RESEARCH REPORT

BREEAM Green Leaf Eco-Rating Program

Canada

CMHC SCHL
HOME TO CANADIANS

CMHC—HOME TO CANADIANS

Canada Mortgage and Housing Corporation (CMHC) has been Canada's national housing agency for more than 60 years.

Together with other housing stakeholders, we help ensure that Canada maintains one of the best housing systems in the world. We are committed to helping Canadians access a wide choice of quality, affordable homes, while making vibrant, healthy communities and cities a reality across the country.

For more information, visit our website at **www.cmhc.ca**

You can also reach us by phone at 1-800-668-2642 or by fax at 1-800-245-9274.

Outside Canada call 613-748-2003 or fax to 613-748-2016.

Canada Mortgage and Housing Corporation supports the Government of Canada policy on access to information for people with disabilities. If you wish to obtain this publication in alternative formats, call 1-800-668-2642.

BREEAM

Green Leaf™ Eco-Rating Program

CMHC Multi-Residential Buildings Assessment Pilot

Final Report

ECD Energy and Environment Canada Ltd.
Tel : 416 699 6671
Fax : 416 699 9250
E-mail : skopen@interlog.com

BREEAM

Green Leaf™ Eco-Rating Program

CMHC Multi-Residential Buildings Assessment Pilot

Final Report

ECD Energy and Environment Canada Ltd.
Tel : 416 699 6671
Fax : 416 699 9250
E-mail : skopen@interlog.com

Executive Summary

Background

There are many reasons for measuring the environmental performance of buildings, chief among them being that it can help building owners decide where to put their retrofit dollars to improve their buildings and reduce operating costs. In North America, there is a large stock of buildings constructed in the 50's and 60's whose systems are reaching obsolescence and will require major retrofit. This is an opportune time to be making environmental enhancements to these buildings, which can improve their bottom line. For example, energy efficiency measures can reduce the sizing of mechanical equipment. Through the evaluation of their buildings by an outside party, management, staff also receive insights into better management practices. Implementing better maintenance and environmental management can reduce operating costs and help avoid - or respond to occupant complaints about building-related health issues.

Although measuring the environmental performance of buildings is still not a main-stream activity, one of the key recommendations by the *Issue Tables for Climate Change for the Building Sector* was to have a national building labelling and rating program. Moreover, a growing number of energy practitioners argue that the promotion of energy efficiency needs to be linked to other issues such as comfort, health, IAQ and productivity. This calls for a comprehensive measuring and benchmarking tool, which will allow owners and occupants to compare their buildings' performance with others.

Objectives

CMHC commissioned the environmental assessment of six high-rise multi-residential buildings, using the BREEAM Green Leaf assessment methodology. The purpose of the pilot assessment was to obtain property manager feedback on their buildings' environmental issues, then on the value of environmental assessment, and to find ways to improve upon the current methodology.

The BREEAM Green Leaf Environmental Assessment Protocol

BREEAM/Green Leaf is an environmental assessment protocol that was developed in response to the need in the marketplace for a less expensive methodology that could be partially conducted in-house. This makes it an appropriate introductory whole-building, comprehensive energy and environmental assessment for managers of multi-residential buildings. The assessment is based on an investigation of building performance and management practices by use of a checklist and walk-through survey. The data is then used to generate a report, which provides a building rating and a list of recommendations to improve the building and management performance. The methodology originated in Canada and was developed by ECD Energy and Environment Canada and Terra Choice. It combined the BREEAM set of environmental issues with the Green Leaf Eco-Rating procedure.

In its scope, the BREEAM Green Leaf covers issues similar to CMHC's *Five Essentials of Healthy Housing*[1], namely Occupant Health; Energy Efficiency; Resource Efficiency; Environmental Responsibility; and Affordability. In addition, BREEAM Green Leaf addresses operation and management issues. Some elements of the *Five Essentials* such as better use of the site to increase occupant density; flexible design to reduce future renovation costs, and use of recyclable materials are covered in greater detail in the *BREEAM Green Leaf for New Buildings*, which has been developed for projects at the design stage.

Building Assessments

Six large property management firms were approached with the offer of a subsidized assessment, in exchange for which they would complete a survey. Participants provided access to the buildings they would prefer to have assessed. The sample represented a wide range of the multi-residential building types, age and size and ranged from inner city housing to city/suburban locations.

The six buildings were assessed with respect to the following environmental performance issues.

ENVIRONMENTAL MANAGEMENT
- Environmental Management System
- Policy
- Emergency Response

ENERGY & WATER EFFICIENCY
- Building Energy Efficiency
- Energy Management
- Transportation
- Water Efficiency

RESOURCES
- Waste Reduction & Recycling
- Site

EMISSIONS, EFFLUENTS & OTHER ENVIRONMENTAL IMPACTS
- Air Emissions
- Ozone Depletion
- Water Effluents
- Microbial Contamination
- Hazardous Materials

INDOOR ENVIRONMENT
- Lighting
- Ventilation
- Filtration
- IAQ profile
- Parking, Shipping and Receiving

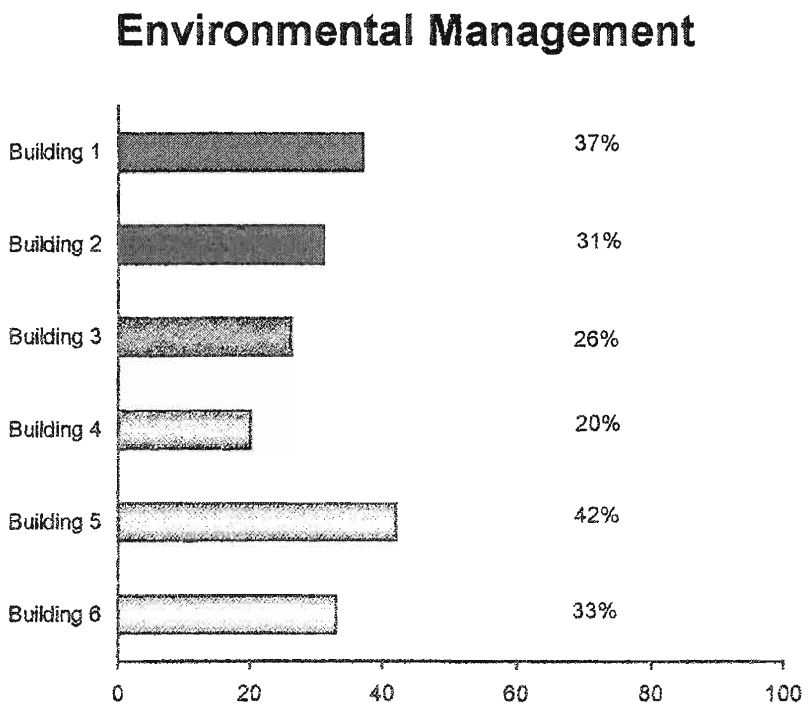
[1] http://www.cmhcschlc.ca/cmhc.html

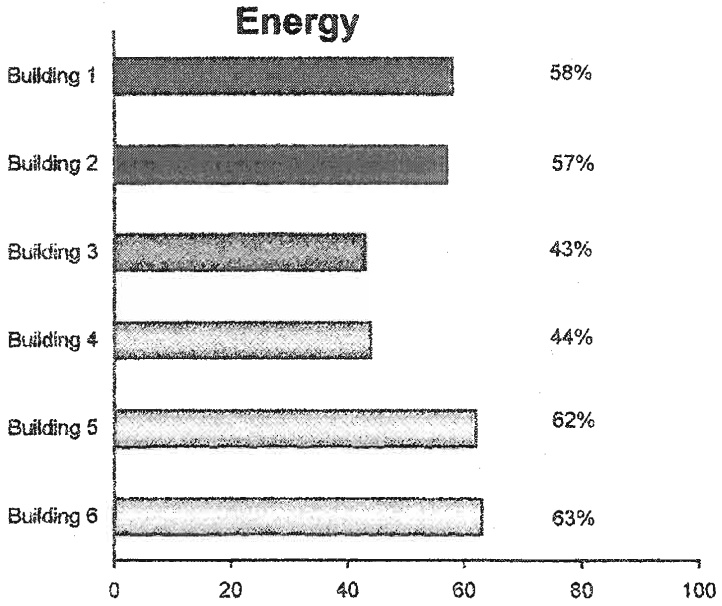
- Renovation, Decorating and Remodeling
- Smoking

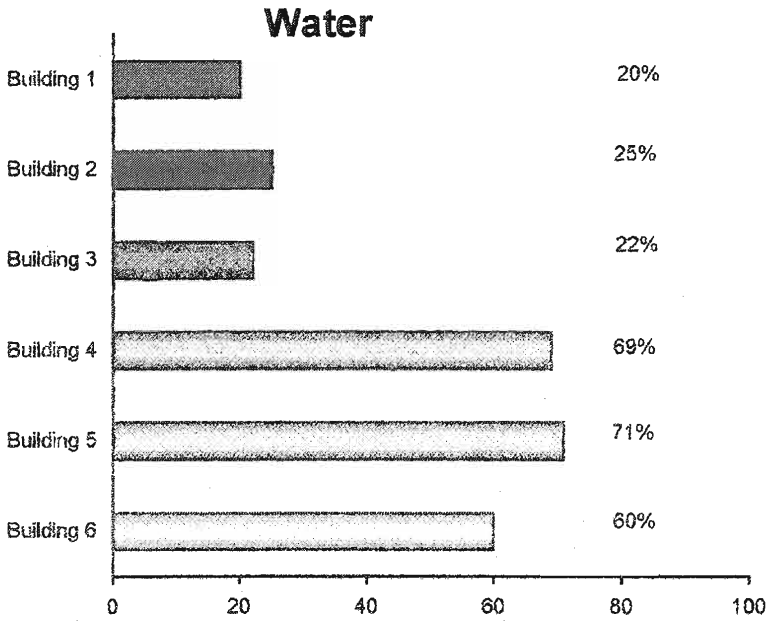
DWELLING UNIT CRITERIA

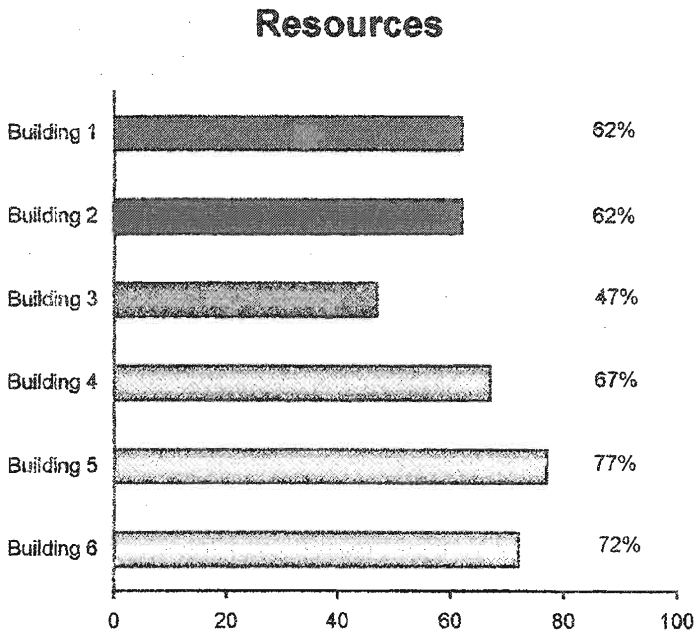
- Safety and Location
- Environmental Controls
- Daylighting and Views
- Acoustics
- Household Information kit
- Dwelling IAQ
- Adaptability

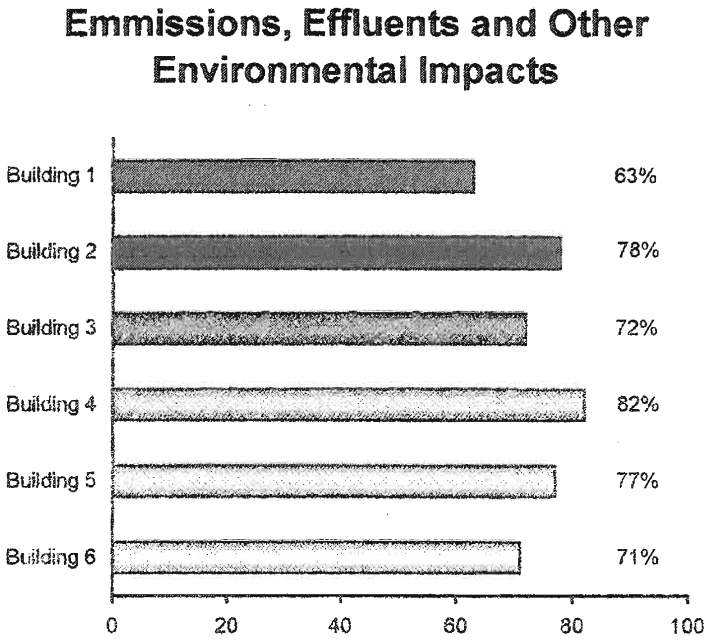
Detailed reports were prepared for each building. The results are summarized in the following charts.



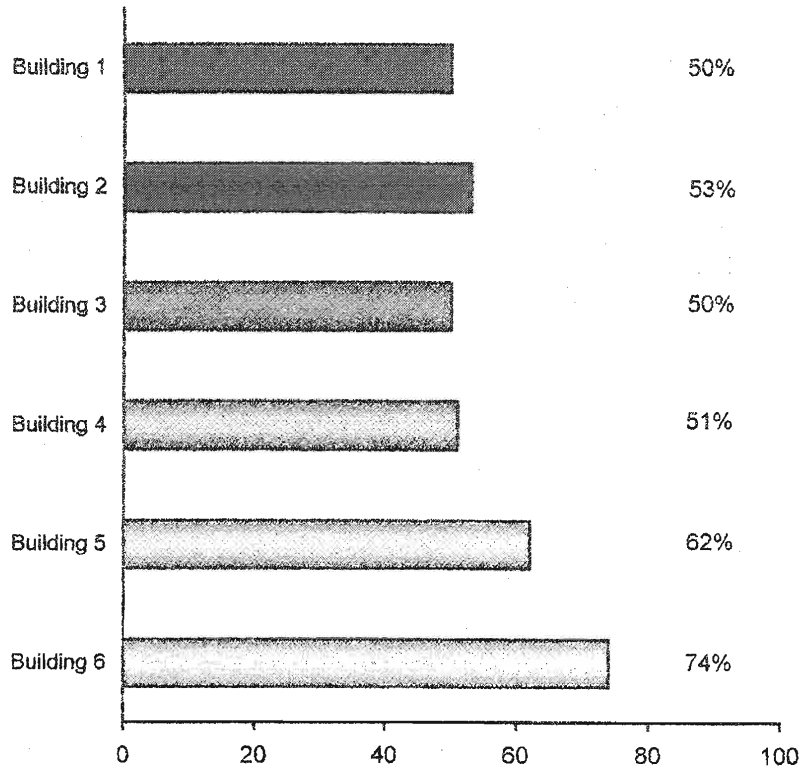

Energy
Building 1
Building 2
Building 3
Building 4
Building 5
Building 6
58%
57%
43%
44%
62%
63%
0
20
40
60
80
100


Water
Building 1
Building 2
Building 3
Building 4
Building 5
Building 6
20%
25%
22%
69%
71%
60%
0
20
40
60
80
100


Resources
Building 1
Building 2
Building 3
Building 4
Building 5
Building 6
62%
62%
47%
67%
77%
72%
0
20
40
60
80
100


Emmissions, Effluents and Other Environmental Impacts
Building 1
Building 2
Building 3
Building 4
Building 5
Building 6
63%
78%
72%
82%
77%
71%
0
20
40
60
80
100

INDOOR ENVIRONMENT (COMMON AREAS)



User Survey

One of the objectives of the pilot project was to evaluate the usefulness of the BREEAM/Green Leaf environmental assessment by means of a survey to gauge:

- Perception of the importance of building environmental issues by building managers and tenants
- Perceived value of environmental assessments
- Views on the BREEAM Green Leaf methodology

The survey was done in two stages – the first taking place prior to the assessment and the latter, after the clients had had a chance to review the report. The two surveys had many of the same questions, in order to compare the perceptions before and after the assessment. The respondents were building managers.

Results of the survey indicated that:

- The assessment produced a notable shift of perception regarding
  i) *the environmental impact of buildings*. In the pre-assessment survey, the majority of responses indicated a perception that buildings had "negligible" or "not very significant" impact on the environment. In the post-assessment survey, the greater majority of

responses to the same question was that the impacts were "somewhat significant" to "extremely significant".

ii) *the value of environmental assessments.* Five out of the six respondents indicated that the report exceeded their expectations.

iii) *the potential of property managers to influence tenants.* In the pre-assessment survey, all of the respondents indicated that they felt they had no potential to influence the tenants to conserve energy. In the post-assessment survey, four of the respondents had changed their positions and said they probably could have some influence if they tried.

- Building managers are driven by "bottom line considerations". The value of the assessment lies in indicating areas where operational savings can be achieved.

- Building managers are interested in having an overview of their building and in comparing their building to others. They favor a rating/labelling system.

Discussion on the Usefulness of a Comprehensive Environmental Assessment

- *A comprehensive environmental assessment protocol is relevant to management goals* By linking the environment with the bottom line, it raises awareness that the majority of "green" practices for buildings are not only good for the environment but also contribute to improved efficiencies, operational savings, and tenant comfort and satisfaction. This realization is crucial, for without it, few facilities managers would be inclined to develop an environmental management system to improve their business- and ultimately, their bottom line. By synthesizing the best practices that are relevant to the majority of buildings by means of a simple checklist that can be completed in half a day, this makes it an affordable tool that can be used in-house or with minimal help of a consultant.
- *For large portfolios, it is a suitable tool for doing a portfolio-wide review.* A portfolio-wide review is often more acceptable than isolated building audits, because senior management tends to take the strategic view that collecting, compiling and summarizing operating expense information about a portfolio of properties can lead to better decision-making. By elevating energy and environmental management to a strategic initiative, there is increased likelihood of obtaining senior management buy-in.

- *Used for an overall portfolio review, it provides numerous recommendations for low-cost maintenance measures, many of which can be done in-house.* A number of these may apply to a large portion of a portfolio. These should be communicated as soon as possible following the portfolio review.
- *Used for an overall portfolio-wide review, it gives strong indications where retrofit dollars would be best spent.* These are the buildings that are most in need of an energy audit. Where dollars are scarce, the portfolio review can also help determine which buildings would benefit most from a full energy audit and which ones would suffice to have an audit to one or two systems.
- *It can be used as a benchmark for society.* The potential for benchmarking that the assessment offers is useful not only to owner/property managers who want to know how they

are doing in relationship to others; it also can be used a as benchmark for society, as an indication of how well society is responding to environmental pollution. In future, it might be possible to put the results of all assessments (without providing the building addresses) on the web. Property managers and owners could come to see how well they are doing.

