Pitching Green Design 101

A Green Design Toolkit and Resource Guide for Architects

Prepared for the Consulting Architects of Alberta (CAA)
by Tantus Solutions Group and the Social Community Consulting Group (SoCo)

Introduction

This toolkit serves as a resource guide designed for the members of the Consulting Architects of Alberta, and serves as a resource when initiating, implementing, and designing green building projects. Within this guide, we outline:

(a) the **common practices** of green design within different building types, as well as their benefits and costs;
(b) common **stakeholder concerns**;
(c) **differences in common practices** and stakeholder concerns by building type;
(d) additional **resources** (government incentives and grants); and
(e) **local example**s of successful Alberta-based projects.

What is Green Design?

While the definition of a green building/design may change between stakeholder groups and goals, there appears to be a consensus among architects[1] that centers around sustainability, stewardship, and social responsibility. For the purpose of this guide, we have defined a 'green building' as a structure that in its design, construction, and/or operation reduces or eliminates negative impacts – and can create positive impacts – on our climate and natural environment. Green buildings were defined by the group as those that preserve precious natural resources and improve the quality of life for the people who occupy and surround them. A key part of this definition is the emphasis on impact reversion and regenerative solutions, pushing the standard beyond mitigating and reducing negative impacts.

[1] Based on interviews with a selection of Consulting Architects of Alberta Members

1. Common Practices

In this section, we cover the common green practices, designing principles, and derived benefits of implementing green design, in new and retrofit builds.

Green design practices are commonly broken down into 5 categories[2]:

1. **Sustainable Sitting**: how land is used and developed to reduce negative impacts and ecological footprint.
2. **Energy Efficiency**: improved performance targets for energy occupancy.
3. **Water Efficiency**: decreasing demands on "fresh water" and reducing wastewater, via rain-water catchments, recycling grey water, optimal landscaping, and wastewater treatment.
4. **Building Materials**: sustainable construction materials and resources, to reduce solid waste, excess processing, extraction, transportation, and reduced consumption. Focuses here include being ecological, healthy (for occupants), high-performing, and recycling.
5. **Healthy Indoor Environment Quality:** ventilation, thermal comfort, moisture control, daylighting, environmental tobacco smoke control, protecting air quality through construction (drywall, paint, etc.), green spaces.

These design principles reflect the five major categories found within the Leadership in Energy and Environmental Design (LEED) certification:
(a) sustainable site development, (b) water savings, (c) energy efficiency, (d) materials selection, (e) indoor environmental quality.

LEED in Canada

LEED is a widely accepted benchmark for recognizing the implementation of green building practices and design, across the world. In Canada, the certification's rating system is licensed by the Canadian Green Building Council (CaGBC): a non-profit organization that advocates for the advancement of green building development across the country.[3] Natural Resources Canada describes LEED as a means of giving "building owners and operators the tools they need to immediately and measurably improve their building's energy performance."[4] The CaGBC further walks through the certification process on their website.

[2] "Guiding Principles of Green Building Practices." *Planning for Complete Communities in Delaware*, University of Delaware, https://www.completecommunitiesde.org/planning/sustainable/guiding-principles-gbp/.
[3]Advanced Solutions International, Inc. "LEED®: the International Mark of Excellence." *Why LEED?*, https://www.cagbc.org/CAGBC/LEED/CAGBC/Programs/LEED/_LEED.aspx?hkey=54c44792-442b-450a-a286-4aa710bf5c64.
[4]"Green Building Certification." *Natural Resources Canada*, 9 May 2018, https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-buildings/energy-efficiency-existing-buildings/energy-management-buildings/energy-management-best-practices/green-building-certification/20695.

Obtaining LEED also supports the WELL Building Standard and Green Real Estate Sustainability Benchmark (GRESB) in Canada. The latter measures the sustainability performance of buildings for investors of real assets.

Additionally, information on LEED pricing can be found, here.

Green Building Materials:

Green building materials include those which are less-carbon intensive than traditional materials, emit fewer toxic substances that could negatively impact the health of buildings' habitants, are sourced locally (to reduce transport emissions), and are high performing (heat control, insulation) among other benefits.

Other Canadian Certification Programs:

There are other certification programs for Green Buildings in Canada, including Energy Star (Commercial and Institutional), Building Owners and Managers Association's Building Environmental Standards (BOMA BEST), and Green Key Eco-Rating Program.

Energy Star

The Energy Star rating system focuses on incentivizing commercial (offices, supermarkets) and institutional (K-12 schools, health-care facilities, senior care facilities, community ice rinks) buildings to be energy efficient without compromising on performance. Residential properties can also be evaluated by the government's EnerGuide ratings. This rating is administered by the Natural Resources Canada, and buildings are rating on a scale between 1 to 100. Buildings must earn a score of 75 or higher, and benchmark monthly energy consumption.

BOMA BEST[5]

The Canadian chapter offers various incentives including awards, certificates of excellence, net zero challenges and is most well-known for its informational resources such as the BOMA Best Online Portal and certification program. Resources offered online include utility and energy trackers, and best practices for employee engagement and healthy workplaces. Ratings are provided for a number of building types including Residential Multi-Unit, Commercial Office and Shopping Centre, Light Industrial, and Health Care Facilities.

To receive a certification and rating, a building project must: (a) develop policies, (b) define goals and objectives, and (c) develop and implement programs. Fees range from $500 to $2,000 CAD.

[5]"About BOMA BEST." *BOMA Canada*, 9 Mar. 2018, http://bomacanada.ca/bomabest/aboutbomabest/.

