Four Centres at Red Deer College

A strong focus on planning and design creates energy-efficient buildings to learn in – and to learn from.

The Four Centres building added nearly 16,000 square metres (m^2) of new and renovated space to the main campus of Red Deer College when it was completed in 2009. It provides a "learning commons" for the school's Centre for Innovation in Manufacturing, Centre for Corporate Training, Centre for Visual Arts and Centre for Trades and Technology.

The building's numerous energy-saving design elements make the Four Centres about 61 percent more efficient than the minimum standards in the *Model National Energy Code of Canada for Buildings* 1997 (MNECB 1997). The MNECB 1997 is the predecessor to the *National Energy Code of Canada for Buildings* 2011 (NECB 2011).

This accomplishment helped the building earn Leadership in Energy and Environmental Design (LEED®) Gold certification from the Canada Green Building Council, which awarded the college maximum points in the water efficiency and the innovation and design process categories.

The successful journey through the LEED certification process can be attributed to a combination of factors. They include an organizational commitment to sustainable design and a dedicated team that upheld that commitment through the planning, design, construction and operational stages (and beyond). For example, the team used energy modelling and simulation software to calculate the expected energy performance of the facility before the first shovel hit the ground.

Key features at a glance

Building name:
Four Centres

Building owner:
Red Deer College

Prime consultant:
Group2 Architecture Interior Design Ltd.

Location:
Red Deer, Alberta

Building size:
15,960 m^2

Completion:
August 2009

Investment:
$50 million

LEED® certification:
Gold (46 of 70 points)

Campus-wide commitment to energy efficiency

Sustainability is embedded in the long-term development strategy of the college. The philosophy is formalized in the college's 2003 *Land Use Master Plan*, which states that any new buildings must pursue LEED certification. This focus on energy efficiency predates Alberta's 2008 energy strategy, which requires that new, government-funded buildings meet LEED Silver requirements.

"Going after LEED certification is not something we do because it is mandated by the government," says Doug Sharp, Director of Facilities at Red Deer College. "It is a key part of our green strategy – and we have embraced being green as much as we can since 2003."

In 2006, Red Deer College partnered with Group2 Architecture Interior Design Ltd. and Barry Johns (*Architecture*) Limited to create a flexible, open space capable of supporting an innovative mix of trades, technology, manufacturing, business and arts programs. The resulting design used several energy-saving features to meet LEED requirements, including:

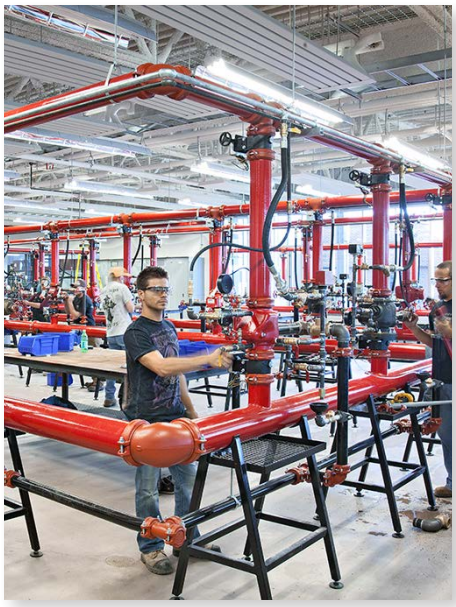
- **Lighting:** The building's design allows a generous amount of sunlight into labs and classrooms. Daylight sensors automatically dim the lights when there is sufficient natural light, and motion sensors automatically turn off the lights in unoccupied areas. Combined, these sensors give the Four Centres an average adjusted lighting power density (LPD) of 8.50 watts per square metre (W/m²). This level is significantly more energy efficient than the average LPD of 20.03 W/m² for an MNECB reference building of similar scope and size (the NECB 2011 equivalent is 10.7 W/m²).
- **Ventilation:** A large portion of the Four Centres uses displacement ventilation, which introduces air at floor level and exhausts air at ceiling height. This method creates a more efficient airflow than is in typical institutional buildings, in which air both enters and exits through overhead diffusers, which are commonly used in conventional systems. In addition, the building has occupancy sensors for demand-controlled ventilation and heat-recovery ventilators that recapture heat from exhaust air with an effectiveness of 67 percent.
- **Water:** Rainwater and snowmelt from the large arched roof of the Four Centres is stored in underground cisterns and used for toilet flushing in the facility. The washrooms feature waterless urinals, low-flow faucets and ultra-low-flow toilets. The building's heating and circulation pumps use variable-speed drives.

National Energy Code of Canada for Buildings 2011 (NECB 2011)

In 1997, a consortium of industry stakeholders, provinces, utilities, the National Research Council Canada and Natural Resources Canada developed the *Model National Energy Code for Buildings* (MNECB 1997), which created a national standard for building energy performance.