Résumé

Contexte

De nombreuses raisons militent pour l'évaluation de l'efficacité environnementale des bâtiments, la principale étant que cela peut aider les propriétaires à décider dans quels éléments il est préférable d'engager leurs dépenses de rénovation pour améliorer leurs immeubles et réduire leurs frais d'exploitation. En Amérique du Nord, il existe un important parc d'immeubles construits dans les années 50 et 60, dont les composantes arrivent au point de désuétude et ont besoin d'importants travaux de mise à niveau. Le moment est donc opportun pour apporter des améliorations environnementales à ces immeubles, et ce faisant pour bonifier leurs résultats financiers. Par exemple, les mesures d'efficacité énergétique peuvent réduire la taille de l'équipement mécanique. En faisant évaluer leurs immeubles par un tiers, la direction et le personnel sont également mis au fait de meilleures pratiques de gestion. La mise en place d'une meilleure gestion de l'entretien et de l'environnement peut réduire les frais d'exploitation et contribuer à éviter les plaintes des occupants en matière de salubrité des immeubles, ou à y répondre le cas échéant.

Bien que l'évaluation de la performance environnementale des immeubles ne soit pas encore une activité courante, l'une des principales recommandations de la Table de concertation sur les changements climatiques pour les bâtiments était la création d'un programme national d'étiquetage et de cotation des bâtiments. De plus, un nombre grandissant de praticiens du secteur de l'énergie pensent qu'il faut lier la promotion de l'efficacité énergétique avec d'autres questions comme le confort, la santé, la QAI et la productivité. Ces constatations militent pour la création d'un outil global d'évaluation et de référenciation, qui permettrait aux propriétaires et aux occupants de comparer le rendement de leur immeuble avec celui d'autres bâtiments.

Objectifs

La SCHL a commandé l'évaluation environnementale de six tours d'habitation, au moyen de la méthode d'évaluation BREEAM - Green Leaf. Le but de l'évaluation pilote était d'obtenir la rétroaction des gestionnaires immobiliers quant aux questions environnementales touchant leur immeuble, puis quant à la valeur de l'évaluation environnementale et de déterminer les points à améliorer par rapport à la méthodologie actuelle.

Le protocole d'évaluation environnementale BREEAM - Green Leaf

Le protocole d'évaluation environnementale BREEAM - Green Leaf a été élaboré pour répondre aux besoins exprimés sur le marché d'une méthode moins coûteuse pouvant être partiellement appliquée à l'interne. Le protocole produit consiste en un outil global préliminaire d'évaluation énergétique et environnementale de l'ensemble de l'immeuble à l'usage des gestionnaires des immeubles résidentiels. L'outil se fonde sur une évaluation du rendement de l'immeuble et des pratiques de gestion au moyen d'une liste de vérification et d'une inspection à vue. Les données

servent alors à produire un rapport, dans lequel une cote est attribuée à l'immeuble et une liste de recommandations sont formulées pour en améliorer le rendement et la gestion. Cette méthode a été élaborée au Canada par ECD Energy and Environment Canada et Terra Choice. Elle combine les points abordés par la méthode BREEAM avec le programme d'écocotation Green Leaf.

Par son ampleur, la méthode BREEAM - Green Leaf couvre les *Cinq composantes essentielles de la maison saine*[1] de la SCHL, soit la santé des occupants, l'efficacité énergétique, l'utilisation efficace des ressources, la responsabilité en matière d'environnement et l'abordabilité. De plus, le protocole BREEAM - Green Leaf aborde les questions se rapportant à l'exploitation et à la gestion. Quelques éléments des *cinq composantes essentielles*, comme un meilleur usage de l'emplacement par une augmentation de la densité d'occupation, la conception flexible afin de réduire le coût des rénovations futures et l'utilisation de matériaux recyclés sont abordés, plus en détail dans le *protocole BREEAM - Green Leaf pour les immeubles neufs*, qui a été élaboré pour une application à l'étape de la conception d'un bâtiment.

Évaluation des immeubles

On a prix contact avec six importantes entreprises de gestion immobilière pour leur offrir une évaluation subventionnée, en contrepartie de laquelle l'entreprise acceptait de remplir un questionnaire. On a permis aux participants de choisir l'immeuble à inspecter au sein de leur parc. L'échantillon présentait une grande variété de types, d'âge et de taille d'immeubles, dont l'emplacement allait des quartiers centraux à la banlieue.

Les six immeubles ont été évalués relativement aux points suivants :

GESTION ENVIRONNEMENTALE
- Système de gestion environnementale
- Politique
- Intervention d'urgence

EFFICACITÉ ÉNERGÉTIQUE ET ÉCONOMIE DE L'EAU
- Efficacité énergétique des bâtiments
- Gestion de l'énergie
- Transport
- Économie de l'eau

RESSOURCES
- Réduction et recyclage des déchets
- Chantiers

ÉMISSIONS, EFFLUENTS ET AUTRES IMPACTS ENVIRONNEMENTAUX
- Émissions dans l'air
- Amincissement de la couche d'ozone
- Effluents dans l'eau
- Contamination microbienne
- Matériaux dangereux

[1] http://www.smhc-schl.gc.ca

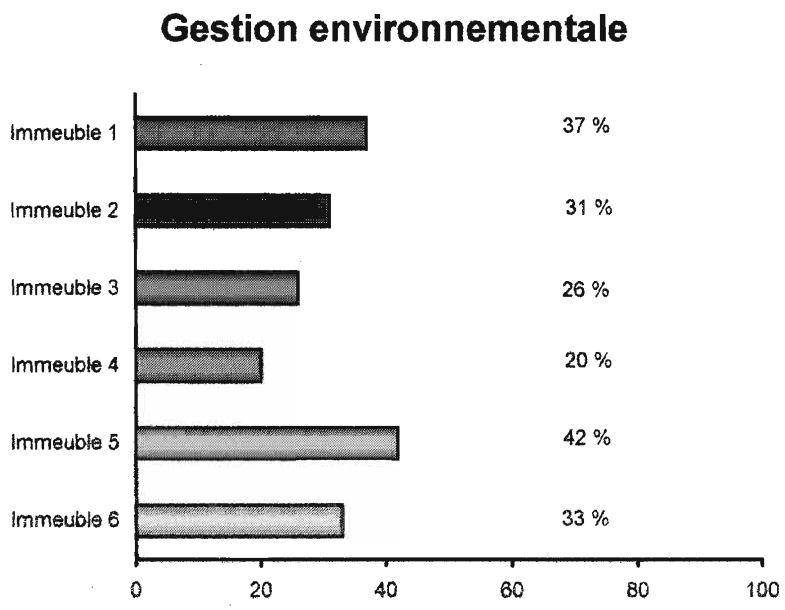
ENVIRONNEMENT INTÉRIEUR

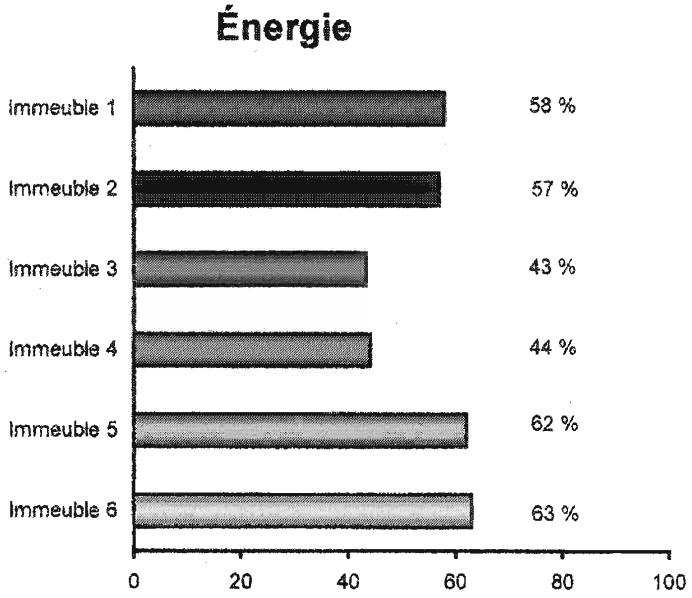
- Éclairage
- Ventilation
- Filtration
- Profil de QAI
- Stationnement, expédition et réception
- Rénovation, décoration et réaménagement
- Fumée du tabac

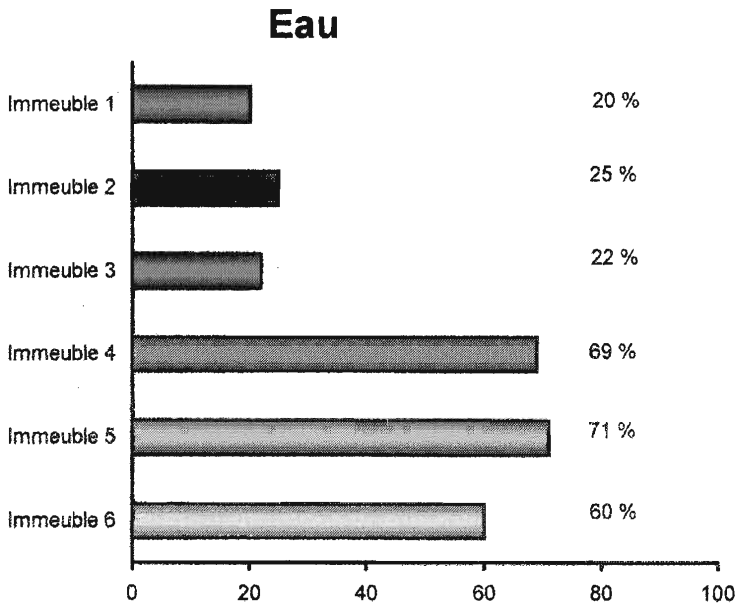
CRITÈRES D'ÉVALUATION DES LOGEMENTS

- Sécurité et emplacement
- Contrôles environnementaux
- Lumière du jour et vue
- Acoustique
- Trousse d'information pour les ménages
- QAI des logements
- Adaptabilité

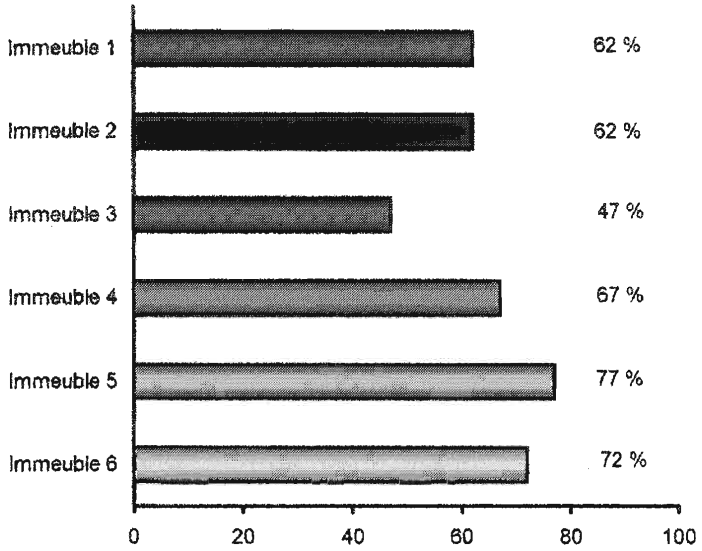
Des rapports détaillées ont été rédigés pour chaque immeuble. Les résultats sont résumés dans les tableaux suivants.



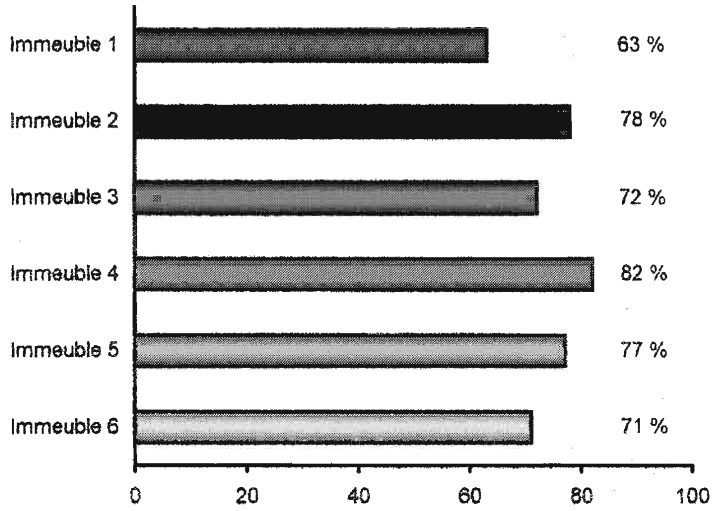

Énergie
Immeuble 1
Immeuble 2
Immeuble 3
Immeuble 4
Immeuble 5
Immeuble 6
58 %
57 %
43 %
44 %
62 %
63 %
0
20
40
60
80
100


Eau
Immeuble 1
Immeuble 2
Immeuble 3
Immeuble 4
Immeuble 5
Immeuble 6
20 %
25 %
22 %
69 %
71 %
60 %
0
20
40
60
80
100

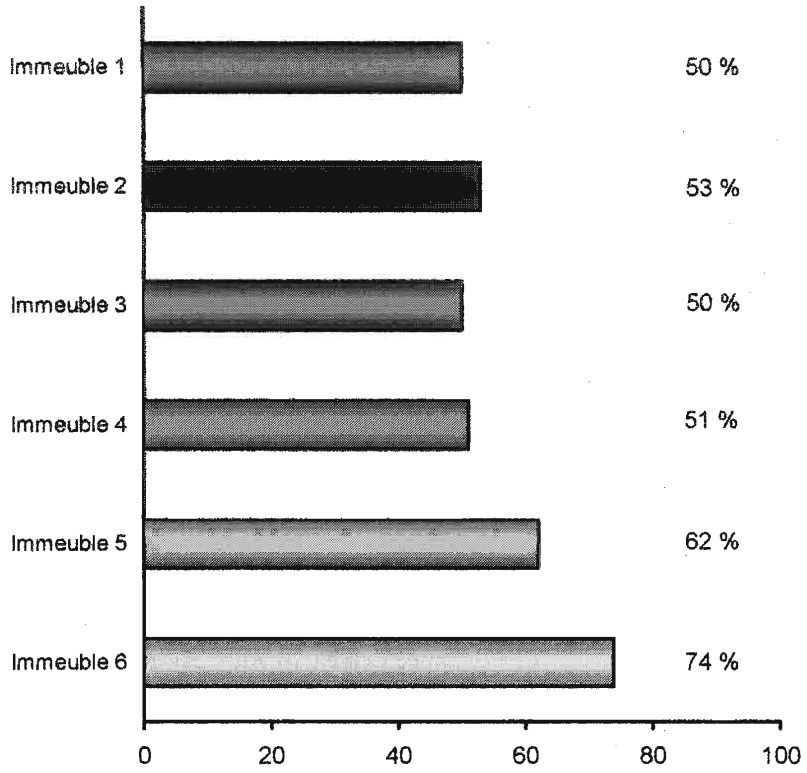
Ressources



Émissions, effluents et autres impacts environnementaux



ENVIRONNEMENT INTÉRIEUR (AIRES COMMUNES)



Enquête auprès des utilisateurs

L'un des objectifs du projet pilote était d'évaluer l'utilité du protocole d'évaluation environnementale BREEAM - Green Leaf au moyen d'une enquête visant à mesurer :

- la perception de l'importance des questions environnementales par les gestionnaires immobiliers et les locataires
- la perception de la valeur des évaluations environnementales
- la perception du protocole BREEAM - Green Leaf

L'enquête a été effectuée en deux étapes : la première ayant lieu avant l'évaluation et la seconde, après que les clients aient eu l'occasion d'examiner le rapport. Les deux questionnaires avaient beaucoup de questions en commun afin de permettre une comparaison entre les perceptions avant et après l'évaluation. Ce sont les gestionnaires immobiliers qui ont répondu à ce questionnaire.

Les résultats de l'enquête indiquent que :

- l'évaluation a sensiblement modifié la perception touchant :
  i) *L'incidence environnementale des immeubles*. Dans l'enquête pré-évaluation, on dénotait chez la majorité des répondants une perception selon laquelle les immeubles n'avaient

qu'une incidence « négligeable » ou « pas très importante » sur l'environnement. Dans l'enquête après l'évaluation, la majorité des réponses obtenues étaient que l'incidence était « assez importante » ou même « très importante ».

ii) *La valeur des évaluations environnementales.* Cinq répondants sur six ont indiqué que le rapport dépassait leurs attentes.

iii) *La possibilité pour les gestionnaires immobiliers d'influencer leurs locataires.* Dans l'enquête avant l'évaluation, tous les répondants estimaient qu'ils n'avaient pas d'influence éventuelle sur les locataires en matière de conservation de l'énergie. Dans l'enquête après l'évaluation, quatre répondants avaient changé d'idée à cet égard et indiquaient détenir une influence probable s'ils faisaient un effort en ce sens.

- Les gestionnaires immobiliers sont motivés par des considérations financières. La valeur de l'évaluation repose sur les points permettant de réaliser des économies de fonctionnement.

- Les gestionnaires immobiliers sont intéressés à disposer d'une évaluation générale de leur immeuble et à comparer leur immeuble à d'autres. Ils sont en faveur d'un système de cotation et d'étiquetage.

Discussion sur l'utilité d'une évaluation environnementale globale

- *Un protocole d'évaluation environnementale global est pertinent pour les objectifs de gestion.* En liant l'environnement aux aspects financiers, on perçoit mieux que la majorité des pratiques écologiques de gestion des bâtiments sont non seulement favorables à l'environnement mais contribuent également à réaliser des gains d'efficience et des économies d'exploitation, tout en assurant le confort et la satisfaction des locataires. Cette prise de conscience est cruciale, parce que sans elle, peu de gestionnaires seront enclins à mettre en place un système de gestion environnementale pour améliorer leur entreprise, et ultimement, leurs résultats financiers. En synthétisant les meilleures pratiques, celles-ci deviennent pertinentes pour la majorité des immeubles grâce à une liste de vérification simple pouvant être remplie en une demi-journée, ce qui en fait un outil abordable pouvant être utilisé à l'interne ou avec l'aide minimale d'un consultant.
- *Dans le cas des entreprises possédant un parc important, l'outil est utile pour un examen à l'échelle du parc.* Il est parfois plus avisé de procéder à une inspection à l'échelle d'un parc en entier plutôt que de le faire à la pièce, parce que la direction adopte alors un point de vue stratégique selon lequel la collecte, la compilation et la synthèse des renseignements sur les dépenses touchant des propriétés ou le parc en entier peuvent favoriser une prise de décisions mieux éclairée. En élevant la gestion de l'énergie et de l'environnement au niveau d'une initiative stratégique, il est beaucoup plus probable que la haute direction d'une entreprise approuvera la démarche.