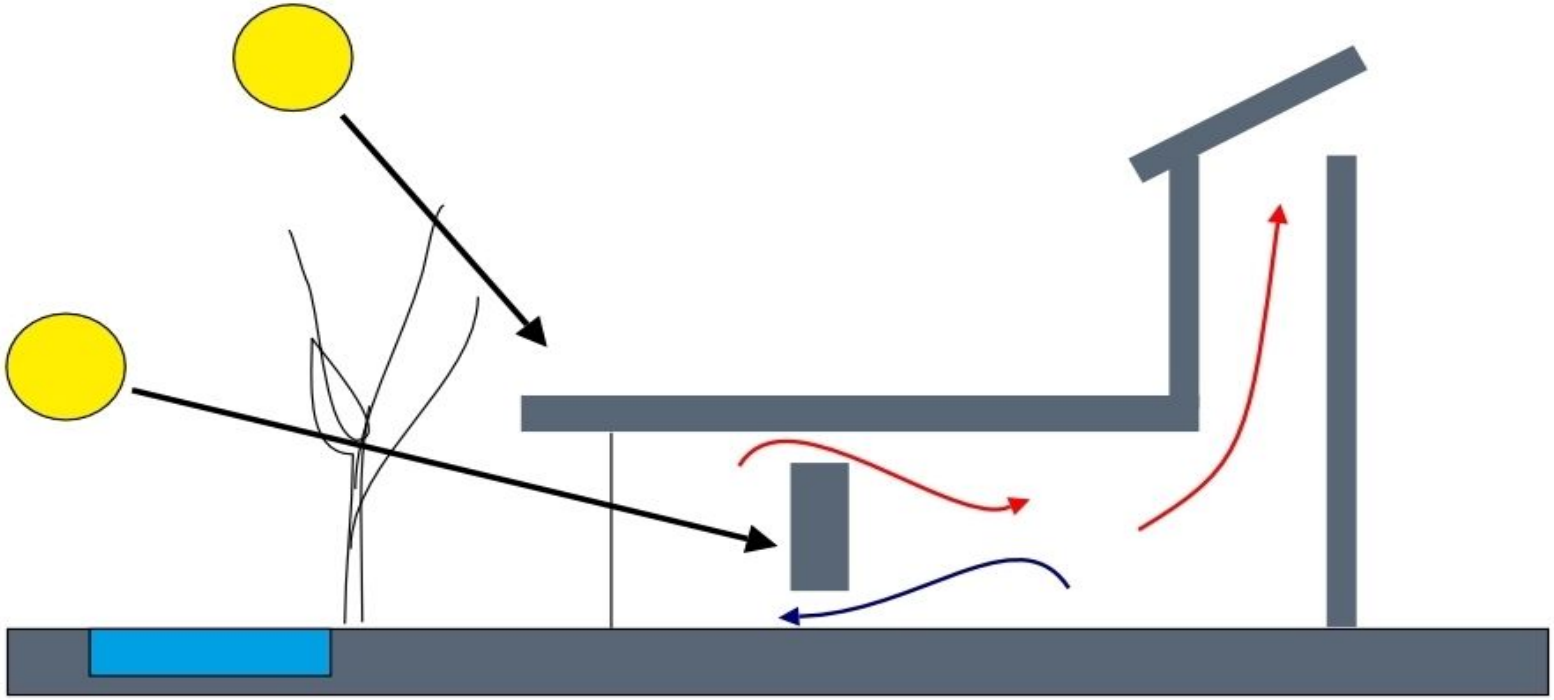
Green Key Eco-rating Program

The Green Key Eco-Rating Program is a rating system that recognizes hotels, motels, and resorts by providing a rating on a scale of 1-5 upon an audit of the building's environmental practices. This rating can be used by members of the accommodation industry to appeal towards more environmentally-conscious consumers. The program helps to further educate hotels on how they can improve upon their green practices, highlighting environmental impacts, energy consumption and cost savings.

Active vs. Passive Design:

Passive Design

A design practice is considered "passive" when the resulting system or structure maximizes the use of naturally occurring resources (e.g. sunlight, wind, gravity, heating/cooling, air pressure) to create comfortable internal conditions for the occupants. This type of design does not need electrical or mechanical systems to operate. Some examples of passive green design features include green roofs, rain-water collection, waste-water recycling, thick walls, skylights, high ceilings, ventilators, landscaping and window/door positioning. Passive design also includes the use of building materials that are natural, locally sourced, and recycled.

 [6]

An image showing elements of passive design in a building that help leverage on natural ventilation, natural lighting and natural heating.

Passive design features tend to have low or no maintenance costs, long-term durability, reduced noise pollution when operating, and have a lighter environmental footprint. They can also be aesthetically appealing. On the other hand, passive design requires active participation of the occupants (opening and closing of windows for natural ventilation). It also tends to be less accurate compared to active design, and in some circumstances requires a larger capital investment to implement.

Active Design

A design practice is considered "active" when the resulting system or structure uses (or creates) a form of electrical or mechanical power to optimize the internal conditions of the building. Examples of active design include solar panels, wind turbines, geothermal heat pump, district heating, deep water cooling, fans, air-conditioning systems, and lighting.

[6] "Passive Building Design." *Passive Building Design - Designing Buildings Wiki*, https://www.designingbuildings.co.uk/wiki/Passive_building_design.

A simpler way of distinguishing passive and active design is to consider the differences between passive and active solar energy—one is used passively, such as window placement, to optimize heating in the building and the other is used actively, such as solar panels, to generate electricity for the building.