After more than 10 years in the market, the energy code needed to be updated.

The NECB 2011 targeted an overall 25 percent improvement in energy efficiency over the MNECB 1997. This new energy code, with its updated requirements, places Canada on a level footing with countries that lead the world in energy-efficient building construction.



Other features that contribute to the energy efficiency and environmental sustainability of the Four Centres include:

- A high-performance building envelope that features:
  - Walls that have an RSI-value (thermal resistance) of 3.6 to 4.5 metres squared times kelvin per watt (m^2K/W), compared to the MNECB minimum RSI-value of 1.82 m^2K/W (the NECB 2011 equivalent is 4.76 m^2K/W).
  - Roofs that have an RSI-value of 4.7 to 5.7 m^2K/W, compared to the MNECB minimum RSI-value of 2.13 m^2K/W (the NECB 2011 equivalent is 6.17 m^2K/W).
  - Windows that have a heat loss U-value of 2.36 to 2.68 W/m^2K, compared to the MNECB maximum allowances of 3.20 and 3.40 W/m^2K for fixed and operable windows, respectively (the NECB 2011 equivalent is 2.2 W/m^2K).
- Modulating gas-fired boilers that have a thermal efficiency of 87 percent, compared to the MNECB minimum efficiency of 80 percent (the NECB 2011 equivalent for a 510-kilowatt (kW) boiler combustion efficiency is 83.3 percent).
- A condensing water heater that has a thermal efficiency of 95 percent (compared to the MNECB and NECB minimum efficiency of 80 percent).
- Ceiling-suspended passive radiant panels.
- Low-emitting materials and finishes for better indoor air quality.

Verifying energy and cost savings through energy modelling

One of the key steps in securing LEED certification is to get third-party verification of the proposed energy and cost savings. As part of the consulting team assembled by Group2 Architectural, Calgary-based engineering firm Foraytek Inc. was tasked with conducting the assessment that would confirm the energy efficiency of the Four Centres.

Through Natural Resources Canada, Foraytek used EE4 energy modelling software[1] to compare the estimated energy consumption of the Four Centres with that of an equivalent reference building designed in accordance with the MNECB. The energy modelling allowed various energy-efficiency options to be compared and their impacts evaluated against overall design goals.

[1] EE4 has been replaced by CAN-QUEST, a building energy analysis tool based on the U.S. Department of Energy's eQUEST software.

Building energy modelling

The NECB 2011, like its predecessor the MNECB 1997, provides several paths to demonstrate a building's compliance with the energy code: prescriptive, trade-off, and performance or energy modelling.

When one or more building components do not meet the prescriptive requirements, either the trade-off path or the performance path must be used. The trade-off path helps to effectively balance components in a single part of the code such that the result is at least as efficient as the prescriptive requirements. For example, the lighting in one space can be traded off against lighting in other spaces. For the performance path, an hourly energy modelling tool must be used, such as CAN-QUEST, that provides an overall energy comparison between the proposed design and an equivalent building that meets just the minimum requirements of the NECB 2011.

Taking a "whole building" approach, the simulation looked at everything from the building envelope to lighting controls and mechanical systems. An hourly simulation was performed by using the climate data for the location. The software also generated a breakdown of energy uses and costs for both the proposed design and the MNECB equivalent reference building.

"Energy modelling is a very useful tool," says Jim Love, President of Foraytek. "If you do it during the design's earliest stages, not only can you judge how you are doing on your energy and cost targets, but it might also prompt you to evaluate alternative systems that could give you better returns."

The EE4 simulation indicated that the building's design was suitable for LEED certification. The computer model estimated that the Four Centres would be 61 percent more efficient than a similar building that meets only the minimum MNECB requirements. See Table 1.