- *Lorsqu'il est utilisé pour l'inspection globale d'un parc, l'outil permet la formulation de nombreuses recommandations de mesures d'entretien à faible coût, dont beaucoup peuvent être appliquées à l'interne.* Un certain nombre de ces mesures peuvent s'appliquer à une

large portion du parc. Ces mesures doivent être communiquées le plus tôt possible après l'inspection des immeubles.

- *Lorsqu'il est utilisé pour l'inspection globale d'un parc d'immeubles, l'outil donne de bons indices des éléments sur lesquels il serait préférable d'engager des dépenses de rénovation.* Il s'agit probablement des immeubles qui ont le plus besoin d'une vérification du rendement énergétique. Lorsque les ressources financières sont rares, l'évaluation à l'échelle d'un parc permet également de déterminer quels immeubles profiteraient le plus d'une vérification complète du rendement énergétique et quels immeubles pourraient se contenter d'une vérification portant sur une ou deux composantes.

- *L'outil peut servir d'analyse comparative pour la société.* La possibilité de référenciation que l'évaluation offre est utile non seulement aux propriétaires et aux gestionnaires immobiliers qui veulent savoir quels sont leurs résultats comparativement à d'autres intervenants, mais elle peut servir également d'analyse comparative pour la société en indiquant dans quelle mesure la société réagit à la pollution de l'environnement. Dans l'avenir, il pourrait être possible d'afficher les résultats de toutes les évaluations (en préservant la confidentialité des résultats) sur Internet. Les gestionnaires et propriétaires pourraient consulter ces données pour évaluer leur rendement comparatif.

CMHC SCHL

National Office
700 Montreal Road
Ottawa ON K1A 0P7
Telephone: (613) 748-2000

Bureau national
700 chemin de Montréal
Ottawa ON K1A 0P7
Téléphone : (613) 748-2000

Puisqu'on prévoit une demande restreinte pour ce document de recherche, seul le résumé a été traduit.

La SCHL fera traduire le document si la demande le justifie.

Pour nous aider à déterminer si la demande justifie que ce rapport soit traduit en français, veuillez remplir la partie ci-dessous et la retourner à l'adresse suivante :

Centre canadien de documentation sur l'habitation
Société canadienne d'hypothèques et de logement
700, chemin Montréal, bureau C1-200
Ottawa (Ontario)
K1A 0P7

Titre du rapport: _____

_____

Je préférerais que ce rapport soit disponible en français.

NOM _____

ADRESSE _____
rue App.

_____
ville province Code postal

No de téléphone ( ) _____

Part 1 - Goals and Objectives of the Project

Background

There are many reasons for measuring the environmental performance of buildings, chief among them being that it can help building owners decide where to put their retrofit dollars to improve their buildings and reduce operating costs. In North America, there is a large stock of buildings constructed in the 50's and 60's whose systems are reaching obsolescence and will require major retrofit. This is an opportune time to be making environmental enhancements to these buildings which can improve their bottom line. For example, energy efficiency measures can reduce the sizing of mechanical equipment. Through the evaluation of their buildings by an outside party, management staff also receive insights into better management practices. Implementing better maintenance and environmental management can reduce operating costs and help avoid - or respond to occupant complaints about building-related health issues.

Although the environmental performance assessment of buildings is still not a mainstream activity, there are several signals that indicate it soon may be.

- *Experts agree that building performance rating is one of the most effective ways to increase the market demand for environmentally designed and managed buildings.* For example, one of the key recommendations by the *Issue Tables for Climate Change for the Building Sector* was to have a national building labelling and rating program.
- *The promotion of energy efficiency needs to be linked to other issues such as comfort, health, IAQ and productivity.* This calls for a measuring and benchmarking tool. This is the conclusion of a growing number of energy practitioners such as Peter Love, representing the Canadian Energy Alliance.
- *Municipalities are showing interest in performance evaluation programs for buildings.* Toronto's *Better Building Partnership (BBP)* has already licensed BREEAM as a screening tool. Programs such as the BBP are gaining interest in other cities such as Vancouver and Ottawa. The Federation of Canadian Municipalities is launching a *Green Leaf for Municipal Operations* rating program to assess overall municipal building operations currently being developed by ECD and TerraChoice.

Objectives

CMHC commissioned the environmental assessment of six high-rise multi-residential buildings, using the BREEAM Green Leaf assessment methodology. The objectives of the pilot were:

- To find out how well the six buildings apply healthy housing principles
- To obtain client feedback on environmental issues, including healthy housing principles.
- To obtain client feedback on the value of the environmental assessment.
- To find ways to better reflect healthy housing principles in the assessment methodology.

Six detailed, individual building assessment reports were undertaken. This report summarizes the results of the findings and the user survey.

Part 2 - Evaluation Protocol

Environmental assessments can cost several of thousands of dollars. BREEAM/Green Leaf was developed in response to the need in the marketplace for a less expensive methodology that could be partially conducted in-house. This makes it an appropriate introductory, whole-building, comprehensive energy and environmental assessment for managers of multi-residential buildings. Note that it is not intended to replace a full engineering study of the building, but rather gives an overview that highlights the achievements and redflags areas where improvements or further investigation should be conducted. The assessment is based on an investigation of building performance and management practices by use of a checklist and walk-through survey. The data is then used to generate a report, which provides a building rating and a list of recommendations to improve the building and management performance. The methodology originated in Canada and was developed by ECD Energy and Environment Canada and Terra Choice. It combined the BREEAM set of environmental issues with the Green Leaf Eco-Rating procedure.

Origin

BREEAM/Green Leaf was conceived in 1998 to provide a simplified approach to a broad scope of issues while maintaining the principles of credibility, affordability and efficiency. The program is based on the internationally recognized BREEAM (Building Research Establishment Environmental Assessment Method) criteria, and the assessment procedure modelled on the Green Leaf Eco-Rating Program for the Canadian Hotel Industry. *BREEAM CANADA* Methodology was developed by ECD Energy and Environment Canada and published by the Canadian Standards Association as their CSA Plus 1132 publication. It provides the technical basis of the method. The original design and implementation of the Green Leaf eco-rating methodology was directed by the Hotel Association of Canada (HAC) with support from Environment Canada, Public Works and Government Services Canada, Natural Resources Canada, and Heritage Canada. It was developed and operationalized by TerraChoice. The Program was a natural extension of the work TerraChoice had been doing in its delivery of the Environmental Choice Program, which applies the EcoLogo to products and services that are less stressful to the environment.

Benefits

Through the BREEAM Green Leaf' Program, a building owner or property manager is able to:

- identify ways for achieving energy savings and addressing health and comfort issues that are important to their clientele, through improved operations;
- gain increased market share by providing the public with an independent, credible verification of its environmental performance; using trained assessors;
- better protect investments by reducing environmental liability risks; and
- demonstrate its commitment and responsibility to the environment and community.
- learn how their building performs relative to others in the same sector.

Guiding Principles

The BREEAM Green Leaf Eco-Rating Program is designed to be:

- ***Practical:*** simple, understandable, based on best practices;
- ***Comprehensive:*** covers major building management and operations areas
- ***Credible:*** ratings based on a facility's performance against current best practices in the industry
- ***Verifiable:*** independent third party verification of performance claims is essential to the success of any credible evaluation program
- ***Adaptive:*** can be applied to a wide variety of buildings in terms of size, scale, types and combinations of services and facilities, etc.
- ***Fair:*** based on realistic, practical initiatives currently in place in the industry, not impractical standards that facilities could never meet.

Scope

The multi-residential buildings assessment addresses six primary environmental performance issues. These are further subdivided into subcategories.

ENVIRONMENTAL MANAGEMENT

- *Environmental Management System* :
  Strategic planning, performance targets, prioritisation, training sessions, programs, regulatory compliance, continual improvement
- *Purchasing Policy*:
  Environmental purchasing, contract procurement and energy efficient equipment,
- *Emergency Response*:
  Risk assessment and emergency response procedures to chemical spills, asbestos, accidental CFC release,

ENERGY & WATER EFFICIENCY

- *Building Energy Efficiency*:
  Energy performance targets, demand reduction, building envelope, air sealing and energy efficiency features.
- *Energy Management*:
  Energy policy, audits, monitoring and targets, budgeting, metering and preventive maintenance,
- *Transportation*:
  Access to public transit and provision for alternative modes of transport
- *Water Efficiency*:
  Water performance targets, water saving features, metering, leak detection systems, landscape irrigation, water-cooling towers

RESOURCES

- *Waste Reduction & Recycling*:
  Waste handling and recycling facilities for recyclables, composting, waste reduction programs, reuse of building materials in construction or demolition, and reduce, reuse, recycle programs
- *Site*:
  Environmental site assessments, remediation and ecological enhancement

EMISSIONS, EFFLUENTS & OTHER ENVIRONMENTAL IMPACTS

- *Air Emissions*:
  NOx emissions, boiler control, monitoring and upgrades, analysis of flue gasses, low sulfur content of fuel, boiler upgrades
- *Ozone Depletion*:
  Phase out plans for ozone depleting refrigerants, leak detection and recovery, refrigerant inventories, refrigerant storage
- *Water Effluents*:
  Floor drains protection, roof drains disconnected from sanitary or combined sewers, non-toxic cleaning supplies, landscaping practices, minimization of glycol loss
- *Microbial Contamination*:
  Maintenance schedules for wet cooling towers, drift eliminator(s), stratification of hot water tanks, deadlegs in hot water system, point-of-use heaters
- *Hazardous Materials*:
  Asbestos, lead pipes, radon, PCBs, storage tanks, hazardous materials storage and containment, pesticides, MSDS sheets, WHMIS labels, education/training.

INDOOR ENVIRONMENT

- *Lighting*:
  Use of electronic ballasts, shading and blinds, cleaning of light fixtures.
- *Ventilation*:
  Location of air intakes, CO_2 concentrations, corridor make-up air, standing water in condensate drip trays, corrosion in AHU, clean ducts, percentage of fresh air in HVAC, openable windows, cross ventilation, occupant's HVAC controls and maintenance
- *Filtration*:
  Filter efficiency, fitted manometers for replacement schedules, and ease of access to filters
- *IAQ profile*:
  Source control, mould, chemical storage areas, complaint response procedures,
- *Parking, Shipping and Receiving*:
  Ventilation of parking areas, street level air intake monitoring for CO
- *Renovation, Decorating and Remodeling*:
  Renovation procedures including IAQ concerns,
- *Smoking*:
  Designated smoking areas

DWELLING UNIT CRITERIA

- *Safety and Location*:
  Safety of the neighborhood, building security, distance to shopping, schools, places of worship, parks etc., common facilities in the building.
- *Environmental Controls*:
  Thermal comfort, relative humidity
- *Daylighting and Views*:
  Views, overshadowing,
- *Acoustics*:
  Noise separation
- *Household Information kit*:
  Access to environmental information
- *Dwelling IAQ*:
  Mould, off-gassing, VOC, carpeting
- *Accessibility*:
  Accessibility conditions

In its scope, the BREEAM Green Leaf covers issues similar to CMHC's *Five Essentials of Healthy Housing*[1]

The Five Essentials of Healthy Housing

- High efficiency ventilation system to ensure superior indoor air quality
- Low emission paints to reduce vapours
- Hardwood and tile floors which are easier to clean
- Cabinetry and shelving from special products that do not emit formaldehyde and other vapours
- Storage rooms ventilated to exterior

- High efficiency hot water heating system to reduce fuel consumption
- Increased insulation levels in walls and attic
- High efficiency windows and doors
- Energy efficient appliances
- Energy efficient lighting like compact fluorescents
- Generous windows to reduce lighting costs

- Low flow toilets and plumbing fixtures to conserve water
- Efficient use of building materials to reduce construction waste
- Extensive use of recycled building materials
- Use of rapid growing woods like spruce and maple
- Locally produced materials to support local economy

[1] http://www.cmhcschlc.ca/cmhc.html

- Recycling of old building materials
- Recycling center in the kitchen
- Exterior composter
- Better use of site by increasing occupant density
- Use of building products that require lower energy to manufacture
- Home office to reduce vehicle usage

- Use of products that are readily available at reasonable cost
- Flexible design will reduce future renovation costs
- Low maintenance, long lasting materials and finishes
- High indoor air quality for better occupant health and lower health care costs
- Energy efficiency means lower heating and electricity costs

In addition, BREEAM Green Leaf addresses operation and management issues. Some elements of the *Five Essentials* such as better use of the site to increase occupant density; flexible design to reduce future renovation costs, and use of recyclable materials are covered in greater detail in the *BREEAM Green Leaf for New Buildings*, which has been developed for projects at the design stage.

Many of the health related risk factors are in the dwelling units themselves are not under direct control of the property manager. However, the property manager can make suggestions to occupants for their own benefit, using various media, for example, bulletin board notices, newsletters and a household information kit.

Sectional Assignment of Points/Weights for Evaluation Purposes

The building and management performance evaluation result is generated by addition of scores assigned to various performance and prescriptive criteria. All six primary issues have been assigned certain point levels to reflect their relative environmental impacts. Out of a maximum possible 1000 points, the section "weightings" are:

Environmental Management Systems	100 points
Energy Efficiency	345 points
Water Efficiency	55 points

Resources	100 points
Emissions, Effluents & Other Environmental Impacts	185 points
Indoor Environment	105 points
Dwelling Unit Criteria	110 points

Building evaluations can either be *performance*-based or *prescriptive*. Without question, the most scientifically rigorous method of evaluating building performance is by using a life cycle assessment, based on calculations of the environmental impacts during the entire lifecycle of the building from the moment the raw materials are extracted, and including production of building materials, building construction, and use, to demolition and potential reuse. This includes the impact of embodied energy (used in the extraction and production of building materials), operational energy, and maintenance during the building-use phase. It must take into account the differences in the durability of building components related to the life span of the building. Life-cycle assessment requires calculations of the energy flow of all materials and processes used in buildings. Such a system requires lengthy research and is not practical for all buildings. Other performance based evaluations use performance benchmarks, which are easier to determine for some issues, e.g. energy but more difficult to define for others, e.g. IAQ. Prescriptive systems evaluate facilities based on best practice criteria. However in order to prioritize the criteria, such an evaluation system needs to use weighting. BREEAM and BREEAM Green Leaf use a combination of prescriptive and performance-based criteria. For example, points are awarded based on water consumption figures, as well as for implementing water conservation best practices.

The question of assigning points or "weightings" is complex, and has produced several schools of thought. The UK BREEAM weightings are based on a series of consultations, which BRE (Building Research Establishment) conducted with 1,000 participants, who were asked to assign social, economic values to each of the building-related activities and its environmental impacts. In Canada, the program developers have not yet had the opportunity to conduct such extensive consultations. For this reason, a mean of the British BREEAM, the Harvard and the EPA environmental weightings were used. The overall results, compared to the American LEED system and the Canadian GBC tool were found to be generally consistent.

The practical value of performance evaluation lies not in the actual number of points but in the ability to compare different buildings and identify systems within any particular building which need improvement.

Overview of the Checklist, Assessment Procedure and Evaluation Framework

Organization of the Checklist

There are three parts to the evaluation checklist. The first section addresses the management aspects of the building and its operation. This section is typically reviewed with the property manager. The second part of the questionnaire deals with the physical aspects of the building envelope and mechanical systems and is typically addressed during the walk-through survey of

the building. The third section addresses the specific aspects of the building type, in the case of MURBS, these are dwelling criteria.

Checklist Questions

The program is based on BREEAM Canada and the BREEAM adaptation for PWGS Canada called "Progress Towards Sustainable Development Commitments" in consultation with PWGSC building industry experts. The criteria were then reviewed and revised in consultation with CMHC experts to ensure that they were suitable for multi-residential buildings.

The criteria relate to specific performance benchmarks or management best practices. For example, current best practices in terms of energy include:

- lighting retrofit using high efficiency lighting
- installation of high efficiency boilers
- installation of hot water savings devices
- programmable thermostats/ controls in dwelling units

Responses to the questions take several forms including:

- simple "yes/no" responses;
- the placement of check marks in appropriate boxes corresponding to affirmative statements; and
- examples, estimates or specific data to be provided
- specific data or supporting documentation

Assessment Procedure

The following steps describe the process for doing each building assessment in the pilot:

Prior to the assessment

1. The property management firm was asked to provide the name of the property manager for the selected building.
2. The property management firm briefed the property manager about the pilot.
3. The assessor called the property manager to describe the process and set up an appointment to do the assessment.
4. Prior to the appointment, the assessor sent the property manager a copy of the BREEAM Green Leaf questionnaire and a list of required supporting documentation. The property manager was invited to fill in as much of the questionnaire as he/she felt comfortable with, prior to the appointment.

On the day of the assessment

1. The property manager was asked to fill in the pre-assessment survey to find out about:

- the existing level of awareness and concern regarding environmental and healthy housing principles.
- expectations, needs and concerns regarding the assessment.

This took approximately 10 minutes.

2. The assessor and the property manager completed the sections of the BREEAM Green Leaf questionnaire that deal with environmental management systems, purchasing policy, emergency response, and communications. This was done using an interview approach, whereby the assessor asked questions and recorded the responses. (None of the participants had filled in the questionnaire prior to the assessment.).
3. The assessor requested supporting documentation, including energy and water bills. The steps two and three of the assessment took approximately 1.5 hours.
4. The assessor conducted a walk-through survey of the building, including the plant room, the basement, common areas and one or two sample dwelling units. During the walk-through, further questions in the questionnaire were asked regarding the building mechanical systems and the current procedures that were being used to operate and maintain them. This portion of the assessment took approximately 1.5 hours.

Following the assessment

1. The assessor prepared the report.
2. The assessor sent the report to the property manager.
3. The assessor called the property manager to set up a follow-up meeting.

Follow-up meeting

1. The property manager and the assessor reviewed the report.
2. The property manager was asked to complete the post-assessment survey, designed to:
   - compare the level of awareness and concern regarding environmental and healthy housing principles before and after the assessment
   - ascertain whether the assessment met the client's expectations,
   - find out how the assessment could be improved.

Rating Score

The program provides for a designation of one to five trademarked "Green Leafs", and issues a program participation plaque to the pertinent facility with the appropriate eco-rating designation applied. In general, the designations reflect the following objectives for each eco-rating level:

- **1 Green Leaf**: To participate in the BREEAM/Green Leaf Eco-Rating Program, a building must have identified and initiated some measures to improve the environmental performance such as energy use reduction strategies, water conservation steps, waste reduction, etc. A key component should be commitment to a set of guiding environmental principles.