Active designs tend to be user-friendly, specific and precise (for example, an automated ventilation system) and they are usually designed and optimised for a particular purpose. On the other hand, they typically present higher operational costs, and regular maintenance and replacement is required. They tend to carry a larger environmental impact than passive design elements, as they may create noise/light pollution.

Hybrid designs, which are often used, are a blend of both passive and active designs. This helps to maximize the use of natural resources and simultaneously optimize the internal conditions for the occupants.

Benefits of Green Design Practices:

Economic

There are numerous economic benefits to going green when it comes to building operations and design. These include savings from using cheaper, less carbon-intensive building materials (e.g. wood vs. concrete/brick) and reduced site preparation and operational costs through sustainable sitting. Sustainable buildings are also differentiated in the market, providing competitive value for selling or leasing the building. Additionally, energy and water efficiency features and practices reduce utility costs, municipal waste-water treatment costs, peak power demand, and have up to 70 percent lower fuel and electricity costs. Through intentional commissioning practices, building and equipment may also last longer and require less frequent repairs or replacement. Local suppliers may be commissioned to reduce the carbon footprint associated with transporting building materials, benefiting their local economy.

Social

Social benefits are also a significant reason why organizations choose to abide by green building practices. One of the most direct benefits are improved occupant satisfaction, comfort, and individual productivity in spaces that promote a healthy indoor environment. Additionally, reducing energy and water waste aligns with societal interests in preserving our natural resources and environment. Sustainable sitting often promotes condensed cities and urban development that can allow more equitable access to infrastructure services (eg. public transportation). Green design also promotes the growth of the environmental sector and forward-thinking environment-based products and services.

Environmental

Green design practices are predominantly established with the environment in mind, seeking to either minimize negative ecological impacts or create positive ones. Several benefits from green buildings can therefore be derived, some key benefits including land preservation, lower resource and energy

consumption, water resource preservation, and decreased impacts of fossil fuel production. This leads to reduction in pollution, greenhouse gas emissions, waste, and carbon footprint.

2. Stakeholder Concerns

When it comes to a new building project, there are various stakeholders that should be accounted for when determining a project's goals, objectives, and strategic implementation.

In this section, we will discuss common stakeholder concerns that may come up during a sustainable building project, and strategies that can be used to mitigate misconceptions/barriers or highlight unexpected benefits.

Common Barriers to Green Design Thinking

There are common and recurring industry barriers to convincing clients to 'go green'. While the benefits and development of sustainable practices continues to build a promising resume, industry awareness of potential gains keep many of these benefits from being realized.

Common concerns you may hear from clients and stakeholders include:

- Having unclear economic perceptions around upfront capital and maintenance costs
- Lack of common knowledge + technical capacities
- Lack of existing green infrastructure to compare with

In Table 1 - Comparison of Conventional and Green Building Models from The University of Delaware's Center for Energy and Environmental Policy 2008 study[7] provides a side-by-side comparison of the benefits and costs to a conventional building design vs. a sustainable green building model that can be used as a starting point to provide knowledge and clarity for key stakeholders. Economic, Social, and Environmental benefits based on different building types (Residential, Commercial, Institutional) are further explored in Section 3.

[7] *GREEN BUILDINGS IN DELAWARE: CHALLENGES AND OPPORTUNITIES*. Center for Energy and Environmental Policy, University of Delaware, Sept. 2008, https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/3/848/files/2013/08/2008_sd_READY_Green_Buildings_2.pdf.

Table 1. Comparison of conventional and green building models

Economy		Environment		Equity	
Conventional Building Model	**Sustainable / Green Building Model**	**Conventional Building Model**	**Sustainable / Green Building Model**	**Conventional Building Model**	**Sustainable / Green Building Model**
Lower upfront cost but higher operation and maintenance costs.	Higher upfront cost but lower operation and maintenance, utility costs	Fossil fuel based.	Greater use of alternative energy sources.	Segregated design approach.	Close collaboration between design team, stakeholders and community.
Based on short term decision-making. Short life expectancy.	Based on long term decision-making. High life expectancy.	Heavily dependent on grid energy.	Use onsite energy generation technologies and integrate into building.	Sick Building Syndrome.	Occupant comfort and well-being and improved indoor air quality.
Resource intensive.	Energy efficient with life cycle benefits.	Energy and electricity intensive.	Demand reduction and high energy efficiency.	Access to traditional transportation options.	Inclusion of alternative transportation.
Depreciating market value loss of productivity due to employee absenteeism and turn over.	Higher market value and non monetary benefits such as improved occupant productivity.	Energy-technology focused.	Energy-environmental conservation focused.	Ignores utility costs and health of low-income occupants.	Minimization of utility costs and health effects on low-income occupants.
		Environmental impact external to economic choice.	Environmental impact central and important as economical choice.		
		Rely on virgin material, resource intensive.	Promote re-use, recycling and resource conservation.		

