="mailto:emcatee@toronto.ca">emcatee@toronto.ca</a></td>
</tr>
<tr>
<td>Geoff Lupton</td>
<td>City Of Toronto</td>
<td><a href="mailto:glupton@epcor.ca">glupton@epcor.ca</a></td>
</tr>
<tr>
<td>Jiri Skopek</td>
<td>ECD Energy &amp; Environment</td>
<td><a href="mailto:jiriskopek@sympatico.ca">jiriskopek@sympatico.ca</a></td>
</tr>
<tr>
<td>Matthew Somerville</td>
<td>ECD Energy &amp; Environment</td>
<td><a href="mailto:mw.somerville@gmail.com">mw.somerville@gmail.com</a></td>
</tr>
<tr>
<td>Scott Rouse</td>
<td>Energy @ Work</td>
<td><a href="mailto:scott.rouse@energy-efficiency.com">scott.rouse@energy-efficiency.com</a></td>
</tr>
<tr>
<td>Bob Bach</td>
<td>Energy Profiles Ltd</td>
<td><a href="mailto:bbach@energyprofiles.com">bbach@energyprofiles.com</a></td>
</tr>
<tr>
<td>Mike McGee</td>
<td>Energy Profiles</td>
<td><a href="mailto:mmcggee@energyprofiles.com">mmcggee@energyprofiles.com</a></td>
</tr>
<tr>
<td>Rick Bojahra</td>
<td>Epcor Ontario</td>
<td><a href="mailto:rick.bojahra@rigadev.com">rick.bojahra@rigadev.com</a></td>
</tr>
<tr>
<td>David Chernushenko</td>
<td>Green and Gold</td>
<td><a href="mailto:david@greengold.on.ca">david@greengold.on.ca</a></td>
</tr>
<tr>
<td>Brian Fountain</td>
<td>GreenSim Inc.</td>
<td><a href="mailto:bfountain@greensim.com">bfountain@greensim.com</a></td>
</tr>
<tr>
<td>Byron Hurn</td>
<td>Riga Development</td>
<td><a href="mailto:byron.hurn@rigadev.com">byron.hurn@rigadev.com</a></td>
</tr>
<tr>
<td>Len Hart</td>
<td>EnerQuality Corp</td>
<td><a href="mailto:lhart@summerhillgroup.ca">lhart@summerhillgroup.ca</a></td>
</tr>
<tr>
<td>Steve Clayman</td>
<td>Knauf Insulation</td>
<td><a href="mailto:steve.clayman@knaufUSA.com">steve.clayman@knaufUSA.com</a></td>
</tr>
<tr>
<td>David Meredith</td>
<td>Enbridge</td>
<td><a href="mailto:david.meredith@enbridge.com">david.meredith@enbridge.com</a></td>
</tr>
<tr>
<td>Michelle Parker</td>
<td>Enbridge</td>
<td><a href="mailto:michelle.parker@enbridge.com">michelle.parker@enbridge.com</a></td>
</tr>
<tr>
<td>Richard Lu</td>
<td>Toronto Hydro</td>
<td><a href="mailto:rlu@torontohydro.com">rlu@torontohydro.com</a></td>
</tr>
<tr>
<td>Stephen Thuringer</td>
<td>Upper Canada College</td>
<td><a href="mailto:sthuringer@ucc.on.ca">sthuringer@ucc.on.ca</a></td>
</tr>
<tr>
<td>Hisakatsu Sawada</td>
<td>Sanyo Canada</td>
<td><a href="mailto:cthompson@sci.sanyo.com">cthompson@sci.sanyo.com</a></td>
</tr>
<tr>
<td>Christopher Thompson</td>
<td>Sanyo Canada</td>
<td><a href="mailto:cthompson@sci.sanyo.com">cthompson@sci.sanyo.com</a></td>
</tr>
<tr>
<td>Yoshinori Kaido</td>
<td>Sanyo Canada</td>
<td><a href="mailto:cthompson@sci.sanyo.com">cthompson@sci.sanyo.com</a></td>
</tr>
<tr>
<td>Heinz Vog</td>
<td>Stone McQuire Vogt</td>
<td><a href="mailto:hvogt@smvarch.com">hvogt@smvarch.com</a></td>
</tr>
<tr>
<td>Shalini Modi</td>
<td>Sustainable Buildings Canada</td>
<td><a href="mailto:shalinimodi@msn.com">shalinimodi@msn.com</a></td>
</tr>
<tr>
<td>Mike Singleton</td>
<td>Sustainable Buildings Canada</td>
<td><a href="mailto:mike-singleton@rogers.com">mike-singleton@rogers.com</a></td>
</tr>
<tr>
<td>Tom Ponessa</td>
<td>Sustainable Buildings Canada</td>
<td><a href="mailto:Ponessa@sympatico.ca">Ponessa@sympatico.ca</a></td>
</tr>
<tr>
<td>Bill Humber</td>
<td>Seneca College</td>
<td><a href="mailto:bill.humber@senecac.on.ca">bill.humber@senecac.on.ca</a></td>
</tr>
<tr>