- **2 Green Leafs**: This designation indicates that the facility has moved beyond awareness and commitment to sound environmental practices, and has demonstrated good progress in reducing environmental impacts of its operations.
- **3 Green Leafs**: This designation indicates excellent progress in achieving eco-efficiency results through current best practices in all areas of a facility's operations and management.
- **4 Green Leafs**: This designation indicates national industry leadership in terms of eco-efficiency practices and management commitment to continuous improvement and industry leadership.
- **5 Green Leafs**: This designation is reserved for select facilities, which are serving as world leaders in eco-efficiency, and are continually introducing policies and improved practices that can be adopted by others.

The cost of a BREEAM/Green Leaf assessment is under $1,000.

How BREEAM/Green Leaf Compares with BREEAM

BREEAM/Green Leaf covers the same global, local and indoor environmental issues as BREEAM. As with a BREEAM assessment, the BREEAM/Green Leaf assessor also conducts a walk-through survey of the building that includes the plant room, common areas and typical tenant areas. Similar to BREEAM, the BREEAM/Green Leaf deliverables include a comprehensive report with recommendations. Highlights of the report are summarized, as well as the main opportunities for improvement in terms of operational savings, due diligence and occupant health and comfort.

There are three areas where BREEAM/Green Leaf differs from BREEAM:

1. The BREEAM/Green Leaf system addresses important tenant issues in addition to the same global and local environmental issues that are covered by BREEAM.
2. The BREEAM/Green Leaf assessment procedure is more streamlined than BREEAM. Whereas a BREEAM assessor verifies all supporting documentation, the BREEAM/Green Leaf assessor conducts only spot checks. The report indicates which of the building's achievements have been verified. Random spot audits may be conducted at any time to confirm continuing performance at reported levels. This is essential in order to ensure the credibility and reliability of the program.
3. BREEAM/Green Leaf uses a different rating nomenclature.
4. The BREEAM assessment includes "before and after" assessments and reports. the preliminary report provides recommendations. The final report takes into account any improvements that were made.

Part 3 - Selection of Buildings

Six large property management firms were approached with the offer of a subsidized assessment, in exchange for which they would complete a survey. Participants provided access to the buildings they would prefer to have assessed. The sample represented a wide range of multi-residential building types, age and size. The buildings ranged from inner city housing to city/suburban locations and from social housing to a luxury condominium. The characteristics and mechanical systems of the participating buildings are shown in Tables 1 and 2.

Building	Size	No. of units	No. of stories above grade	No. of stories below grade	Date of construction	Age of building	Type
31	324,360	228	17	2	1974	26 years	Rental
3 2	367,140	483	29	3	1972	28 years	Rental
3 3	159,850	145	5	1	1986-87	13 years	Rental-social housing
3 4	95,040	90	6	0	1958-59	41 years	Rental
3 5	228, 990	260	12	1	1965	35 years	Rental
3 6	813,393	504	46	3	1991	9 years	Condominium

Table 1 Building Characteristics

Building	Mechanical system	Make-up air	Exhaust
B 1	fan coil unit with central hot water tanks (central A/C)	Yes	B
B 2	central hydronic via baseboard converters (window A/C)	Yes	B/Central
B 3	incremental electric heating and cooling	Yes	B
B 4	central hydronic via baseboard converters (window A/C)	No	B/Central
B 5	fan coil unit with central hot water tanks (window A/C)	Yes	K/B
B 6	electric baseboard with fan coil unit (central A/C)	Yes	K/B/L

K-KITCHEN, B-BATHROOM. L-LAUNDRY

Table 2 Mechanical Systems

Part 4 - Comparative Results for the Assessed Buildings

ENVIRONMENTAL MANAGEMENT SYSTEM AND ENVIRONMENTAL POLICIES

Although none of the building management firms in this pilot had a formal environmental management system or environmental policy, all had a strong corporate culture of conformance to environmental legislation and strategic planning. All of the managers who were interviewed were highly experienced. Five of them had worked with the same building for many years. All showed a remarkable personal commitment. Working within tight budgets and with never enough hours in the day, it is understandable that it could appear almost superfluous for these building managers to formalize an environmental management system and document information, which they know so well from long experience.

ECD has learned from numerous past assessments that whilst some buildings do have extensive policies and environmental systems, these are not necessarily followed through or sufficiently monitored. Other companies have the benefit of highly experienced, knowledgeable and committed building operators, but little formal documentation. Corporate experience in recent years and the growing acceptance of quality management systems such as ISO 9000 and 14000 show that well documented policy statements and procedures can have a strong effect towards their implementation, provided there is also a culture of quality management to ensure that a company "walks the talk".

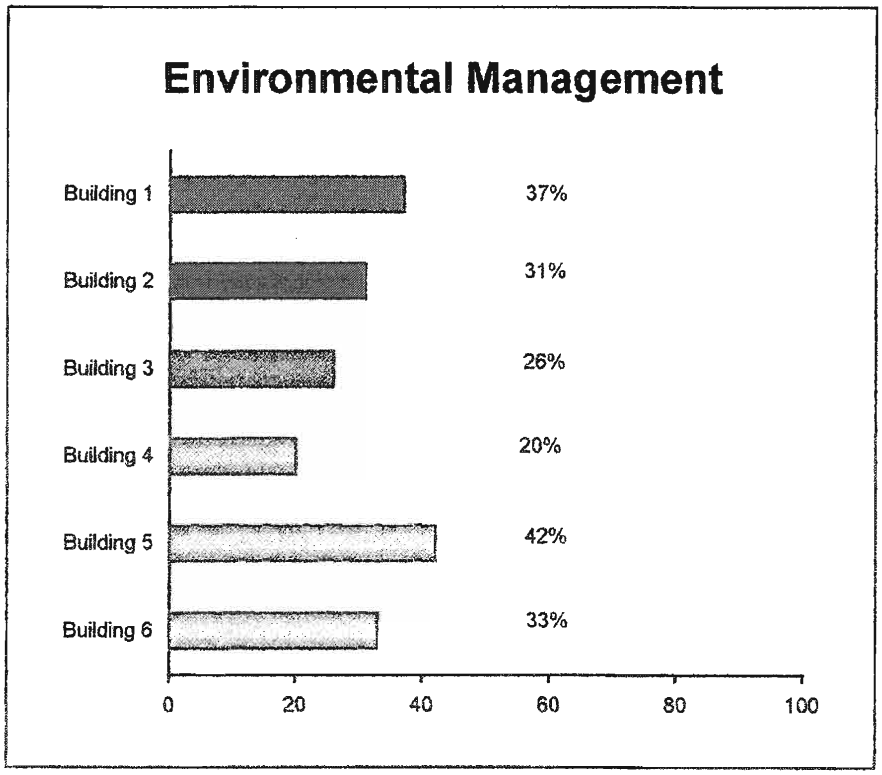


Fig 1: Environmental management - performance of the assessed buildings.

ENERGY

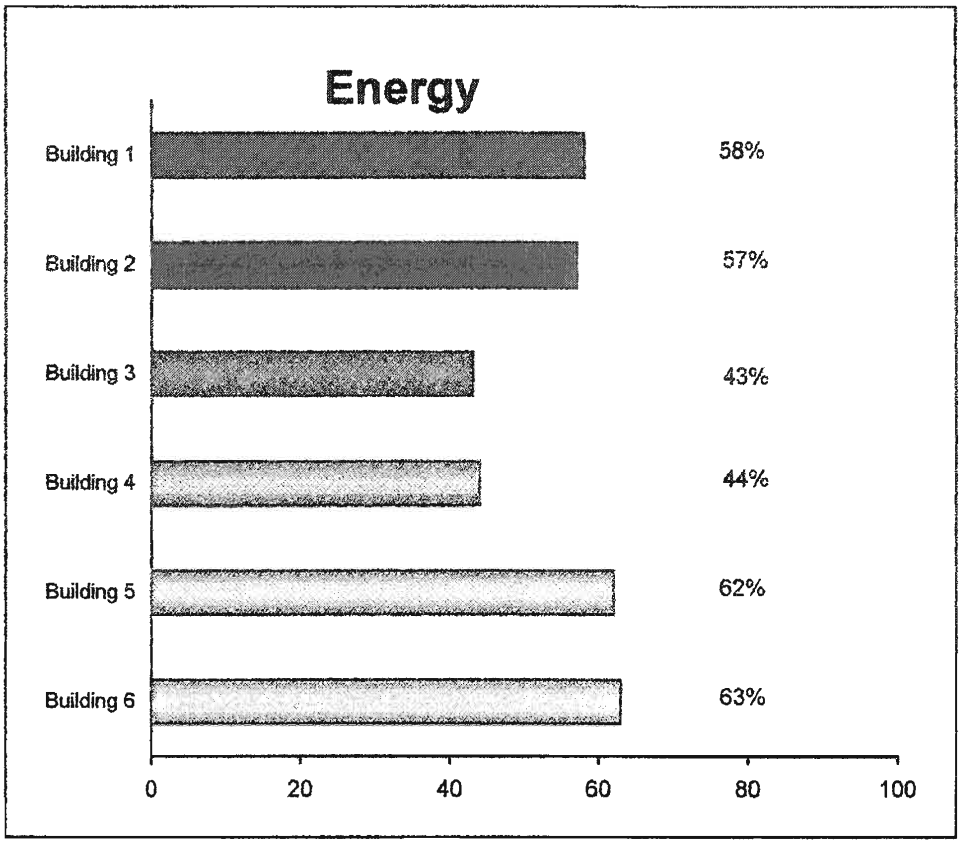


Fig 2: Overall energy performance of the assessed buildings

Energy Consumption

Energy consumption of the participating buildings is shown in Table 1, and graphically in Figures 3 and 4. Note that buildings 3 and 4 had tenant submetering. Billing is done directly to the tenant and is confidential. The full energy data was therefore not available. Electrical energy consumption figures for these buildings were only given for common areas. However, energy modeling was used for the whole building rather than the actual data.

Building	Energy kWh/ SF/yr	Energy kWh/ unit/yr	Size of building	Age of building	Tons CO_2/yr	Gas (m^3)	Electricity (kWh)
B 1	22.13	24, 929	324,360	26 years	3,222	465,929	2,382,000
B 2	44.44	33, 788	367,140	28 years	6,225	1,211,487	3,887,200
B 3	20.00	22, 023	159,850	13 years	1,771	154, 265	239,200*
B 4	25.20	26, 568	95,040	41 years	N/A	N/A	120,910*
B 5	24.40	21, 488	228, 990	35 years	2,286	393,932	1,546,000
B 6	23.53	37, 968	813,393	9 years	13,807.7	540,047	13,596,054

* common areas only

Table 1: Energy Consumption

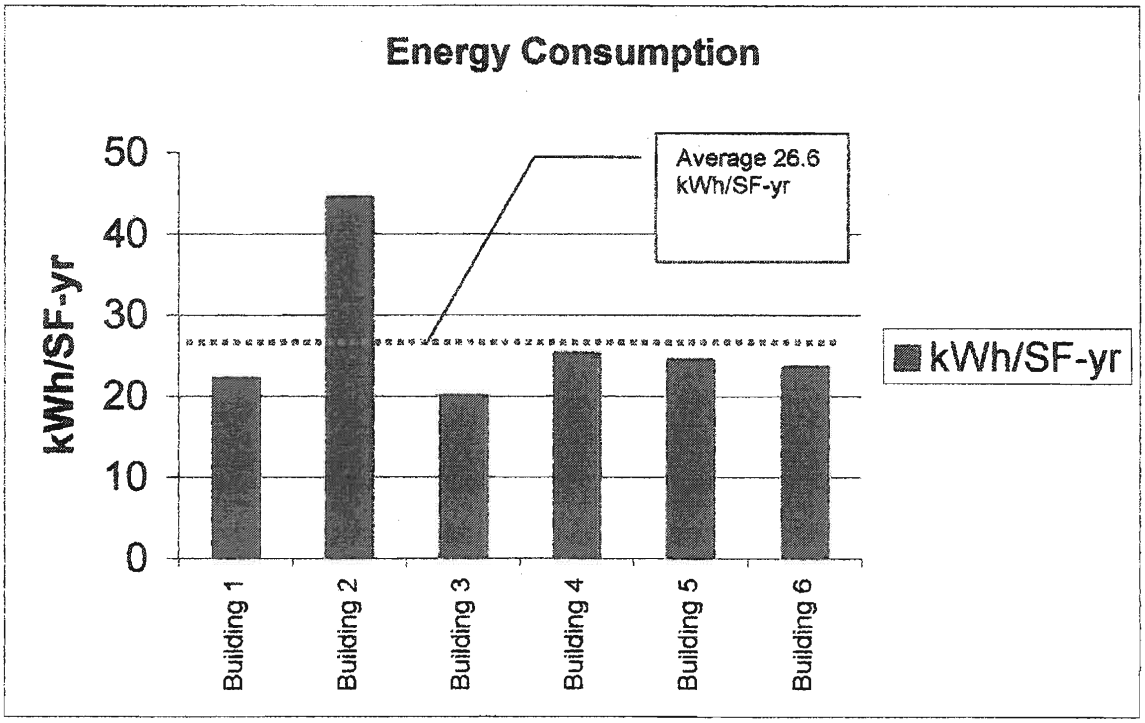


Figure 3: Energy Consumption per SF

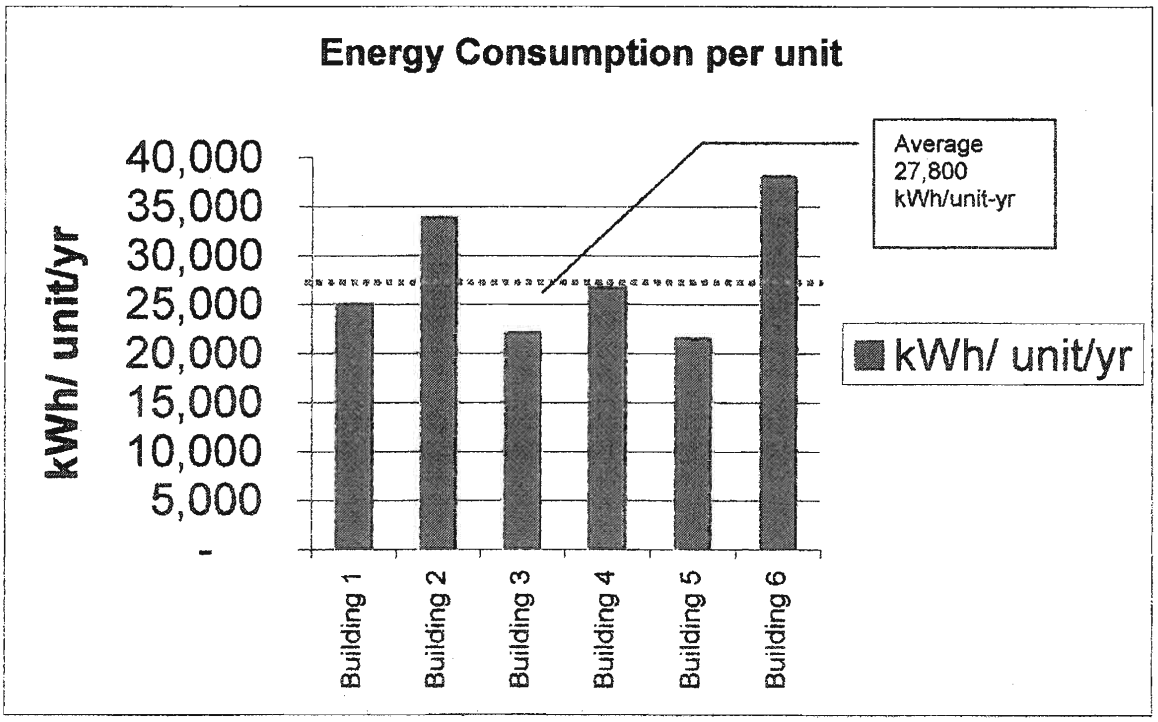


Figure 4: Energy Consumption per dwelling unit

The sample size is too small to make any conclusion about the energy performance of the participating buildings, with few patterns in the energy consumption emerging. For example, in this sample, the older buildings do not consume more than the newer ones, nor do the larger buildings consume less energy per square foot than the smaller. However there appears to be some correlation between energy consumption per dwelling unit and the height of the building as well as the size of the dwelling units (and thus indirectly, to the income bracket of occupants). The two buildings (2 and 6) with the highest energy consumption per dwelling unit are the tallest, have larger-sized units, and have higher-income tenants, whereas the buildings with the lowest energy consumption per unit are the least tall and have the smallest units, and offer social housing. Air leakage due to height, and occupant lifestyle habits may be the cause of the high consumption in Buildings 2 and 6.

Energy Efficiency Measures

The table below shows how many buildings in the pilot implemented some common energy efficiency measures. The most common improvement was the lighting retrofit, followed by installation of the building automation system (BAS) and hot water saving devices such as aerators and low flow showerheads. Another common measure was to replace electrical clothing dryers with gas appliances. The more capital-intensive items such as high efficiency boilers or variable speed fans were less commonly found. There were some comments about the less-than-satisfactory performance of building automation controls, particularly for boilers. One property manager complained that following installation of the BAS, the building's gas consumption went up. The controls were therefore disconnected. Building managers expressed the opinion that there was little incentive to install programmable thermostats in bulk-metered apartments, since they believed that they would not be used and would just result in increased maintenance costs.

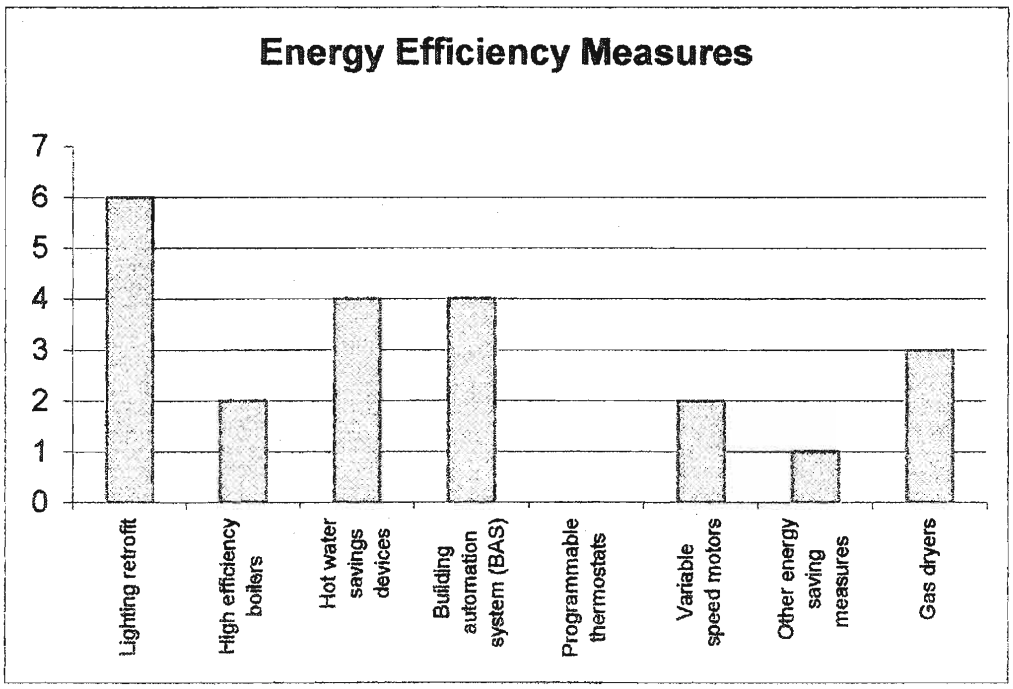


Figure 5: Energy Efficiency Measures

Many of the buildings had undergone recent retrofits. Four out of six of the buildings had new roofs, with improved insulation, and new or recently retrofitted windows. Four out of six had recently repaired the garages or were in the process of doing so. The oldest building in the sample had been partially reclad with improved insulation. Property managers indicated that there were no problems of air-leakage or stack effect. This may have been due to the fact that the work on the roofs and the garages had resulted in better tightness of the buildings' envelopes, although it was not clear whether the retrofits included air sealing.