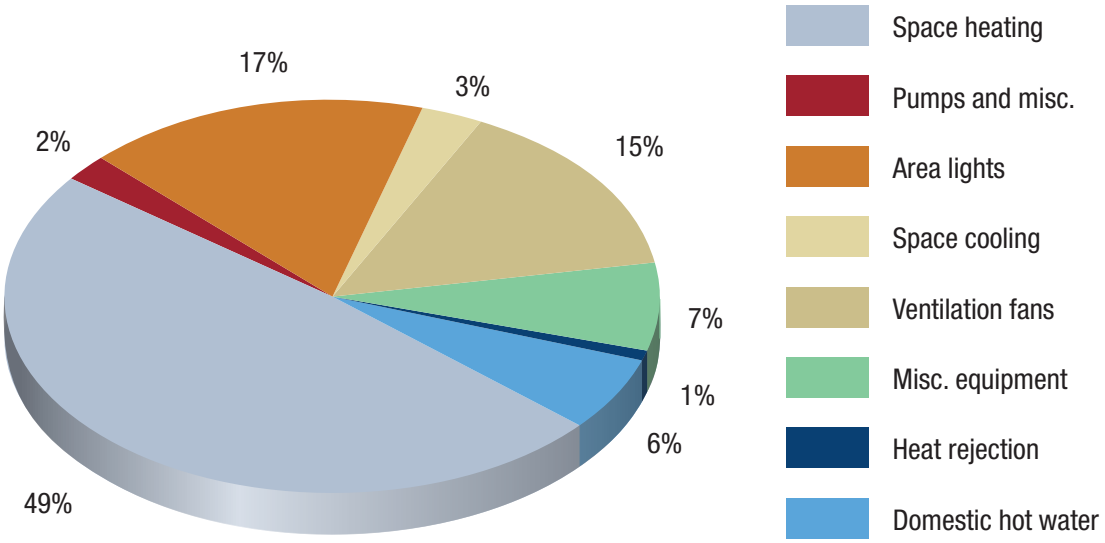
Natural Resources Canada validated the energy performance levels of more than 500 new buildings, building additions and major renovations in the commercial, institutional and government sectors between 2007 and 2011. The projected energy savings are more than 1.8 million gigajoules. The work contributed to the decision to develop the current *National Energy Code of Canada for Buildings* 2011 (NECB), which is 25 percent more energy efficient than the previous MNECB (1997) version.

Table 1. Comparison of simulated energy and cost savings

	Electricity (MJ*)	Natural gas (MJ)	Total energy (MJ)	Total energy per square metre (MJ/m²)	Energy cost ($)	Cost/m² ($)
Four Centres	3,877,498	4,642,918	8,520,416	526.6	146,206	9.04
MNECB reference building	8,582,146	12,265,634	21,847,780	1,350.2	337,077	20.83
Savings	**4,704,648**	**8,622,716**	**13,327,364**	**823.6**	**190,871**	**11.80**

*MJ = megajoule

Figure 1: Red Deer College - Four Centres Estimated energy use breakdown



Ensuring sustainability during commissioning – and beyond

One of the primary goals of the Four Centres project was to demonstrate the leadership of Red Deer College in local sustainability. During the construction process, 29 percent of the materials were sourced regionally, 25 percent came from recycled sources and 62 percent of the wood came from sustainably managed forests.

Because the Four Centres is still quite new, the college has not yet added any additional energy-saving features – it is still fine-tuning those in the initial design. However, several sustainability initiatives will be proposed in the future. For example, Sharp wants to work with the college administration to have blocks of classes scheduled in just one part of the building at a time (especially at night), which would allow some mechanical and ventilation systems to be shut down strategically in areas not in use – enabling further energy and cost savings.

Building a better learning environment

The Four Centres has had a considerable impact on students at Red Deer College. In addition to providing a bright, naturally lit common space that connects students and staff from several programs, the Four Centres serves as a teaching tool. Most of the building's components and systems are fully exposed – from electrical conduits to the main mechanical room – allowing trades students to see and understand how they function in an operating context.

"One of our objectives was to create a building you can learn in and learn from," says Sharp. "Where you would normally have classrooms and labs behind concrete walls, we have lots of windows so you can always see what is going on. The same is true with the building's structure and its mechanical and electrical systems. They are not hidden in the ceiling or behind walls – they are all there in plain view."

The Four Centres is also helping raise awareness of the benefits of green technologies. The college has installed displays and interpretive signage about the building's energy-saving features, giving students and visitors a better understanding of the underlying concepts behind the technologies used.

Effective approach

Although Red Deer College cannot monitor energy use in the Four Centres building separately from the rest of the campus, Sharp is confident the institution is benefitting from its energy-saving features.

"We are not able to isolate the Four Centres specifically in terms of gas and electricity costs and consumption," says Sharp. "But as far as we know, it is performing at the high levels predicted by the simulation."

Foraytek also believes the decision to incorporate energy-performance simulation into the Four Centres design was quite useful for Red Deer College, even though institutional buildings do not have the same predictable hours of energy use as, for example, office towers. Schools often serve as community hubs, hosting a variety of functions at night and on weekends – meaning that the hours of operation can vary greatly across campus and even within individual buildings. While the simulation used a standard academic operating schedule of 80 hours per week, the real-world energy use could be much higher, or lower, than predicted by the simulation, depending on how the building is being used by students and the public.

For Sharp, the design and commissioning of the Four Centres reinforced both the benefits and challenges of LEED certification. Although he likes the LEED energy-conservation targets for areas such as insulation, glass, air and light quality, he also acknowledges that certification can be a lengthy process. Drawing from this experience, Sharp says future building developments will zero in on the energy-saving initiatives that have the potential to deliver the greatest return on investment – allowing Red Deer College to put greater focus on making the best possible use of green technologies that enhance both the learning environment and the bottom line.

For more information

For more information on how you can make your building more energy efficient, visit Natural Resources Canada's Efficiency in buildings page or email info.services@nrcan.gc.ca.

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