<td>Donna Cansfield</td>
<td>MPP, Government of Ontario</td>
<td><a href="mailto:marion.fraser@energy.gov.on.ca">marion.fraser@energy.gov.on.ca</a></td>
</tr>
<tr>
<td>Marion Fraser</td>
<td>Ministry of Energy</td>
<td><a href="mailto:donna.cansfield@energy.gov.on.ca">donna.cansfield@energy.gov.on.ca</a></td>
</tr>
<tr>
<td>Brian Byrnes</td>
<td>Ministry of Energy</td>
<td><a href="mailto:brian.byrnes@energy.gov.on.ca">brian.byrnes@energy.gov.on.ca</a></td>
</tr>
<tr>
<td>Sarah Baker</td>
<td>Ministry of Energy</td>
<td><a href="mailto:sarah.baker@energy.gov.on.ca">sarah.baker@energy.gov.on.ca</a></td>
</tr>
<tr>
<td>John Rinella</td>
<td>Ministry of Energy</td>
<td><a href="mailto:john.rinella@energy.gov.on.ca">john.rinella@energy.gov.on.ca</a></td>
</tr>
<tr>
<td>Radian Gurov</td>
<td>Ministry of Energy</td>
<td><a href="mailto:rgurov@rnca.gc.ca">rgurov@rnca.gc.ca</a></td>
</tr>
<tr>
<td>Masoud Almassi</td>
<td>NRCAn-OEE</td>
<td><a href="mailto:masoud.almassi@powerauthority.on.ca">masoud.almassi@powerauthority.on.ca</a></td>
</tr>
<tr>
<td>Audrey Lemieux</td>
<td>Ontario Power Authority</td>
<td><a href="mailto:alemieux@bridgepointgroupltd.com">alemieux@bridgepointgroupltd.com</a></td>
</tr>
<tr>
<td>Ian MacPherson</td>
<td>Bridgepoint Group Ltd</td>
<td><a href="mailto:ian.macpherson@enbridge.com">ian.macpherson@enbridge.com</a></td>
</tr>
<tr>
<td>Brian Beatty</td>
<td>Enbridge</td>
<td><a href="mailto:bbeatty@bbeatty.com">bbeatty@bbeatty.com</a></td>
</tr>
<tr>
<td>Graham MacDowall</td>
<td>Beatty and Associates</td>
<td><a href="mailto:gjm.angus@rogers.com">gjm.angus@rogers.com</a></td>
</tr>
<tr>
<td>James Glasspool</td>
<td>John Angus &amp; Associates</td>
<td><a href="mailto:james.glasspool@enbridge.com">james.glasspool@enbridge.com</a></td>
</tr>
<tr>
<td>Leo Calderone</td>
<td>Enbridge</td>
<td><a href="mailto:leo.calderone@utoronto.ca">leo.calderone@utoronto.ca</a></td>
</tr>
<tr>
<td>Stephen Curtis</td>
<td>Lighting Associates</td>
<td><a href="mailto:scurtis1@rogers.com">scurtis1@rogers.com</a></td>
</tr>
<tr>
<td>Clarence Yu</td>
<td>Philips Lighting</td>
<td><a href="mailto:clarence.yu@philips.com">clarence.yu@philips.com</a></td>
</tr>
<tr>
<td>Leah Werry</td>
<td>City Of Toronto</td>
<td><a href="mailto:lwerry@utoronto.ca">lwerry@utoronto.ca</a></td>
</tr>
<tr>
<td>Cameron Ridsdale</td>
<td>Cement Association of Canada</td>
<td><a href="mailto:ridsdale@cement.ca">ridsdale@cement.ca</a></td>
</tr>
<tr>
<td>John C. Thomson</td>
<td>NGen Inc.</td>
<td><a href="mailto:john.thomson@nrgen.com">john.thomson@nrgen.com</a></td>
</tr>
<tr>
<td>Suneel Gupta</td>
<td>Energy Advantage</td>
<td><a href="mailto:suneel.gupta@energyadvantage.com">suneel.gupta@energyadvantage.com</a></td>
</tr>
<tr>
<td>David Elfstrom</td>
<td>Trane Central Ontario</td>
<td><a href="mailto:david@elfstrom.com">david@elfstrom.com</a></td>
</tr>
<tr>
<td>Darcy Mulrooney</td>
<td>Ryerson University</td>
<td><a href="mailto:djmulrooney@energyadvantage.com">djmulrooney@energyadvantage.com</a></td>
</tr>
<tr>
<td>Arlene Gould</td>
<td>Prolink North America Inc.</td>
<td><a href="mailto:aougld@ryerson.ca">aougld@ryerson.ca</a></td>
</tr>
<tr>
<td>Ed Oliver</td>
<td></td>
<td><a href="mailto:eoliver@prolinkplm.com">eoliver@prolinkplm.com</a></td>
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<td>Brian Williams</td>
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