There may be a lack of awareness of the importance of making the buildings airtight among the property managers, many of whom assume that roof or garage repairs deal with the this issue. Whilst new roofs, improved insulation, and new or retrofitted windows represent an improvement in the building envelope performance, they do not necessarily constitute air tightening of the envelope, which is necessary for envelope durability.

Air leakage is defined as the uncontrolled migration of conditioned air through the building envelope caused by pressure differences due to wind, chimney (or stack) effect, and mechanical systems. A CMHC study-*Energy Audits of High-Rise Residential Buildings*, indicates that air leakage is the single largest source of heat loss or gain through the building envelopes of nearly all types of buildings. Tests carried out by the National Research Council of Canada on high-rise commercial and residential buildings, schools, supermarkets, and houses have shown that 30% to 50% of heat loss could be attributed to air leakage. Proper air sealing of a building can save 15% of the utility cost with an average payback of less than 5 years. Uncontrolled air leakage can also affect thermal comfort of occupants, air quality through ingress of contaminants from outside, cause imbalance of mechanical systems, and affect the structural integrity of the building envelope - through moisture migration. Property managers need therefore to be aware that there is a high probability that further investigation of air leakage could be beneficial. The fact that the highest rate of energy consumption occurs in the two tallest building in the sample, in spite of several energy conservation measures that these buildings have implemented, may be the result of air leakage and point to the need of further investigation with a view to improving air-sealing.

Control of air leakage involves the sealing of gaps, cracks and holes using appropriate materials and systems, to create a continuous plane of air-tightness to completely encompass the building envelope. Part of this process should be the decoupling of floors from each other to avoid vertical leakage and to compartmentalize components of the building.

Buildings in the pilot that had not already done so, were recommended to investigate some or all of the following measures to produce further improvements to their energy efficiency:

- examine the air-tightness of the building envelope.
- replace of aging boilers with high efficiency boilers.
- make better use of building automation controls.
- introduce of variable speed drives.
- improve windows (including use of low-e films for retrofits).
- improve ventilation systems incorporating heat recovery.
- evaluate insulation upgrades for walls and roofs.
- schedule make-up air, central exhaust and laundry room exhaust systems.
- calibrate thermostats.

- lower thermostat set-points in garages, storage and service rooms.[1]
- investigate feasibility of cogeneration

Some strategies for energy reduction that focus on the decreased use of purchased energy may be offset by increases in other areas. For example, reduced air leakage may require improved ventilation. Or, energy-efficient lighting, at least indoors during the heating season, may require increased space heating.

Energy Management

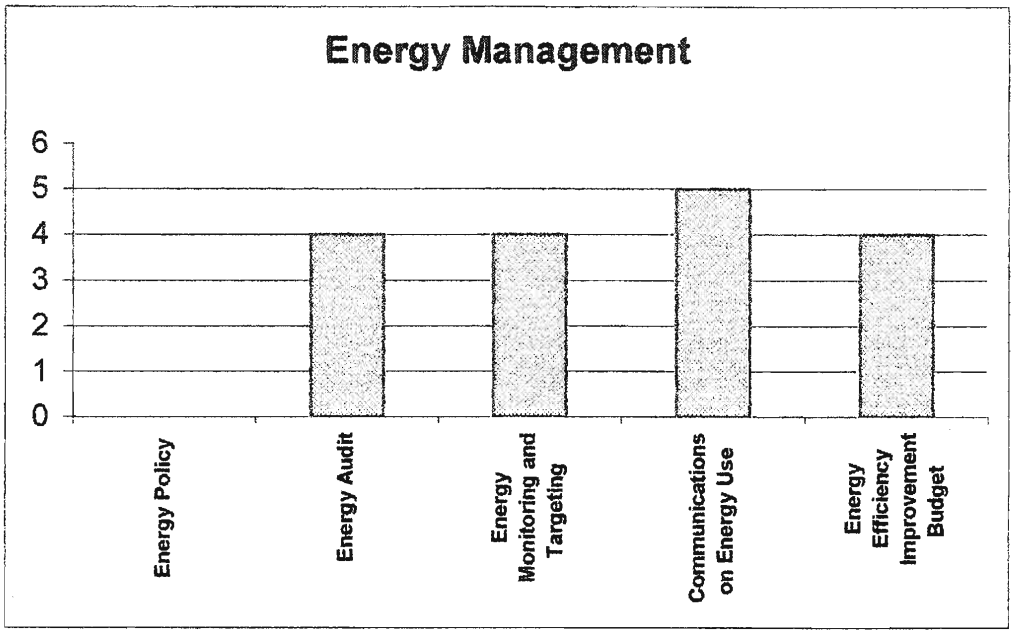


Figure 6: Energy Management

Although many of the buildings had an energy program, none had a documented energy policy. Energy audits had been carried out and energy monitoring done on a majority of the buildings. Similarly most of the buildings had some financial allowance for energy improvements through capital budget allocations. Whilst most buildings had some form of one-way communication on energy use in the form of newsletters or notices to tenants, this never involved a dialogue with tenants on energy use. Dialogue with tenants on energy matters, for example, by way of a survey with feedback, is inexpensive and can be effective.

[1] CMHC *Study report on the Energy Audits of High-Rise Residential Buildings*, Technical Series 97-100 Energy Audits of High-Rise Residential Buildings

Submetering

Four out of the six buildings in the pilot had bulk metering, and included utility costs in the tenant rents. Two charged the tenants individually for utility costs. Both of the buildings that practiced submetering were in the low-cost social housing category. The buildings in the higher category did not practice submetering - reportedly for marketing reasons.

Whether utilities are included in the rent or billed separately, there are inherent problems in terms of motivating energy efficiency. Reducing energy use in buildings involves two components: i) motivation on the part of landlords to install energy efficiency features, and ii) motivation on the part of tenants to adopt energy conserving habits. Where utility costs are borne by the tenants, there is little financial motivation for building operators to install energy efficiency measures that require capital outlay, and to monitor energy consumption. Since separate utility billing is currently practiced in lower-end accommodations, and there is little incentive for building owners to improve the energy efficiency of these buildings, this effectively penalizes the poor. Conversely, where utility costs are included in the rent, building owners are motivated to improve the energy efficiency of their building, but there is little motivation for the tenants to practice energy conservation. This largely occurs in higher-end accommodations, and is part of the marketing strategy. In both cases, there results a lack of motivation to seriously address energy conservation, which, in turn undermines efforts to establish and meet energy targets.

In the near future, submetering will no doubt become an essential component for dealing with energy deregulation, and property managers will increasingly require more sophisticated metering, for example, interval metering and submetering of major energy uses, such as hot water heating or make-up air.

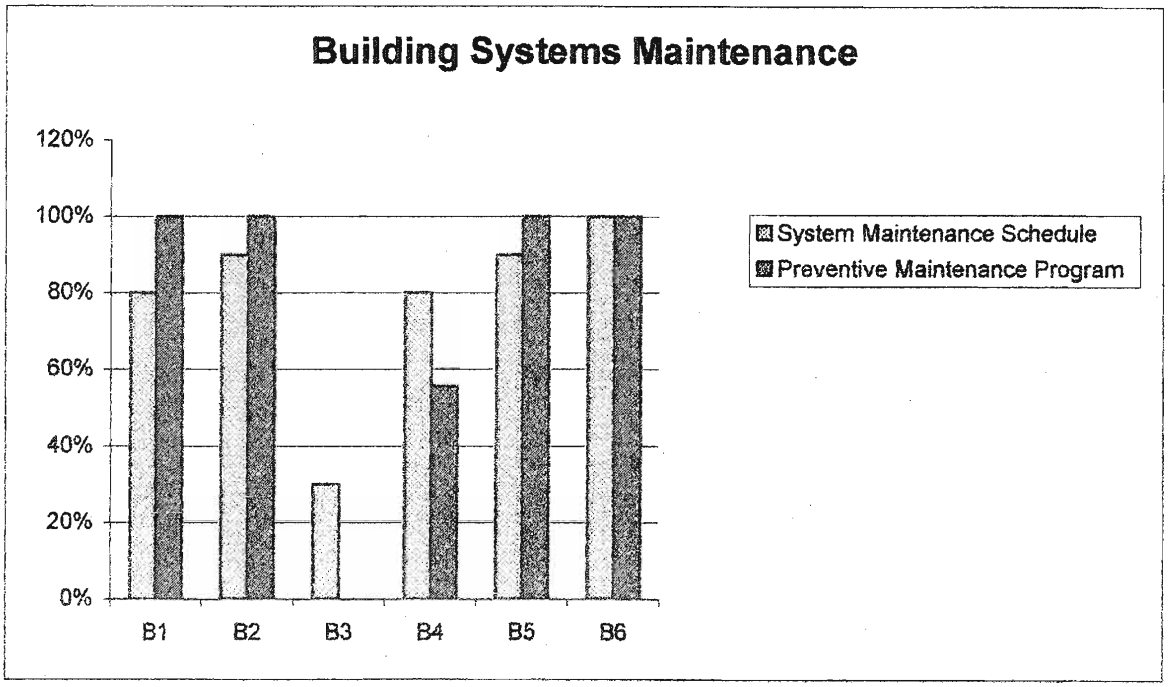


Figure 7: Building Systems Maintenance

A typical system maintenance generally includes checking of temperatures, checks on the correct operation of ventilation and cooling controls and monitoring of controls to ensure they are set correctly and are responding as intended, and cleaning of burners. Only two buildings had mechanical systems of the type that would require checks for refrigerant leaks, checks of air handling units and cooling towers, replacement of filters, and cleaning of wet regions in the air conditioning system. Additional measures that were not carried out by most buildings are:

- regular measurements of boiler efficiency;
- checking of air exhaust grilles to ensure they are delivering fresh air as required;
- identification and investigation of occurrences of excess energy use;
- cleaning of air intake grilles.

Many of the participants relied entirely on subcontractors to perform the key maintenance tasks. However, in some instances, there appeared to be little monitoring of the actual performance of the maintenance contractors. One participant mentioned intercepting a contractor as he was filling, in advance, his weekly reports in one day.

In some instances the operational manuals were not available on the premises. Two of the participants had a simple but effective method, which consisted in posting operational notes directly on, or next to the equipment. This method could be particularly useful in an emergency or during staff turnover.

While some companies are developing computerized preventive maintenance programs, the most common practice is the regular semi-annual or annual inspection of the building. This practice results in the timely retrofit and replacement of most of the building elements, such as roofs, windows, structural work on garages, and mechanical retrofits on as as-needed basis. However, without a long-term preventive maintenance program, there is little advance warning of potential failure of a system or component, due to its typical lifecycle aging process, and little possibility to do advance budgeting with a view to maintaining the building's value. CMHC's manuals (available on the internet) *An Operating Manual for Owners and Managers*[2] and *An Operating Manual for Maintenance and Custodial Staff*[3] would be helpful in setting up the maintenance programs.

Cycling and Storage for Bicycles

Good facilities for storing bicycles were found in only one building. In many buildings, this item of the assessment raised eyebrows. Bicycles were viewed as a nuisance, or building operators commented, "our tenants don't ride bicycles."

In a city like Toronto, cycling can be practiced for about half the year. Cycling to work not only has health benefits but can save as much energy in a day as is used by one person at an office job. Canada lags far behind European countries in the use of bicycles. In previous assessments of office buildings in Canada, it was found that when bicycle parking was provided, it was always fully used.

[2] ftp://ftp.cmhc-schl.gc.ca/highrise/om1final.pdf
[3] ftp://ftp.cmhc-schl.gc.ca/highrise/om2final.pdf

WATER

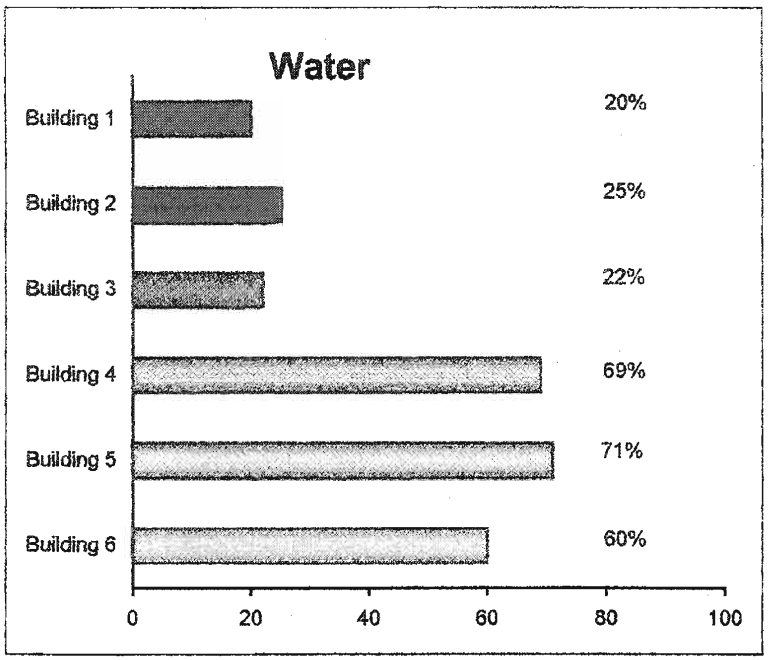


Fig 8: Water performance of the assessed buildings.

The majority of the buildings had undergone water conservation retrofits, such as installing water-conserving faucet aerators and showerheads, with considerable operational savings. The installation of low flush toilets reportedly met with varying degrees of success. Of the two solutions, i.e. retrofitting existing toilets by water displacement, water retention, and early closure devices - or replacing them with new low flush (LF) fixtures, replacement has proved to be more successful. Retrofit devices have often been found to have intrinsic design problems. Although the first low flush replacement toilets also had inferior performance, forcing many users to "double flush" and lose the water savings, the low-flow requirement of 6-L (1.6-gal.) in the Ontario Plumbing Code has prompted Canadian toilet manufacturers to redesign these products. There are now many CSA-approved LF toilets available on the Canadian market that offers superior performance and greater water reductions than do retrofits to existing toilets.

Three of the buildings assessed had swimming pools, which did not have water saving strategies. In one building, it was reported that water-saving measures had been considered but it was felt that they were not justified. This building had the highest water consumption.

Building	Total Consumption m3	Size of building	Water m3/m2/yr	Number of units	Water m3/unit	Water l/person/day*
1	69,733	324,360	2.3	228	306	209
2	101,540	367,140	3.0	483	210	144
3	33,408	159,850	2.2	145	230	158
4	13,633	95,040	2.0	90	151	104
5	40,345	228, 990	1.9	260	155	106
6	31,080	813,393	0.4	504	62	42

* an average of 4 persons per unit/household was assumed.

Table 2: Water Consumption

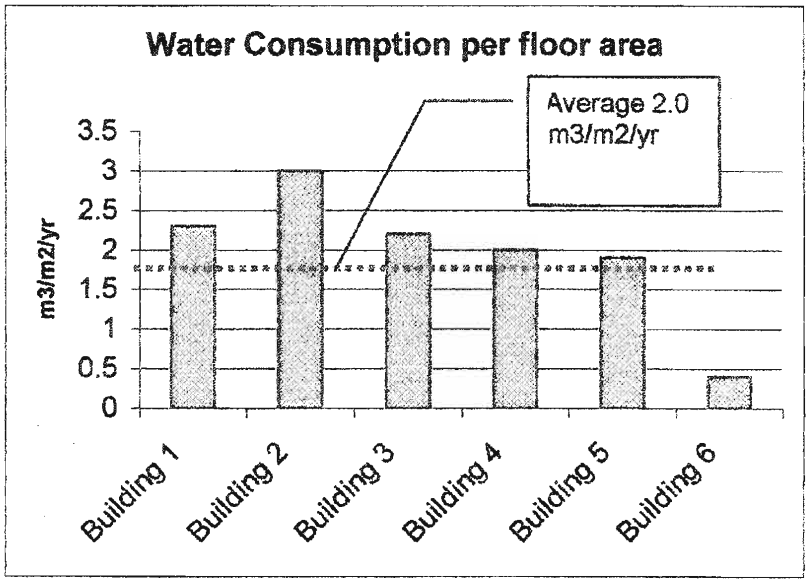


Figure 9: Water Consumption per floor area

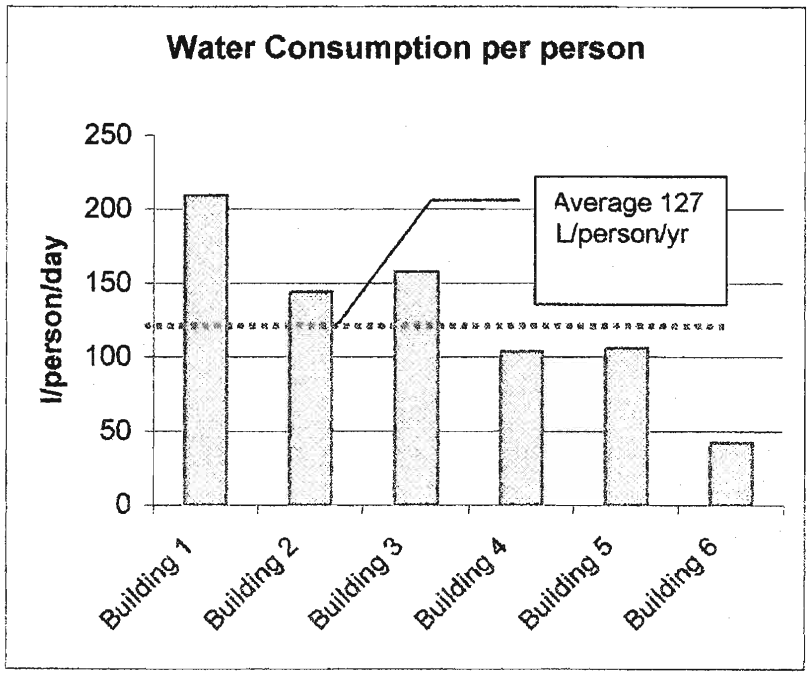


Figure 10: Water Consumption per person

The water consumption per person of most of the buildings compares favorably with the average consumption of 271 L/person/day in Ontario[4] as indicated by the *Municipal Water Use Database.* However, it should be noted that the *Municipal Water Use Database* includes transmission leaks, which could be quite significant. Thus it appears that in most of the buildings

[4] Lasselle D. *Municipal Water Use Database*, 1996, Environment Canada

there is potential for improvement in water conservation, especially when compared to Building 6.