2.1 Stakeholder Incentives, Concerns and Mitigation Strategies

Stakeholder	Direct or Indirect?	Common Incentives	Common Concerns	Mitigation Strategy
Landlord/ Developer	D	○ Marketability and differentiation ○ Reduced utility bills & increased energy efficiency ○ Reputation (via green building ratings) ○ Tax and government rebate programs	1. Increased capital costs 2. Additional risk (supply chain, timeline, cost) 3. Increased maintenance makes it harder to sell	1. Break down the costs for your client. The average premium for green buildings is just below 2% or $3-5 more per Sq.Ft. (Kats et al, 2003[8]). Case studies have shown that an initial 2% increase in upfront costs yields a savings of 20% construction costs (based on a 20 year building life) 2. Seek to understand the client's risk tolerance, explain the benefits, and the long-term risks of not being a green leader.
General Contractor	D	○ Demand from Developers & Builders	1. Delays in supply chain 2. Lack of experience in implementing new features	1. Integrated planning and fall-back suppliers 2. Training and workshops, as well as open communication to help parties understand design features
Owners	I	○ Better air quality ○ Energy efficiency ○ Increased productivity of human capital	1. Increased Maintenance Labour and Cost	1. Reduced maintenance costs in other areas (e.g. smaller air ducts)
Building Users & Community Members	I	○ Aligns with values ○ Healthier indoor & outdoor settings (e.g. green wall, green roof) and air quality	1. Use of taxpayer funds to supplement projects 2. Transferred costs to consumers (e.g. higher rent)	1. Highlight impacts of green initiatives, such as energy efficiency and water conservation. Educate on the level of increased costs and resulting building performance 2. Reduced utility bills

[8]Kats, Greg. *The Costs and Financial Benefits of Green Buildings*. U.S. Green Building Council, https://www.usgbc.org/drupal/legacy/usgbc/docs/Archive/MediaArchive/607_Kats_PA184.pdf.

3. Differences by Building Type - Common Practices and Stakeholder Concerns

3.1 Residential

3.11 Single Family

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.[9]
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.[10]
Energy Efficiency	Substitute double-glazed glass	Reduced heating/cooling costs	Improved thermal conditions, acts as a sound barrier	Reduces heat losses and gains, and encourages energy efficiency (less active heating and cooling)	Double glazed glass: $180-$500[11]
	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300[12]
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000[13]
	High Efficiency Furnace	Reduced heating/cooling costs Lower initial costs, when systems can be downsized due to integrated energy systems.			Curtain wall technology: New: $150-$250/ Sq.Ft. Retrofit: $25- $50 High efficiency heating and

[9] "How Much Does It Cost To Hire An Architect?" *ImproveNet*, https://www.improvenet.com/r/costs-and-prices/architect-cost-estimator.
[10] "Window Prices in Edmonton." *Ecoline Windows*, 26 Sept. 2017, https://www.ecolinewindows.ca/window-prices-in-edmonton/.
[11] "Learn How Much It Costs to Replace Glass Window Pane." *HomeAdvisor*, https://www.homeadvisor.com/cost/doors-and-windows/replace-window-glass/#pricebyglasstype.
[12] "Cost to Install Thermostat - Estimates and Prices at Fixr." *Fixr.com*, https://www.fixr.com/costs/thermostat-installation.
[13] "Introduction to Geothermal Drilling." *Geothermal Pros and Cons*, 19 Apr. 2012, https://geothermalprosandcons.net/introduction-to-geothermal-drilling/.

					cooling plant: $1,900 to $5,500[14]
Water Efficiency	Rain-water retention	Reduced annual water costs	Preservation of water resources	Less strain on aquatic resources in water-scarce areas	Rain-water retention: $8,000-$10,000 for single family.[15]
	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80[16]
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000[17]
Building Materials	Wood		Fewer landfills and associate nuisances	Reduced carbon footprint/emissions	Wood: $15 - $30/ Sq.Ft.
	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

[14] "Save Money on Curtain Wall Replacement." *Thermolite Windows*, 4 Aug. 2014, https://thermolitewindows.com/save-money-on-curtain-wall-replacement/.

[15] "Rainwater HarvestingFAQ." *Texas Co-Op Power Magazine*, https://www.texascooppower.com/texas-stories/life-arts/rainwater-harvesting-faq.

[16] "Kitchen & Bar Faucets." *Kitchen Faucets & Bar Faucets | The Home Depot Canada*, https://www.homedepot.ca/en/home/categories/kitchen/kitchen-and-bar-faucets.html.

[17] "How Much Does a Greywater System Cost?" *Greywater Action*, https://greywateraction.org/faq/how-much-does-a-greywater-system-cost/.

3.12 Multi-Family

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation, reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Edible landscape	Reduced cost for clear-cutting for parking lots and adjacent roads & space efficiency	Improved aesthetics & air quality; food for consumption	Counteracts greenhouse gases	
Energy Efficiency	Substitute double-glazed glass	Reduced heating/cooling costs	Improved thermal conditions, acts as a sound barrier	Reduces heat losses and gains, and encourages energy efficiency (less active heating and cooling)	Double glazed glass: $180-$500
	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	High Efficiency Furnace	Reduced heating/cooling costs Lower initial costs, when systems can be downsized			High efficiency heating and cooling plant: $1,900 to $5,500[18]

		due to integrated energy systems.			
Water Efficiency	Rain-water retention	Reduced annual water costs	Preservation of water resources	Less strain on aquatic resources in water-scarce areas	Rain-water retention: $8,000-$10,000 for single family
	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	Wood	N/A	Fewer landfills and associate nuisances	Reduced carbon footprint/emissions	Wood: $15 - $30/ Sq.Ft.
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Green Wall	Organizational productivity improvements due to improved worker performance	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon dioxide and carbon monoxide	Green wall: $195-$265/ Sq.Ft.[19]
	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

[18]"Learn about the Cost of Projects in the Heating & Cooling Category." *2019 HVAC Costs | Average Heating & Air Conditioning Prices*, https://www.homeadvisor.com/cost/heating-and-cooling/#price.
[19]Solutions, Architek Green Building. "Links to Our Partners." *Architek*, http://architek.com/products/vertical-gardens.

