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### **Highlights: How green is your building?**

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acceptée du manuscrit ou la version de l'éditeur.

### **Publisher's version / Version de l'éditeur:**

*Holmes Magazine, 2010-03-01*

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# How green is your building?

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**March 01, 2010**

Buildings are major consumers of non-renewable energy sources and contribute to a rise in greenhouse gases. To reduce the size of that environmental footprint, so-called "green" buildings have emerged with the goal of using minimal energy in both their construction and operation, while also providing a healthier and more satisfactory indoor environment for their occupants.

Several countries and regions have developed green building programs aimed at promoting more sustainable buildings, such as the LEED (Leadership in Energy and Environmental Design) initiative in Canada and the United States.



NRC researchers will compare "green" and conventional office buildings on everything from carbon dioxide concentration and noise levels to job satisfaction of workers.

## How do green buildings perform?

In an analysis of data from 100 LEED-certified commercial buildings, the [NRC Institute for Research in Construction](#) (NRC-IRC) found that, on average, the buildings used 18 to 39 percent less energy per floor area than otherwise equivalent conventional buildings. Yet despite these average savings, when it came down to individual buildings, between 28 and 35 per cent of these LEED buildings were actually using more energy than equivalent conventional buildings – suggesting that predicted improvements are often only partly realized.

Furthermore, the measured energy performance of LEED buildings was found to have little correlation with the certification level of the building (for instance, LEED Gold and Platinum buildings performed no better than LEED Silver) or the number of energy "credits" (based on the predicted energy savings) achieved by the building at the time of its design.

"Green buildings tend to get their certification based on design, but there's very little follow-up after they're occupied to see how they're performing and whether they're living up to the expectation of reduced energy use and improved indoor environmental quality," explains Dr. Guy Newsham, who leads the Lighting group at NRC-IRC.

## Bringing science to the question

To make a proper assessment, Dr. Newsham and Dr. Alexandra Thompson, a research officer with NRC-IRC's Ventilation and Indoor Air Quality group, are leading a project that will evaluate and compare equivalent conventional and green office buildings across Canada and the northern U.S.

The goal is to gather data to help the building community improve the design and performance of both green and conventional buildings and provide a stronger scientific basis for green-rating schemes.

To achieve this objective, NRC researchers have designed and built devices to measure a building's physical environment, including acoustics, lighting, thermal conditions and air quality. A mobile cart of instruments will take "snapshot" measurements of physical variables such as air speed, temperature, humidity, the concentration of various gases (e.g. carbon-dioxide and carbon-monoxide), airborne particulates and light distribution. These measurements will be repeated at multiple locations in a building over one or more days.

The research team will also use six indoor "weather stations" to capture data on a subset of variables, including light and noise levels, temperature and carbon dioxide concentration. These pyramid-shaped monitors will be left at a specific location for several days or weeks to provide a longer-term view of the conditions.



Left to right: Team members Chantal Arsenault, Dr. Guy Newsham and Dr. Alexandra Thompson. A mobile instrument cart will take snapshots of variables such as humidity and

temperature in both "green" and conventional buildings, while pyramid-shaped "indoor weather stations" will provide a longer-term view.

NRC-IRC is working with several partners, including the federal and provincial governments, utility and office-furniture companies, and green-building organizations, to identify office buildings that could participate in the study (they have around 40 candidates so far). The study is expected to be completed by 2012.

In addition to collecting physical data, the research team has also prepared a questionnaire for occupants, which includes their perceptions of the building's environment, their overall job satisfaction in that workspace, their health and their commuting patterns.

The evaluation will supplement initial findings from other studies. For instance, one trend has shown a decrease in satisfaction with acoustics in green buildings. Introducing daylight through the use of both open-plan offices with lower partition heights between cubicles and hard surfaces to promote air quality can lead to more complaints about speech privacy and noise.

"But our goal is not to diagnose and troubleshoot a single building," explains Dr. Newsham. "We want to collect data from all of the buildings and look at it in aggregate to draw more general conclusions as to what aspects of green buildings work and what aspects need improving."

## A tool for the future

Dr. Thompson says that building managers could use the results of the evaluation to make improvements or modifications to physical space. As well, green building councils or similar building-certification organizations could rely on the information to develop post-occupancy evaluation tools or revise their rating schemes.

Says Dr. Newsham: "If this evaluation proves to be useful to the building community, we could revisit buildings at regular intervals to look at whether things are improving or worsening over time."

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## Related information

- [Cost-effective Open-Plan Environments \(COPE\) project](#)
- [Indoor Air Quality research featured in HOLMES magazine](#)
- [Lighting up tomorrow's office](#)

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