Through the installation of low-flush, six-litre toilets a 40% reduction in water use can be achieved in apartment buildings. A *CSA* or *Warnock Hersey* label ensures that the fixtures have passed primary performance and maintenance tests. The dual-flush concept, a common technology in Europe and USA, has had slow take-up in Canada. CMHC is currently conducting research in this area, the results of which should help property managers to evaluate the applicability of this technology. Another measure, which merits further consideration, is installation of efficient clothes washers. According to a City of Toronto Energy Conservation Study, vertical axis clothes washers with reduced hot water consumption, and horizontal axis clothes washers with internal water heating can reduce hot water consumption by 20% and 80% respectively. Water-use reduction can be also achieved by landscaping. Very few buildings in the pilot actively practiced xeriscaping that is, using indigenous, drought-resistant grass and plant species.

RESOURCES

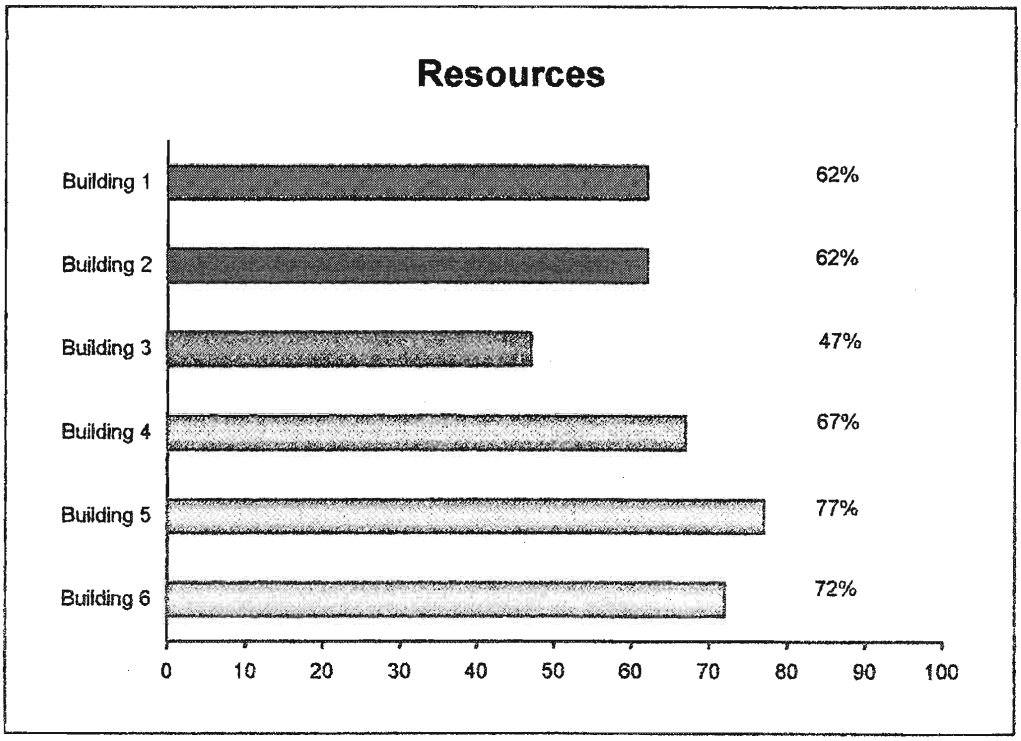


Fig 11: Resource performance rating of the assessed buildings

Recycling Waste

Only two buildings in the pilot have recycling rooms in the basement. In four buildings, tenants have to carry their recyclables to the container at the back of the building for collection. Virtually all participants in the pilot demonstrated a mindset that was not conducive to the promotion of

recycling. They indicated that recycling per floor was labour intensive. One facility manager expressed the opinion that tenants, who want to recycle, will do so, no matter how onerous it is, and those who have no interest in doing so are fixed in their position, no matter how building management tries to facilitate recycling. He mentioned a study he had come across which compared the amount of recycled material collected in a building that had only outside containers, to the amount collected in a building with recycling collection on each floor. According to this study, the amount of recycled material was the same for both buildings, while the costs were, naturally, higher for the building with the per-floor collection. Clearly, there is the need for outreach and training for property managers, to help them to conduct successful waste recycling programs in multi-residential buildings.

Several so-called "green buildings" have tried to find the solution to recycling. For example conservation Co-operative on 140 Mann Ave. Ottawa, Ontario has four recycling rooms per floor for occupants' sorting. Occupants must carry waste garbage to the basement, which further encourages recycling. Composters are located in courtyard for organic waste.
Tatry-Pathway Housing Non-profit Co-operative in Mississauga, Ontario, has a two 0.6m recycling areas for waste collection and sorting on each floor, as well as a mechanical separator chute system that simplifies recycling for occupants.

Due to the fact that in some localities, such as Toronto, garbage is becoming a major political issue, it is clear that reduction, recycling and re-use are pressing needs. The issue also has cost implications, for which everyone will pay.

An effective solid waste-recycling program requires separation and sorting, short-term storage and regular pick-ups. The provision of storage is a necessary part of a recycling program for paper and other consumer recyclables. Two features are of importance:

- *Storage area within the dwelling unit:* Contemporary dwelling units are most often designed to be as small as possible. This means that space for storage of newsprint/paper, plastics and glass recyclables must be purposely included, in or near kitchen areas. If the dwelling plan does not have such a feature, it is reasonably certain that recycling efforts will be impaired.
- *Storage area in the building:* Recyclables storage refers to separate and dedicated storage for all recyclables. The storage area may be central or distributed throughout the building, but in large buildings there must be a pick-up point located at the loading dock.
- *Compaction:* Most recyclables are bulky and are stored in a low-density form. This is particularly problematic when a vehicle without compacting equipment picks them up because it makes transport inefficient. Reducing the bulk of recyclables will make their handling and transport more efficient.
- *Composting:* A considerable amount of organic waste is generated in residential buildings from normal household activities. Such waste is typically mixed with other wastes and directed toward municipal landfills. Providing collection facilities for organic waste and for its composting reduces land-fill space problems while providing composting materials for gardening.

Buildings should have waste reduction targets and should monitor the amount of waste they produce. The property managers should report to tenants to show them that progress is being

made. Communications is a key to changing attitude and behaviour. Initiatives such as yard sales or charity pick-ups of re-usable materials, or providing a place where tenants can leave unwanted furniture for other tenants to take, can also foster community spirit.

Site

All of the sites were free of contamination. In several instances there are possibilities to increase the number of indigenous planting on the site.

EMISSIONS, EFFLUENTS & OTHER ENVIRONMENTAL IMPACTS

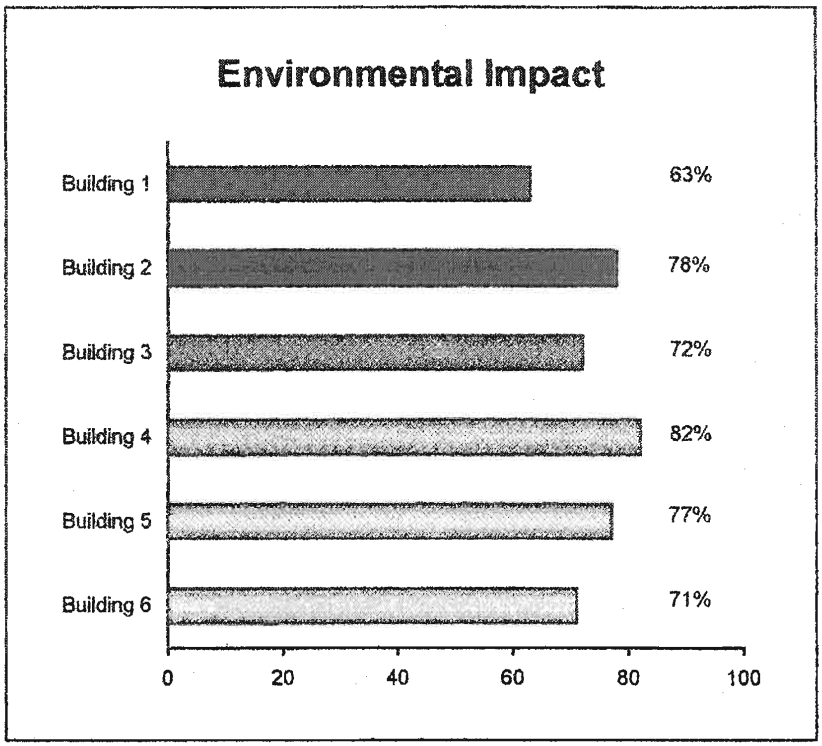


Fig 12: Environmental impact performance rating of the assessed buildings

Ozone-Depleting Substances

Three of the buildings in the pilot had tenant-installed, window air-conditioning units; one had incremental heating-cooling units; and two had fan-coil units with central cooling. In the buildings with window A/Cs, it was interesting to note the varying number of window units, ranging from less than 10% of windows in some buildings, to over 80% in others. Although the sample was small, there did appear to be some relation between the number of A/C units and the age of the buildings (the older the building, the more units there were.) This could perhaps be an indication of the comfort conditions. Buildings with many units also tended to be at the lower-end of the market. Window units are difficult to maintain, but fortunately they contain small amounts of refrigerants.

The central air-conditioning systems in the pilot have better refrigerant leakage control and are maintained by certified contractors. However, there is concern regarding the legislation that may be imposed with respect to the refrigerants (typically R11 and R12) used in central air-conditioners. Under Canada's proposed *Strategy to Accelerate the Phasing-out of Uses of CFCs and Halons*, there is a possibility that there will be a prohibition on refilling and topping up the existing equipment as early as 2003.

In most cases, the replacements are HCFCs (typically R22 and R123). Although HCFCs have only 1/20th the ozone depleting potential of CFCs, the use of HCFCs does still reduce the ozone layer. International agreements put limits on the production of HCFCs and their use will be phased out, beginning in 2004.

There are several classes of refrigerants that have zero ozone-depletion potential. The most common replacement for HCFCs is HFCs (R134a), and many refrigeration systems (such as refrigerators) are available with this new refrigerant. However, R134a is a greenhouse gas and its release contributes to global warming. An alternative to R134a is lithium bromide, a salt solution that is often used in absorption chillers. It is non-toxic, non-flammable and does not contribute to global warming. Ammonia is often used in low-temperature refrigeration applications such as ice-rinks; however, ammonia is very toxic. Research continues into other non-ozone depleting refrigerants. Fluoroidocarbons (FICs) are a promising replacement for CFCs and HCFCs, but as yet are not commercially available.

Hazardous Materials

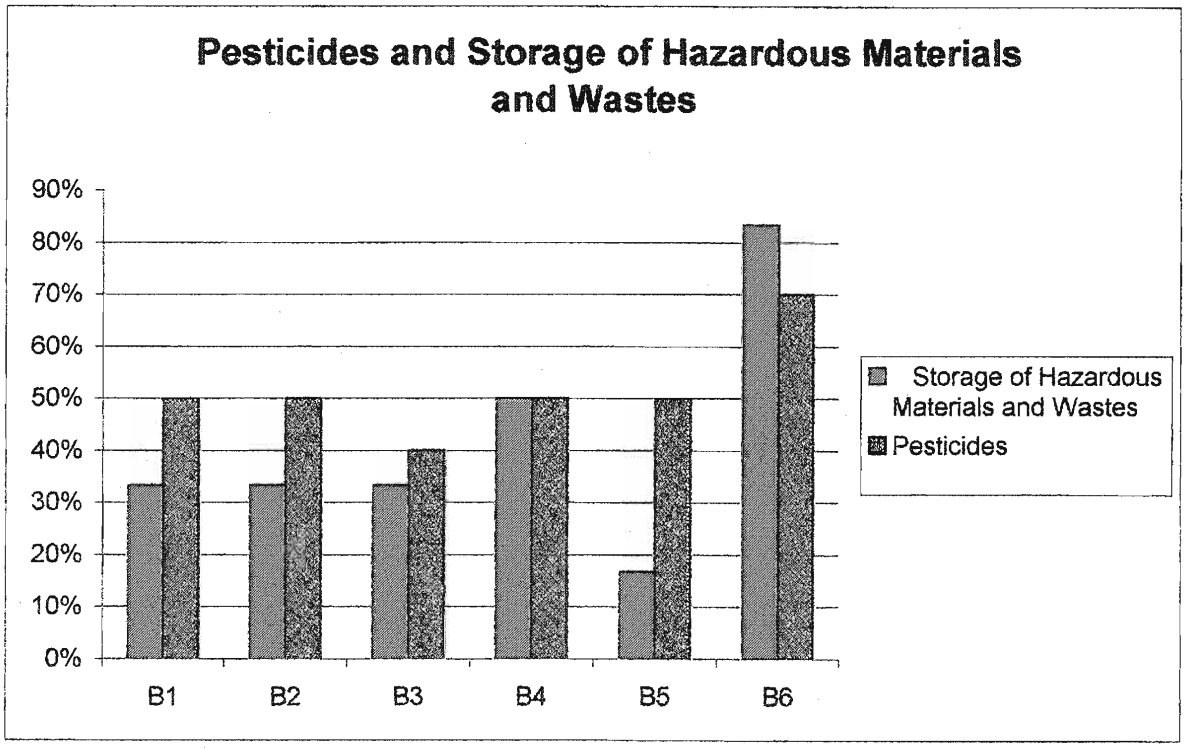


Figure 13: Pesticides and Storage of Hazardous Materials and Wastes

All of the buildings had staff who had received WHMIS training, and most of the buildings had up-to-date (less than 3 years old) MSDSs for some supplies and hazardous substances that are stored or used in the building. However, four of the six building operators in the pilot initially commented that "they do not have any hazardous materials" on site. Building operations and maintenance utilize many chemicals, which are considered hazardous materials, such as:

- commercial cleaners,
- oils,
- surface coatings,
- biocides,

- herbicides
- indoor pesticides.

It appears that some managers have generally little awareness that several of the common cleaners and lubricants or surfactants contained in cleaners are not easily biodegradable and are classified as hazardous materials because they may pose a danger to human health and/or the environment while being stored or used. The quality of storage of chemical and cleaning materials varied from badly ventilated rooms filled with a chemical-cocktail of miscellaneous cleaning products and other chemicals, to spotless, well ventilated, signed and secure storage space with well displayed MSDSs and eye-wash kits. However, only one building had a designated storage and system for handling hazardous materials. None of the buildings had proper spill containment. Some storage areas were cluttered, and it was impossible to locate the drains. Proper, secure and ventilated storage of hazardous materials is important. Containment does not need to be expensive or elaborate, and can consist of a simple measure such as putting chemicals in plastic trays of a sufficient volume to hold a spill.

INDOOR ENVIRONMENT (COMMON AREAS)

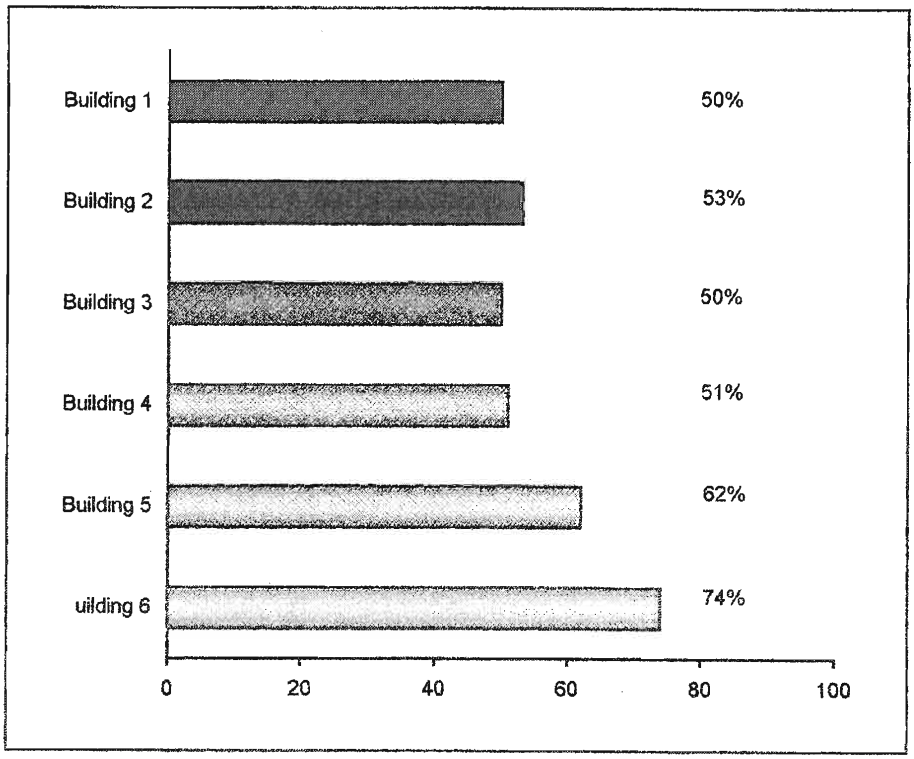


Fig 14: Indoor environment performance rating of the assessed buildings

The indoor environment of the buildings was evaluated by examining several issues represented in the diagram below. These were:

- Lighting
- Ventilation
- Filtration

- IAQ profile
- Parking, Shipping and Receiving
- Renovation, Decorating and Remodeling
- Smoking

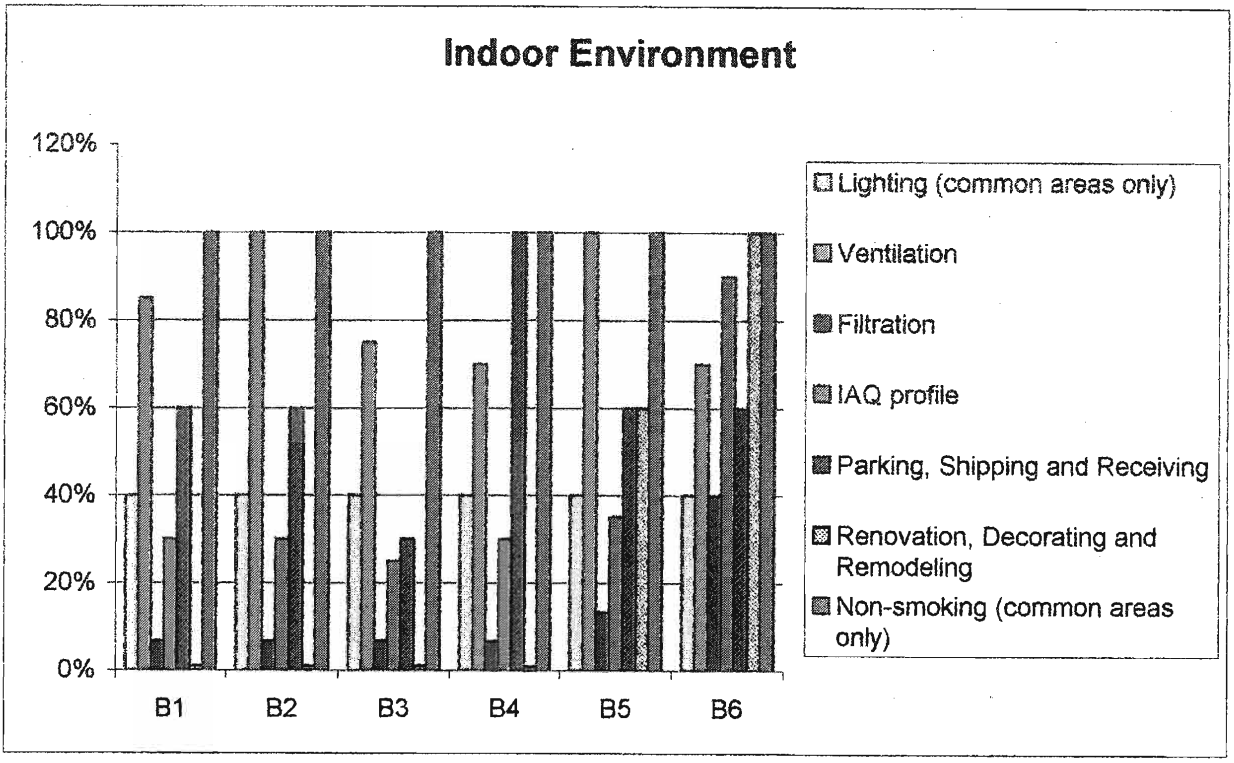


Figure 15: Indoor Environment

Virtually all of the buildings had carried out some lighting retrofit, some quite recently. Because of this, most of the corridor light fixtures were relatively clean and maintained adequate levels of lighting.