3.13 Towers (Condo/Rental)

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Edible landscape	Reduced cost for clear-cutting for parking lots and adjacent roads & space efficiency	Improved aesthetics & air quality; food for consumption	Counteracts greenhouse gases	
	Underground Parking			Reduced habitat loss	
Energy Efficiency	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when systems can be downsized due to integrated energy systems.			High efficiency heating and cooling plant: $1,900 to $5,500
Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600,

					Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Curtain Wall	Reduced materials cost		Reduced materials and carbon footprint	Curtain wall technology: New: $150-$250/ Sq.Ft. Retrofit: $25- $50
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Green Wall	Organizational productivity improvements due to improved worker performance	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon dioxide and carbon monoxide	Green wall: $195-$265/ Sq.Ft.
	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

3.2 Commercial

3.21 Small (Mixed Use/Office)

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Edible landscape	Reduced cost for clear-cutting for parking lots and adjacent roads & space efficiency	Improved aesthetics & air quality; food for consumption	Counteracts greenhouse gases	
	Underground Parking			Reduced habitat loss	
Energy Efficiency	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	Wind Energy	Reduced energy costs			Motion-sensor light control: $15-$25[20]
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when			High efficiency heating and cooling plant: $1,900 to $5,500

[20] "Motion Sensor Lights." *Motion Sensor Lights: Amazon.ca*, https://www.amazon.ca/slp/motion-sensor-lights/5xsg8tga5m745da.

		systems can be downsized due to integrated energy systems.			
Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Curtain Wall	Reduced materials cost		Reduced materials and carbon footprint	Curtain wall technology: New: $150-$250/ Sq.Ft. Retrofit: $25- $50
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Green Wall	Organizational productivity improvements due to improved worker performance	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon dioxide and carbon monoxide	Green wall: $195-$265/ Sq.Ft..
	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

3.22 Towers

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Edible landscape	Reduced cost for clear-cutting for parking lots and adjacent roads & space efficiency	Improved aesthetics & air quality; food for consumption	Counteracts greenhouse gases	
	Underground Parking			Reduced habitat loss	
Energy Efficiency	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat : $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	Wind Energy	Reduced energy costs			Motion-sensor light control:$15-$25
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when systems can be downsized due to integrated energy systems.			High efficiency heating and cooling plant: $1,900 to $5,500

Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Curtain Wall	Reduced materials cost		Reduced materials and carbon footprint	Curtain wall technology: New: $150-$250/ Sq.Ft.. Retrofit: $25- $50
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Green Wall	Organizational productivity improvements due to improved worker performance	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon dioxide and carbon monoxide	Green wall: $195-$265/ Sq.Ft.
	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

3.23 Industrial

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation, reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
Energy Efficiency	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when systems can be downsized due to integrated energy systems.			High efficiency heating and cooling plant: $1,900 to $5,500
Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000

Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		

3.3 Institutional

3.31 Public (Government Sanctioned or Owned - Schools, Healthcare Facilities, Libraries, Community Centres)

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Edible Landscape	Reduced cost for clear-cutting for parking lots and adjacent roads & space efficiency	Improved aesthetics & air quality; food for consumption	Counteracts greenhouse gases	
	Underground Parking			Reduced habitat loss	

Energy Efficiency	Substitute double-glazed glass	Reduced heating/cooling costs	Improved thermal conditions, acts as a sound barrier	Reduces heat losses and gains, and encourages energy efficiency (less active heating and cooling)	Double glazed glass: $180-$500
	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when systems can be downsized due to integrated energy systems.			High efficiency heating and cooling plant: $1,900 to $5,500
Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Curtain Wall	Reduced materials cost		Reduced materials and carbon footprint	Curtain wall technology: New: $150-$250/ Sq.Ft. Retrofit: $25- $50
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor	Green Wall	Organizational productivity improvements due to	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon	Green wall: $195-$265/ Sq.Ft.

		improved worker performance		dioxide and carbon monoxide	
Environment Quality	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		
	Tenant Engagement/Awareness				

3.32 Private (Casinos, Hotels, Theatres, etc.)

Design Category	Common Practice	Benefit - Economic	Benefit - Social	Benefit - Environment	Pricing Estimates
Sustainable Sitting	Preserve open space, compact communities	Reduced urban development/infrastructure cost	Closer access to services & reduced transportation	Land preservation, reduced habitat loss, reduced vehicle traffic	Designing Cost - Architect $1.5-5/Sq.Ft.
	Minimize soil disturbance & compaction during construction	Reduced costs for site preparation	Reduced air pollution	Soil and water conservation , reduced air pollution	
	South-facing windows	Lower energy costs due to optimal orientation	Employee engagement/habitant morale and improved thermal conditions	Reduced electricity usage for heating	Materials Cost - Windows Range from $450 - $4,500.
	Underground Parking			Reduced habitat loss	
Energy Efficiency	Programmable thermostat	Reduced energy costs when building is not occupied	Better occupant comfort and satisfaction	Reduced electricity and fossil fuel use	Programmable thermostat: $90-$300
	Solar	Up to 70% lower annual fuel and electricity costs, reduced peak power demand	Fewer new power plants and transmission lines (+ associated annoyances)	Lower fossil fuel use	Geothermal wells: $5,000
	High Efficiency Heating and Cooling Plant	Reduced heating/cooling costs Lower initial costs, when			High efficiency heating and cooling plant: $1,900 to $5,500