All but one of the buildings in the pilot had corridor make-up air. Some of the latest CMHC research challenges the functionality of corridor air systems with respect to their ability to ventilate individual apartments, since significant amounts of the air provided do not flow as intended.[5] One probable reason that Canadian apartment buildings do not experience serious lack of ventilation may be the temperature differential in the winter which assures a sufficient amount of air changes. According to Tony Wood, a leading expert on building air sealing, even with the best sealing efforts, there will be sufficient gaps in the building envelope to assure sufficient air changes in winter. In the summer when the windows can be opened, obtaining adequate ventilation is also not a problem. This may not be the case, however, during spring and autumn. Where windows have been retrofitted the building may get tighter and humidity build-up may become a problem. For this reason the exhaust from the units, particularly the bathrooms

[5] "*The Potential Application of Compartmenting Strategies in High-Rise Residential Buildings*" CMHC Research Report

becomes critical. Every building in the sample had either dirty or semi-clogged bathroom ventilation grilles. A simple test, done in some of the buildings by holding a tissue to the vents showed that ventilation was not effective. This lack of exhaust may cause humidity build-up and eventually support the growth of mould.

Typically, filtration of the make-up air is minimal. CMHC research on filters shows this is not a critical factor. Corridor air systems do not ventilate individual apartments.

Several of the property managers expressed the view that indoor air quality is not a major concern of occupants. Most of the buildings assessed did not appear to have significant problems with corridor odours but this could have been due to the assessments taking place in the summer when most of the windows were open.

Only a few of the buildings had a health and safety committee or joint tenant/management IAQ task force that meets regularly. It was not clear whether these committees carry out regular inspections. In most cases, it was the property managers who dealt with health and safety issues, including IAQ concerns.

All of the building with exception of one had underground garages. Of these, all but one building had mechanical fan-assisted ventilation, and the air intakes were well distanced from possible sources of outdoor pollution such as idling cars or delivery vehicles.

There was generally little awareness among the property managers of the importance of renovation policies that encourage the use of materials and procedures that minimize off-gassing (VOCs) and other IAQ problems.

All of the buildings had a smoking ban in the common areas of the building.

DWELLING UNIT CRITERIA

The indoor environment of the building was evaluated by examining several issues represented in the diagram below. These were:

- Safety and Location
- Environmental Controls
- Daylighting and Views
- Acoustics
- Household Information kit
- Dwelling IAQ
- Accessibility

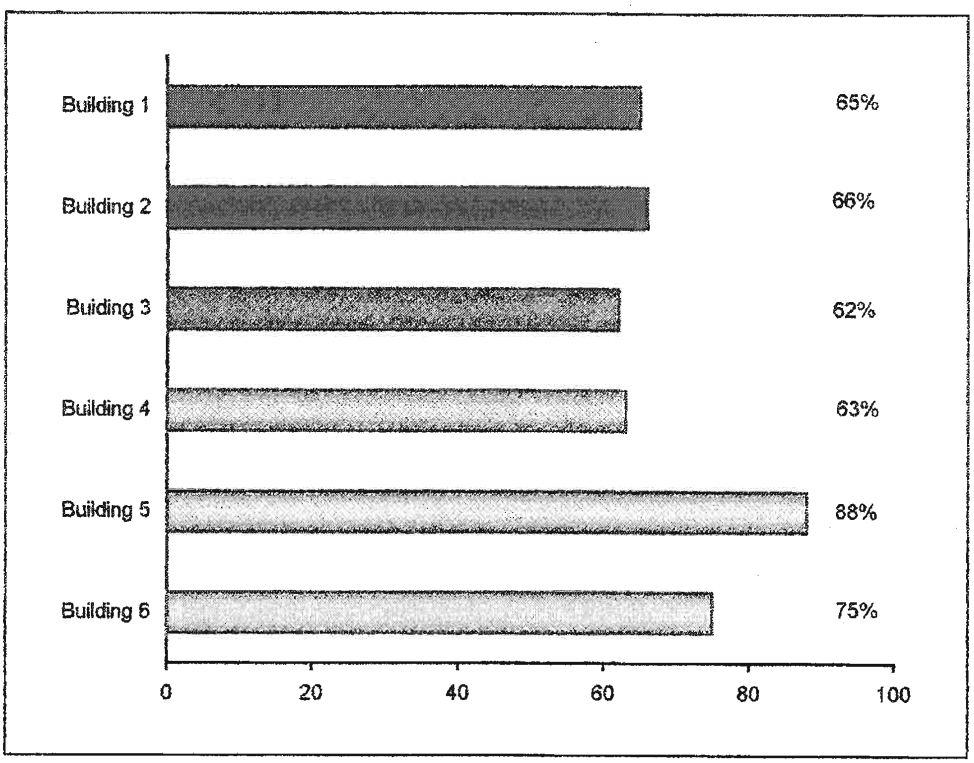


Fig 16: Dwelling Unit Criteria performance rating of the assessed buildings

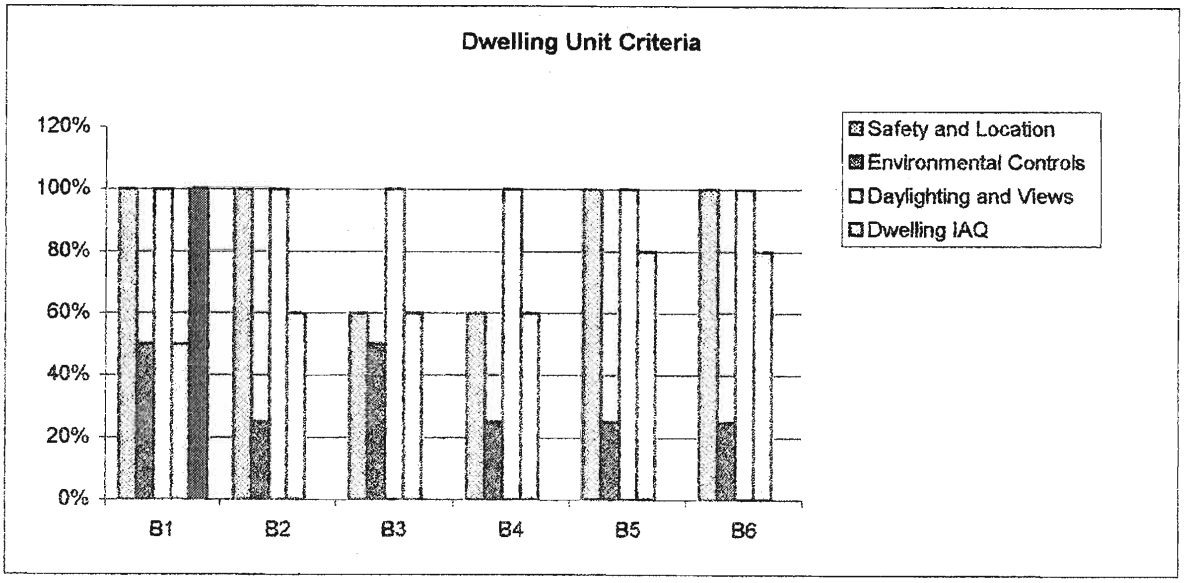


Figure 17: Dwelling Unit Criteria

- Most of the buildings were in safe neighborhoods conveniently located in relation to shopping, schools, and places of worship, parks and other recreational activities.
- While no building had programmable thermostats all buildings were capable of maintaining a comfortable space (i.e. between 68-79 F).

- All of the buildings had good access to daylight and views and were not overshadowed by other buildings.
- All of the buildings had openable windows and their size and placement provided reasonably effective ventilation.
- While most of the kitchen cabinets were sealed particleboard, only two buildings had kitchen hood exhaust.
- Most of the units were not fully accessible. In some buildings the building manager had installed grab bars in the bathrooms as needed. Several of the buildings are planning to participate in special accessibility assessment, a program being introduced by the Ontario Ministry of Housing. The BREEAM Green Leaf assessment protocol could benefit from having more detailed criteria for accessibility. (See comments regarding improving the assessment methodology) in Section 6 "Next Steps").

Part 5 - Feedback from Property Managers

Design and Objectives of the Survey

The property manager survey was designed to gauge the following:

- Perception of the importance of building environmental issues by building managers and tenants
- Perceived value of environmental assessments
- Views on the BREEAM Green Leaf methodology

It consisted of two parts "before and after" – the first part taking place prior to the assessment and the latter, after the clients had had a chance to review the report. The two surveys had many of the same questions, in order to compare the perceptions before and after the assessment.

The six respondents were building managers with many years of experience.

Summary of Results

The survey indicated that:

- The assessment produced in a notable shift of perception regarding i) the environmental impact of buildings; ii) the potential for property managers to influence tenants; and iii) the value of environmental assessments.
- Building managers are driven by "bottom line considerations". The value of the assessment lies in indicating areas where operational savings can be achieved.
- Building managers are interested in having an overview of their building and in comparing their building to others. They therefore favor a comparative system.
- Building managers feel that tenants have limited interest in environmental initiatives.
- The assessment report surpassed clients' expectations.

Shift In "Before and After" Responses.

The most notable result of the survey was the distinct shift in responses from the pre-assessment survey to the post assessment survey, with respect not only to the environmental impact of buildings but also the value of environmental assessments

Shift In Views Regarding Environmental Impact

The following items show a shift of perception with regards to environmental impact of buildings and role of managers:

- In the pre-assessment survey, the majority of responses indicated a perception that buildings had "negligible" or "not very significant" impact on the environment. In the

post-assessment survey, the greater majority of responses to the same question were that the impacts were "somewhat significant" to "extremely significant".

Shift In Views Regarding Ability to Influence Tenants.

- In the pre-assessment survey, all of the respondents indicated that they felt they had no potential to influence the tenants to conserve energy. In the post-assessment survey, four of the respondents had changed their positions and said they probably could have some influence if they tried.
- In the pre-assessment, four respondents said they felt they had no influence on tenants to recycle waste, and one commented that it would take a tremendous effort. In the post-assessment survey, all six of them had shifted their position and said that they felt that there was potential for building management to influence tenants to practice waste recycling.

What caused the increased awareness? Since all efforts were made to complete the assessment questionnaire and walk-through survey in half a day, the pace was very rapid, and very little time was spent discussing issues. Therefore this growing awareness cannot be attributed to any special efforts at education, but probably resulted solely from the design of the questionnaire, the information given in the assessment report, and the brief discussions that occurred as a result of the assessment process.

Shift In Views Regarding the Value of the Assessment

There was also a change in perception with regards to the value of an environmental building assessment:

- Five out of the six respondents indicated that the report exceeded their expectations.
- In the pre-assessment survey, respondents favored a short report (no more than 10 pages) and only wanted certain items covered. In the post-assessment survey, all the respondents found that the report was the right length (approx. 25 pages). All of the respondents said that all of the items discussed were useful.
- In the post-assessment survey, several respondents increased the price they would be prepared to pay for an assessment.

Shift in Perception of the Importance of Building Environmental Issues

Respondents were asked to rate the environmental impact of buildings with regards to each of the following issues:

- energy/ global warming,
- ozone depletion,
- waste landfill,
- contamination of water,

- contamination of air,
- ecological degradation of land
- occupant well-being.

Respondents were asked to rate each impact as being either "negligible", "not very significant", "somewhat significant", "significant", or "extremely significant".

This question was asked both prior to the assessment and following the assessment. The answers differed significantly prior- and post-assessment, indicating an increased awareness that buildings do impact on the environment.

In the pre-assessment survey, 23 out of 42 (or 54%) of the ratings of the responses were in the "negligible" or "not very significant" categories, and 19 out of 42 (46%) of the ratings were in the "somewhat significant" to "extremely significant" categories.

In the post assessment survey, the distribution shifted. Only 10 out of the 42 (24%) ratings were in the "negligible" or "not very significant categories", whereas the number of ratings in the "somewhat significant" to "extremely significant categories" rose sharply to 32 out of 42 (76%).

Perceived relative impacts of the various issues were derived using the following weighting factors: "Negligible" or "Not very significant": 0
"Somewhat significant": 1
"Significant": 2
"Extremely significant": 3

Perceived Environmental Impacts of Buildings

	Pre-assessment score sum	Post-assessment score sum
Energy/global warming	4	9
Ozone depletion	6	8
Waste/landfill	8	12
Contamination of water	5	10
Contamination of air	3	8
Ecological degradation of land	3	5
Occupant well-being	11	15

Note - maximum possible in each category is 6x3=18

In the pre-assessment survey, the impact that received the highest scoring with respect to significance was "occupant well-being", followed closely by waste/landfill. "Contamination of air" and "ecological degradation" were perceived as having negligible significance. In the post-assessment survey, perception of the significance of all environmental impacts increased, including that of energy/global warming, which more than doubled.

Building operators were asked in which areas their building would have potential to improve its environmental impact in a reasonably cost effective manner. In the pre-assessment survey, four

out of six buildings identified waste and energy, and two identified contamination of water. Only one identified ozone depletion and contamination of air. In the post-assessment survey, four added ozone depletion and three added contamination of air.

Property Managers' Perception of Tenant Concerns

When building operators were asked to indicate which of the above-mentioned impacts, they felt were of most concern to tenants, the results were evenly distributed and showed no one issue as being more important than any others. The results of this question are surprising, since one might have expected that issues that get a lot of media attention such as waste or energy would have emerged as being of greater concern. The answers to this questionnaire were also at odds with a later question regarding energy, where four out of six of the respondents indicated that energy was a concern to tenants.

Tenant views on indoor air quality: Two thirds of the respondents indicated indoor air quality was important, and half responded that tenants frequently left windows open in winter because they were too warm and desired fresh air. One third of the respondents indicated that they believed that tenants did not care about indoor air quality.

Tenant views on natural lighting: Five out of six respondents indicated that they believed tenants valued natural daylight,

Tenant views on energy: In two of the six buildings, tenants pay for utilities. Not surprisingly, these two also indicated that energy conservation is an "important" issue for tenants. Two respondents indicated that energy conservation was "somewhat important", and two that energy was not an important consideration.

Ability of management to influence occupants to conserve energy: All of the respondents indicated in the pre-assessment survey that they felt they had no potential to influence the tenants to conserve energy. In the post-assessment survey, four of the respondents had changed their positions and said they probably could have some influence if they tried. Two of them commented that as long as utilities are included in the rent, there is little they can do to influence tenants to practice energy conservation. One noted that people are aware of the issue and could conserve energy if they wanted to but the "lack of community atmosphere does not help".

Tenant views on recycling: Five out of the six respondents indicated that waste reduction and recycling matters to tenants. Two of them said tenants view recycling as "important', and three that it is "somewhat important".

Ability of management to influence occupants to recycle waste: In the pre-assessment, four respondents said they felt they had no influence on tenants to recycle waste, and one commented that it would take a tremendous effort. In the post-assessment survey, all had shifted their position and said that they felt that there was potential for building management to influence tenants to practice waste recycling.

Perception of the Value of Environmental Assessments

Why do an environmental assessment? The responses were varied and showed little change in perception from the pre-assessment survey to the post assessment survey.

Pre-assessment responses:

"To reduce operating costs and use environmentally sound practices."
"It's a good business practice."
"Need to have a snapshot of the building, green concerned."
"To benefit owners and residents in the long term. Deregulation of hydro."
"Part of the job."
"Interested to see results."

Post-assessment responses:

"To assist CMHC and to open our eyes to opportunities for improvement."
"Want to identify poor areas."
"More potential for building to last longer, conserve water, energy etc."
"Curiosity."
"To see results from it. Hopefully, the report can be used to further some environment programs within the company." "

The following gives an overview of results from the post-assessment survey on the topic of the usefulness of the assessment:

- ***Potential to help identify operational savings:*** Five out of the six respondents said that it was "likely" or "possible" that the environmental assessment could help to identify operational savings. One said that it was unlikely, *"because the assessment does not provide actual cost figures".*
- ***Enhancing tenant relations:*** Five out of the six respondents said it was "likely" or "possible" that the assessment could help enhance tenant relations. The respondent who said it was unlikely, gave as a reason *"because tenant relations are predominated by "comfort and price issues."*
- ***Overview of the retrofit potential of the building:*** Five out of six respondents said it was "likely" or "possible" that the assessment could provide a useful overview of the retrofit potential of the building.
- ***Energy overview that could help evaluate a proposal by an energy-contracting firm***: Four out of six respondents said that it was "definitely", "likely" or "possible" that the assessment could help evaluate a proposal by an energy-contracting company. Two said it was unlikely, but both of these qualified their Reponses. One of them said it was *"not detailed"* but was a *"screening to get owners interested."* The other said that it was unlikely but that *"it would allow us to look in specific areas of concern."*
- ***Potential to help increase awareness and implementation of best practices:*** All the respondents said that it was "likely" or "possible" that the assessment could help increase awareness and implementation of best practices".