		systems can be downsized due to integrated energy systems.			
Water Efficiency	Low-flow plumbing fixtures	Lower initial costs (for some fixtures)	Preservation of water resources	Preservation of water resources for wildlife and agriculture	Low-flow plumbing fixtures: Toilet: $150-$400, Sink tap: $100-$600, Shower head: $20-$80
	Grey-water reuse	Lower municipal costs for waste-water treatment	Fewer wastewater treatment plants and noise pollution	Lower potable water use and pollution discharge to waterways	Grey-water reuse system: $700-$20,000
Building Materials	On-site composting	Lower costs for waste-disposal	Decreased traffic on main highways	Reduced strain on landfills	
	Regional materials	Stimulate regional economy		Lower energy use for material transportation	
	Landfill waste diversion	Decreased costs due to reuse and recycling		Increase in local recycling market	
Healthy Indoor Environment Quality	Green Wall	Organizational productivity improvements due to improved worker performance	Reduced adverse health impacts	Improved air quality, decreasing toxic organic emissions, carbon dioxide and carbon monoxide	Green wall: $195-$265/ Sq.Ft.
	Increased Ventilation & Outdoor Air Delivery	Lower absenteeism & turnover	Improved occupant satisfaction and comfort		
	Low-emitting materials	Lower disability and health insurance related costs	Better individual productivity		

4. Additional Resources

In this section, you can find further resources to support your green build, including Canada and Alberta-based grants and incentives, local suppliers, and specialty groups.

4.1 Residential

Alberta-Wide Incentives

Energy Efficiency Alberta:

Rebates:

Purchase any eligible, energy-efficient refrigerator, clothes washer, smart thermostat or furnace with high efficiency motor (ECM), then use the application form to input your information and upload your receipt.[21]

Rebates also exist for home improvements on drain water recovery, insulation, windows, and tankless hot water heaters.

Affordable Housing Energy Program:

Energy Efficiency Alberta is now offering the Affordable Housing Energy Solutions program to improve energy efficiency, reduce energy use and increase comfort for those living in affordable housing.

Canada-Wide Incentives

Natural Resources Canada[22]

The objective of this program is to support the development and implementation of building codes for existing buildings and new net-zero energy-ready buildings through RD&D initiatives that:

- Accelerate development and adoption of technologies, design and construction
- Provide more cost-effective solutions
- Validate locally with real-world demonstrations
- Build confidence for adoption of updated codes

[21] "Online Rebates." *Energy Efficiency Alberta*, https://www.efficiencyalberta.ca/online-rebates/.

[22] "Energy Efficient Buildings Research, Development and Demonstration." *Natural Resources Canada*, 5 Feb. 2019, https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/energy-efficient-buildings-rdd/19787.

The contribution is expected to range from $50,000 to $5 million per project, and may be conditionally repayable (for a demonstration project) or non-repayable (R&D or FEED study).

Canada Housing and Mortgage Corporation[23]

CMHC offers a refund of up to 25% on a CMHC mortgage when you buy or build a green home, or make changes to an existing home to make it more energy-efficient.

New Build: Homes built under CMHC energy standards automatically qualify for a premium refund.
Retrofit: The The partial premium refund is based on the level of energy efficiency achieved.

4.2 Commercial

Alberta-Wide Incentives

Energy Efficiency Alberta:

Business Energy Savings[24] offers incentives to businesses to encourage them to choose high-efficiency products. These savings apply to a list of energy changing adaptations including lighting, heating, ventilation, air conditioning, water heating, food measures, plug load measures and hospitality measures.

Rebates range in savings depending on the item but fall between $1 to $1,500, to a total of $25,000 per facility or $100,000 for parent companies to help cover the cost of the equipment per year. These savings do not apply to new construction.

Canada-Wide Incentives

Natural Resources Canada:

The objective of this program is to support the development and implementation of building codes for existing buildings and new net-zero energy-ready buildings through RD&D initiatives that[25]:

- Accelerate development and adoption of technologies, design and construction
- Provide more cost-effective solutions
- Validate locally with real-world demonstrations
- Build confidence for adoption of updated codes

[23]"Energy-Efficient-Housing-Made-More-Affordable-with-Mortgage-Loan-Insurance." *Canada Mortgage and Housing Corporation*, https://www.cmhc-schl.gc.ca/en/finance-and-investing/mortgage-loan-insurance/the-resource/energy-efficient-housing-made-more-affordable-with-mortgage-loan-insurance.
[24]"Business Energy Savings." *Energy Efficiency Alberta*, https://www.efficiencyalberta.ca/business-non-profit-and-institutional/.
[25]"Energy Efficient Buildings Research, Development and Demonstration." *Natural Resources Canada*, 5 Feb. 2019, https://www.nrcan.gc.ca/climate-change/green-infrastructure-programs/energy-efficient-buildings-rdd/19787.

The contribution is expected to range from $50,000 to $5 million per project, and may be conditionally repayable (for a demonstration project) or non-repayable (R&D or FEED study).

4.3 Institutional

Alberta-Wide Incentives

Energy Efficiency Alberta:

Savings apply to all business, non-profit and institutional facilities serviced by an Alberta electric utility are eligible, except for new construction projects, federal and provincially owned buildings, facilities with over 10,000 tonnes of annual GHG emissions and large final emitters.[26]

Eligible organizations include but are not limited to:

- Institutions such as schools, hospitals, universities, and colleges
- Non-profit organizations
- Co-operatives
- Individual businesses
- Municipal facilities
- Common spaces in multi-unit residential buildings

These savings apply to a list of energy changing adaptations including lighting, heating, ventilation, air conditioning, water heating, food measures, plug load measures and hospitality measures. Rebates range in savings depending on the item but fall between $1 to $1,500, to a total of $25,000 per facility or $100,000 for parent companies to help cover the cost of the equipment per year.

Municipal Incentives

Edmonton:

- Edmonton's 2017 Sustainable Building Policy[27]
  - Passive Design
  - Better Insulation (Walls, Windows, Doors)
  - Minimized environmental harm through construction process
  - 1% of project budget dedicated to on site energy-generation
  - Other benefits:

[26] "Business Energy Savings." *Energy Efficiency Alberta*, https://www.efficiencyalberta.ca/business-non-profit-and-institutional/.
[27] *Sustainable Building Policy*. City of Edmonton, 2 May 2017, https://www.edmonton.ca/city_government/documents/PoliciesDirectives/C532.pdf.

- Hedge price-volatility of non-renewable energy resources
- Create economic opportunities for Edmonton businesses by stimulating the demand for green building products and services

❖ EFCL Solar and Energy Efficiency Program[28] for Community Leagues

➢ Workshops (Community Sustainability Programming, Energy Efficiency, Solar/Renewable Energy, and Funding Options)
➢ Ambassador Program (League Members that attend all 4 workshops)

❖ Grants:

➢ Community Leagues Infrastructure Program Grant
➢ EcoCity Edmonton
➢ MCCAC
➢ Building Energy Benchmarking Program[29]
➢ Energy Audit Rebate Program

Calgary:

❖ Calgary's Sustainable Building Policy[30]

➢ All new buildings occupied City-owned/City-funded buildings
➢ Major renovations of occupied facilities must meet or exceed either the Certified level of the LEED® New Construction rating system or the Silver level of the LEED® Commercial Interiors rating system.
➢ Minor renovations, unoccupied buildings, landscape/non-building infrastructure, and building less than 500 meters squared are directed to follow The City of Calgary's Sustainable Building Best Practices[31]

❖ Grants:

➢ Sustainable Building Partnership Program[32] funded by the Alberta Government's Municipal Sustainability Initiative

[28]"Green Leagues: EFCL Solar and Energy Efficiency Program." *City of Edmonton*, https://www.edmonton.ca/city_government/environmental_stewardship/green-leagues.aspx.
[29]"Building Energy Benchmarking Program." *City of Edmonton*, https://www.edmonton.ca/programs_services/environmental/building-energy-benchmarking-program.aspx.
[30] Innovation, Corporate Analytics and. "Calgary's Sustainable Building Policy." *The City of Calgary - Home Page*, The City of Calgary, 18 Apr. 2019, https://www.calgary.ca/CS/IIS/Pages/Green-Building/Calgary's-Sustainable-Building-Policy.aspx.
[31]*The City of Calgary Sustainable Building Best Practices*. Sustainable Building Policy Attachment 2 Appendix 2, https://www.calgary.ca/CS/IIS/Documents/About-land-information/Sustainable Building Best Practices Guide.pdf
[32]Innovation, Corporate Analytics and. "Sustainable Building Partnership Program." *The City of Calgary - Home Page*, The City of Calgary, 12 June 2013, https://www.calgary.ca/CS/IIS/Pages/SBPP.aspx.

4.4 Overview of Green Design Incentives by Government Level & Building Type

Building Type	Municipal Incentives	Provincial Incentives	Federal Incentives
Residential	Edmonton: ● Edmonton's 2017 Sustainable Building Policy ● Passive Design ● Better Insulation (Walls, Windows, Doors) ● Minimized environmental harm through construction process ● 1% of project budget dedicated to on site energy-generation ● Other benefits: (1) Hedge price-volatility of non-renewable energy resources and (2) Create economic opportunities for Edmonton businesses by stimulating the demand for green building products and services. Calgary: ● Calgary's Sustainable Building Policy ● All new buildings occupied City-owned/City-funded buildings ● Major renovations of occupied facilities must meet or exceed either the Certified level of the LEED® New Construction rating system or the Silver level of the LEED® Commercial Interiors rating system. ● Minor renovations, unoccupied buildings, landscape/non-building infrastructure, and building less than 500m2 are directed to follow The City	Energy Efficiency Alberta: *Rebates:* Purchase any eligible, energy-efficient refrigerator, clothes washer, smart thermostat or furnace with high efficiency motor (ECM), then use the application form to input your information and upload your receipt. Rebates also exist for home improvements on drain water recovery, insulation, windows, and tankless hot water heaters. *Affordable Housing Energy Program:* Energy Efficiency Alberta is now offering the Affordable Housing Energy Solutions program to improve energy efficiency, reduce energy use and increase comfort for those living in affordable housing.	Natural Resources Canada The objective of this program is to support the development and implementation of building codes for existing buildings and new net-zero energy-ready buildings through RD&D initiatives that: ● **Accelerate development and adoption** of technologies, design and construction ● **Provide** more cost-effective solutions ● **Validate locally** with real-world demonstrations ● **Build confidence** for adoption of updated codes The contribution is expected to range from $50,000 to $5 million per project, and may be conditionally repayable (for a demonstration project) or non-repayable (R&D or FEED study). Canada Housing and Mortgage Corporation CMHC offers a refund of up to 25% on a CMHC mortgage when you buy or build a green home, or make changes to an existing home to make it more energy-efficient. **New Build:** Homes built under CMHC energy standards automatically qualify for a premium refund.

	of Calgary's Sustainable Building Best Practices		**Retrofit:** The The partial premium refund is based on the level of energy efficiency achieved.