When asked to identify the aspects of the assessment that were most useful, these were the results:

"Action plan": 5 respondents
"Identification of potential for reducing costs": 4 respondents
"Environmental benchmark": 2 respondents
"Identification of health and well being of occupants": 1 respondent

Views On The Methodology

Should there be a rating? Five of the respondents indicated that a rating/labelling system is desirable. One respondent was unsure, and said that the rating would *"need to be market-driven".*

How long should it take to do the assessment? There was no clear outcome, with responses varying from "half a day"; to "as long as it takes." Two of the six respondents indicated a preference of "half a day". One said there should be a preliminary assessment that takes one day, followed by a one-week follow-through assessment.

What should be included in the report? Respondents were asked check off any of the following items they felt should be included in the report:

- the building's rating,
- a brief overview of the building's main environmental profile,
- highlights of the building's strengths, areas that could be improved,
- outline of potential operational savings,
- recommendations to improve due diligence,
- opportunities to improve tenant comfort and productivity,
- detailed recommendations and priority ranking for each, and
- general background information on the environmental issues related to buildings.

The responses in the pre-assessment survey were selective. Respondents wanted some of the elements but not all. In the post-assessment survey, all of the respondents checked off all items, except for one respondent who did not feel that general background information was necessary, one who did not feel the building rating should be included, and one who did not want a brief overview of the building's main environmental profile.

How long should the report be? In the pre-assessment survey, the majority tended to want a short report. Half of the respondent wanted report less than 10 pages. One said *"the shorter the better".* In the post-assessment survey, all the respondents indicated that the report was "perfect in length". The report is generally about 25 pages.

How much should an assessment cost? In the pre-assessment survey, one respondent indicated that the assessment should be paid for by the government, and one *indicated, "It should be free."* Two indicated that $500 was a fair price. One indicated $750, and one indicated $1,000. In the post-assessment survey, one of the respondents who said it should be free, changed the response to $500. One said he *"couldn't put a figure to it. It would depend on the quantity of buildings. Approach per building is not effective."* Three indicated that $1,000 was a fair price.

Issues that were not addressed but that should have been. This was a post-assessment question. All of the respondents answered that they felt that no issues had been omitted.

Interest in ISO: In the pre-assessment, two indicated no interest in ISO 14000, and four indicated that they might be interested in the future. In the post assessment survey, four indicated no interest in pursuing ISO in the future, and two said it could be of interest in the future.

Additional comments: Five post-assessment interviews were conducted. In all these interviews, clients indicated that the report surpassed initial expectations, and requested additional copies of the report. One building manager indicated that the report would be used as *"leverage to implement his ideas in the company"*, and as *"a tool to show the bosses his initiatives"*. Another said she would like to "do the City's entire portfolio, and would encourage her supervisor". One respondent wrote, *"pleased with the turn-out. A lot more than what we thought we were going to get."* One wrote *"Appreciate input. Knowledgeable. Professional."* One comment was unfavourable. It said, *"The surveyor did not have comprehensive understanding of multi-residential buildings. It seems unusual to train the evaluator on standard systems for multi-residential buildings. While it is understandable that one person cannot be knowledgeable in all areas of the survey, it should be performed by a "team" of professionals, knowledgeable in all fields of the survey."* It should be noted that the person who completed the post-assessment survey was not present during the survey. This was also the respondent who indicated that the survey should take "one day for a preliminary survey" and "one week for a thorough follow-through". It is possible that the client did not understand that the assessment was meant to provide no more than an overview. It may be worth mentioning that his comments dealing with the report itself were, for the most part, positive.

When he saw the report, one client expressed surprise at the low cost of the assessment. Nevertheless, it is clear that cost is an issue. One comment was that the biggest concern with doing assessments is to get the funding. One client who was initially very skeptical and critical said that he would consider doing the rest of his portfolio provided he "could get a deal", even though he was disappointed in his rating.

When asked in the post-assessment survey whether they had any additional concerns, four respondents indicated *"none"* or *"none whatsoever."* One indicated *"the fear of failure, which could lead to possible shutdown of a building. Once something has been identified, you have to acknowledge the problem."*

All the respondents were interested in seeing how their building compared to the other buildings in the pilot. Only one owner felt that he deserved a higher rating. It was pointed out to him that although his building was impressive in many ways, nevertheless, there were a number of items – some of them relatively easy to correct - that were not being done, and they added up to a less than perfect score.

Respondents showed mixed response to the section on "Life Cycle Considerations" which was included in the report. This section, which was based entirely on the High Rise Apartment Repair Needs Assessment done by CMHC 1998, and CSA's S478-95 Guideline on Durability in Buildings, provided a graphical representation of lifecycle stage of the building, and showed cost-estimate data for similar buildings. One respondent said this was very informative. Others made no comment. Two said they would not be comfortable relating their building to this data.

Part 6 - Using the Results of the Protocol

RELEVANCE OF THE PROTOCOL TO MANAGEMENT GOALS

For building managers, the overriding objective is, undoubtedly, to achieve a healthy bottom line. In order to do this, they constantly seek means to achieve operational savings without compromising legal compliance or the comfort and satisfaction of their tenants. Because it directly affects the bottom line, the environmental aspect of buildings that attracts the most attention is energy.

Because energy conservation measures can affect the comfort and satisfaction of tenants, indoor air quality is another concern that arises as a corollary of the energy issue. Maintaining HVAC systems is an important element of an IAQ program. What a growing number of building managers are also beginning to realize is that improving the operation and maintenance of their HVAC systems can result in energy savings from 10 to 15 percent, because clean equipment runs more smoothly, and uses less energy. Well-maintained systems also tend to be more durable. The focus on energy and IAQ means that building managers are increasingly aware of ventilation in their buildings and of the control of pollutants at source – including hazardous materials.

The above illustrates that what may start as a simple concern about the bottom line and energy in particular – can, with some education develop into a more far-reaching awareness of building activities that have other environmental and health impacts.

The environmental assessment protocol is relevant to management goals because it synthesizes the best practices that are relevant to the majority of buildings by means of a simple checklist that can be completed in half a day. By linking the environment with the bottom line, it raises awareness that the majority of "green" practices for buildings are not only good for the environment but also contribute to improved efficiencies, operational savings, and tenant comfort and satisfaction. This realization is crucial, for without it, few facilities managers would be inclined to develop an environmental management system to improve their business- and ultimately, their bottom line.

RELEVANCE TO OWNERS OR MANAGERS OF LARGE PORTFOLIOS

Overall Portfolio Review Elevates Energy Management to a Strategic Initiative

Gaining approval for a portfolio-wide energy, and environmental review can sometimes be easier than gaining approval for an energy audit of a single facility because of the time needed for an energy audit (typically 3 to 12 months) and the cost (7 to 20 cents per square foot) to gather information on the construction and operation of the building, and to model the operation of the building. An overall portfolio review is not an engineering study but rather a comprehensive profile of each building. The portfolio review is designed to gather sufficient information to make informed decisions as to which properties offer the greatest energy-saving opportunities from the supply and demand sides. In addition to ranking opportunities, portfolio reviews can

provide the energy task force with a better understanding of expected savings. A portfolio-wide review is often more acceptable than isolated building audits, because senior management tends to take the strategic view that collecting, compiling and summarizing operating expense information about a portfolio of properties can lead to better decision-making. By elevating energy management to a strategic initiative, there is increased likelihood of obtaining senior management buy-in.

A portfolio review can be performed by internal staff or with the assistance of a consultant. Initial information can be gathered by sending a detailed questionnaire such as a BREEAM Green Leaf checklist that can be completed in two to three hours, to the facility staff at each property, and compiling the key data.

The survey should include current utility costs, historical energy use, type and age of energy-consuming equipment, current capital budgets and planned facility upgrades, technical efficiency measures, property management efficiency measures, and information on indoor health and comfort.

The information can then be evaluated to identify obvious opportunities, such as high square footage costs, aging equipment, pending renovations and locations in which electric deregulation has occurred or is pending. All of these conditions represent opportunities that can be mined for savings. The value of a portfolio review is that:

- It provides a clear picture of current energy management efforts and the magnitude of potential savings.
- It is also well suited for applications where facility executives are aware of energy and performance problems with regards to a major energy-using system. An overall portfolio review will reveal the "energy hogs". It also benchmarks all buildings, which may show change in the future.
- It shows how energy values for one facility compare to other facilities and properties within the organization, within the immediate geographic setting and within the industry peer group. Without such initial information it becomes impossible to identify those properties among the portfolio in need of immediate attention.

Portfolio Review Reveals Opportunities for Low Cost Improvement Measures.

The overall portfolio review can provide numerous recommendations for low-cost maintenance measures, many of which can be done in-house. A number of these may apply to a large portion of the portfolio. These should be communicated as soon as possible following the portfolio review.

There are many examples of how O&M measures can result in savings. The US EPA estimates energy savings from improving operation and maintenance can be 10 to 15 percent because clean equipment runs more smoothly and uses less energy. Other economical energy savers include caulking windows and doors and making sure thresholds are clean so that doors close properly. The International Association of Lighting Management is conducting a three-year lighting study

that is expected to show that many facilities may be able to save up to 10 percent of lighting costs simply by cleaning fixtures. One of their expected recommendations is that building owners install fewer lighting fixtures and schedule regular professional cleaning of lighting fixtures, for example, when maintenance crews are replacing lamps and ballasts. In addition to maintenance items, the energy audit may point out operations that can be simplified, streamlined or revised. One of the best ways to save energy is to turn things off: shutting off lights when no one is in the room, for example, or turning air handling equipment off at proper times.

Portfolio Review Helps Identify Buildings that Need Energy Audits

The overall portfolio review combined with the results from a building usage survey should give strong indications where retrofit dollars would be best spent. These are the buildings that are most in need of an energy audit. Where dollars are scarce, the portfolio review can also help determine which buildings would benefit most from a full energy audit and which ones could manage with an audit to one or two systems.

For example, a full building energy audit is recommended especially if a building is complex or is older and is scheduled for major renovation. A full building energy audit will allow multiple measures to be modeled at the same time to determine the combination that provides the greatest return for the investment. By accurately predicting the impact of measures, including their interaction with other building systems, this will indicate what systems are in need of upgrading, and what those upgrades should be.

The individual systems energy audit is best suited for instances where funding is limited, where energy savings are needed quickly or where the property manager is aware of energy and performance problems with respect to a major energy-using system. These conditions are likely to be revealed in the portfolio profile. The individual systems energy audit can be completed quickly, without extensive and lengthy studies of facility operations. The biggest drawback of the individual-system energy audit is that it looks at specific building components in isolation, and fails to consider that alterations to one energy-using system usually impact the energy use and operation of other systems. This may result in inaccurate estimates of the energy savings.

RELEVANCE TO SOCIETY

Benchmarking

The potential for benchmarking that the assessment offers is useful not only to owner/property managers who want to know how they are doing in relationship to others; it also can be used a as benchmark for society, as an indication of how well society is responding to environmental pollution. In future, it might be possible to put the results of all assessments (without providing the building addresses) on the web. Property managers and owners could come to see how well they are doing.

EDUCATION POTENTIAL

The tool has an enormous awareness-enhancing potential for building staff, owners, public authorities and decision-makers. It is an important asset for building professionals to know how well they are actually doing.

The environmental assessment protocol is as much about raising awareness as it is about evaluating buildings. In recent years there has been a proliferation of literature on healthy, green buildings. *The problem is not the lack of information, but finding the means to package it in a way that will make it easy for facilities managers to access it and implement what they have learned.* The assessment can be an excellent vehicle for presenting or recommending to property managers the wealth of useful information that CMHC has compiled in an on-the-job training mode, by applying the best practices knowledge to specific case scenarios.

NEXT STEPS

Several energy and environmental issues emerged throughout the pilot, which could have some bearing on the improvement of the current methodology. The comments which follow suggest ways in which the assessment or the report could be refined or improved, and areas for future CMHC research.

Environmental Management System and Environmental Policies

For building managers who use a pragmatic approach but have little formal documentation, the assessment reports need to stress the many practical benefits that can result from documenting not only policies, goals and targets, but also the more mundane items such as procedures, schedules, responsibilities and training needs. For building managers who already have a documented and formalized EMS system, the reports need to stress the importance of obtaining support from senior management to ensure that the environmental management system is actually being implemented as intended, and includes stringent monitoring and quality assurance.

Improving the Assessment of the Building Envelope

The assessment protocol would benefit from incorporating a more thorough technical evaluation of the building envelope. The pilot has led to a realization of the need to improve the investigation of air leakage. As a result, ECD is working with an envelope specialist to develop a thorough checklist for building envelope.

Finding the Right Level of Detail

Whilst there is a tendency to continuously expand the scope of technological assessment, this can present both an opportunity and a risk. Because the objective of the assessment is to provide an overview - not replace the various specific and detailed technical audits, the challenge is to find the right level which would provide a sufficient level of information but does not compete with specialist audits.

Stressing the Importance of Energy Monitoring, and Communications on Energy Usage

For bulk-metered buildings, the assessment reports should stress the benefits of individual metering (even if utility charges continue to be included in the rent) and communications to stimulate responsibility of tenants. Building operators need to find ways to stimulate energy conservation – for example: i) a communications plan on responsible energy use that includes print-outs of each apartment's energy consumption compared to the average consumption of the building; ii) financial incentives such as a monetary return to tenants based on energy savings, or directing the savings towards something the community can enjoy such as flower boxes, playground equipment, a barbeque or contributions to the United Way. Although ECD has never encountered these practices, they could be considered and evaluated.

For buildings with individual utilities billing, building operators will improve their relations with tenants and increase tenant retention by monitoring energy use, implementing energy savings measures and having a communications plan that serves to describe these measures.

Whether utilities are included in the rent or are billed separately, ***energy monitoring*** and ***communications*** are key to providing the basis for other innovative incentive strategies and should be stressed in the assessment report. It has long been maintained that energy reductions through voluntary systems can only be achieved through changed attitudes and motivation. It is therefore suggested that a study be conducted on *Changing attitudes towards energy in MURBS by means of energy monitoring and communications.* This would be a worthy and feasible exercise, for the costs of implementation and the associated results are easily measurable, and the study could produce valuable strategies for building operators to reduce their energy costs.

Life Cycle Data

One of the participants specifically requested information on building elements' lifecycle data. ECD therefore introduced in the report, a section on life-cycles of building elements and cost estimates, based on information from CMHC studies[1]. This was well received by some. Others said they felt that each building is unique and they would not relate their building to the data in the study because of the differences in repair and retrofit cycles in individual buildings.

[1] *High –Rise Apartment Repair Needs Assessment* CMHC Technical Report, December 1998

Stressing the Importance of Promoting the Recycling of Waste

Because recycling is such an urgent political issue, more research is needed into ways to promote recycling. Issues such adequate size of recycling space, utility of compactors and associated costs as well as the communication aspects of setting up and implementing recycling targets in MURBs also need to be investigated.

As with energy, building managers have a role to play in changing attitudes of tenants. Unfortunately, many managers do not believe it is in their power. Before tenant attitudes can be expected to change, those of the building operators must first change. In a pre-assessment survey of building managers, many indicated that they felt that they had very little influence on tenants. In the post-assessment survey, several had changed their minds, but indicated that *'it would take a great deal of effort"* to make any change. As mentioned in the discussion on energy, ***communications*** and ***monitoring of waste*** are critical. A study on the various strategies that can produce change of attitude would be a useful exercise, and one that could produce measurable results.

Ozone-Depleting Substances

The assessment reports should stress that buildings with central systems will need to monitor upcoming legislation regarding refrigerants, and should develop phase-out plans and investigate alternatives. Building operators should inform tenants who have window units, to dispose of their appliances in a proper manner.

Ventilation

Some of the latest ongoing CMHC research challenges the functionality of corridor air systems with respect to their ability to ventilate individual apartments since significant amounts of the air provided do not flow as intended. Because of this, one possible strategy may be to seal the apartment's front door, and between floors to achieve so called "compartmentalizing". However, there must be an in-suite air supply. Many tenants do seal their doors to prevent light, odour, noise and pest transmission.

Accessibility

The assessment will benefit from incorporating a more thorough evaluation of accessibility, for example, one based on CMHC criteria for universally accessible dwellings. Following the CMHC feedback, questions have been added to the questionnaire to address the following issues: entrance and parking conditions; sensory communication devices; wheelchair accessibility with regards to movement and maneuverability; and ergonomic conditions within the dwelling.

Indoor Air Quality

Because of the limited environmental controls in multi-residential buildings compared to offices, the critical issue is the maintenance and control of sources of pollutants. This is directly linked to

the issue of control of hazardous materials and cleaning products in the building (linked to purchasing policy), management of pesticides, control of CO levels in parking garages and control of sources of pollutants in the dwelling units (i.e. sources of off gassing and VOC's such as carpets and kitchen cupboards). Some of these issues are beyond the scope of the property manager. However, one way to aid tenants is by providing a household information kit telling occupants how they can help to reduce the impact of hazardous materials, improve their IAQ and contribute to energy and water conservation.

Tenant Satisfaction

Tenant satisfaction is a high priority for owners who want to minimize the expense involved each time there is tenant turnover. Therefore it could be informative and useful to the owner and property manager to have a section in the assessment relating to tenant satisfaction.

Effect of Seasonal Variances on Assessment Results

The assessment protocol should take into account the time of the year when the assessment is conducted. Investigative methods need to be developed to compensate for detecting problems such as humidity, and thermal comfort. The report could also expand the discussion on the seasonal variations in water and energy use.

Conclusions:

- The building assessment experience clearly resulted in increased awareness of environmental issues by property managers and building operators. This was despite the fact that due to time constraints, no explicit efforts were made during the assessment to impart background information, other than the minimum needed to fill in the questionnaire. This indicates that there is a high degree of receptiveness and/or that the assessment itself constitutes a learning experience. If it were possible to include a *brief* background document, or *brief* speaking notes to be used in the assessment, the learning could be even greater.
- Building operators need to be clearly informed that the assessment is not intended to replace specialized audits such as energy, water, hazardous materials, but provides an overview that highlights a building's strengths and redflags areas of concern.
- Clearly, resources are the deciding factor when addressing environmental issues. Building operators see value in the assessment if it can provide recommendations to achieve operational savings.
- Building operators are interested in comparing their building to others.

ECD would like to thank all parties for taking part in the pilot and acknowledge each company for their leadership in environmental management.