Commercial	• EFCL Solar and Energy Efficiency Program for Community Leagues
	  • Workshops (Community Sustainability Programming, Energy Efficiency, Solar/Renewable Energy, and Funding Options)
	  • Ambassador Program (League Members that attend all 4 workshops)
		Energy Efficiency Alberta
		• Business Energy Savings offers incentives to businesses to encourage them to choose high-efficiency products. These savings apply to a list of energy changing adaptations including lighting, heating, ventilation, air conditioning, water heating, food measures, plug load measures and hospitality measures.
		• Rebates range in savings depending on the item but fall between $1 to $1,500, to a total of $25,000 per facility or $100,000 for parent companies to help cover the cost of the equipment per year. These savings do not apply to new construction.
			Natural Resources Canada
			The objective of this program is to support the development and implementation of building codes for existing buildings and new net-zero energy-ready buildings through RD&D initiatives that:
			• **Accelerate development and adoption** of technologies, design and construction
			• **Provide** more cost-effective solutions
			• **Validate locally** with real-world demonstrations

Institutional	Edmonton: • Community Leagues Infrastructure Program Grant • EcoCity Edmonton • MCCAC • Building Energy Benchmarking Program • Energy Audit Rebate Program Calgary: • Sustainable Building Partnership Program funded by the Alberta Government's Municipal Sustainability Initiative	Energy Efficiency Alberta Savings apply to all business, non-profit and institutional facilities serviced by an Alberta electric utility are eligible, except for new construction projects, federal and provincially owned buildings, facilities with over 10,000 tonnes of annual GHG emissions and large final emitters. Eligible organizations include but are not limited to:	

		● Institutions such as schools, hospitals, universities, and colleges ● Non-profit organizations ● Co-operatives ● Individual businesses ● Municipal facilities ● Common spaces in multi-unit residential buildings These savings apply to a list of energy changing adaptations including lighting, heating, ventilation, air conditioning, water heating, food measures, plug load measures and hospitality measures. Rebates range in savings depending on the item but fall between $1 to $1500, to a total of $25,000 per facility or $100,000 for parent companies to help cover the cost of the equipment per year.	

5. Local Examples & Case Studies

In this section, we have highlighted local examples of successful projects in Alberta, including an outline of estimated building costs, timelines, and performance.

5.1 Residential

5.11 Single Family

1. MILL CREEK NET-ZERO HOME (Retrofit)

[Video Footage: https://www.youtube.com/watch?v=UdP3eBACjfE**]**

Project Owner/Developer: Chris Herberte (resident)

Location: Edmonton (2nd Net Zero Energy Home)

Description: A 1954 bungalow

Objective:

Cost: $500K[33]

Timeline: approx. 3 years from sale to move-in[34]

Performance: -5408 kWh in electricity (Oct 2010-Nov 11)[35]

Green Design: There was Initial work to get to an Energuide rating of 71 (this rating is typical of a conventional new house between 66 and 74.)

- replacing one of the furnaces
- putting in all new windows,
- sealing the cracks and gaps in its outer shell,
- and covering the outside of the house with rigid foam insulation.

Front View

Back View(south facing windows)

The owner/designer attributes over 85% of the success of a given net-zero project to the following passive design elements:[36]

- A thick wall (16 inch)
- Insulation
- Large south-facing windows*
- Concrete floors *

**Work in Tandem to regulate heating and cooling during the day and night. The concrete absorbs excess heat during the day and radiates heat at night.*

[33] Chris Herberte. "Green Edmonton." *Affordability | Green Edmonton*, http://greenedmonton.ca/mcnzh-affordability.html.
[34] Chris Herberte. "Green Edmonton." *Mill Creek NetZero Home | Green Edmonton*, http://greenedmonton.ca/mcnzh-introduction.html.
[35] "Green Edmonton." *A Net Zero Energy Year : February and March 2011 | Green Edmonton*, http://greenedmonton.ca/net-zero-year-feb-and-march.html.
[36] Chris Herberte. "Green Edmonton." *Passive Solar Design | Green Edmonton*, http://greenedmonton.ca/mcnzh-passive-solar-design.html.

2. WINDSOR PARK NET ZERO HOUSE (Retrofit)[37]

Location: Edmonton

Description: A 1950s bungalow retrofit that was facing possible demolition since it was beginning to demonstrate foundation failure, continuous sewer backups, and the need for a complete mechanical overhaul.

Objective: was to design and build a net zero energy home for a family of 4.

Cost: $20-25K

Building Materials: The home was designed and constructed using mechanical equipment/technologies that were simple, locally accessible and able to be installed by local trades people.

Cross section of home showing energy efficient components
1 Passive Solar Design
2 Under Slab R20
3 Walls R45
4 Attic R80
5 Windows U 0.15
6 ASHP Space Heating COP
7 HRV
8 ASHP Water Heating COP
9 DWHR
10 LED lighting
11 Energy Efficient Appliances
12 Efficient Wood Burning Fireplace
13 Airtight Construction Techniques
14 EV Chargers in Garage
15 Renewable Energy Generation

Green Design: The result was a Net Zero home that produces all its own energy, including that needed for a home office, a secondary accommodation on top of the garage and two electric vehicles. A secondary suite was integrated into the design of the home, creating living space for renters with direct access to the university, downtown, and Light Rail Transit.

Design Principles:

1) passive solar design,
2) increased insulation
3) airtight construction techniques
4) highly efficient mechanical systems
5) and photovoltaic power generation.

These systems and design features worked together to achieve an EnerGuide rating of 100. The home also boasts a *walk score* of 56 and a *transit score* of 58.

[37]Image 1: https://amainsider.com/impressive-eco-friendly-homes-in-alberta/ Image 2: https://www.ecohome.net/guides/1031/award-winning-net-zero-house-in-edmonton/

Strategic Decisions Element of Siting: The backyard faces south with little obstruction, and the width of the lot on the east/west axis is sufficient to allow most 'living spaces' to be facing south, and thereby benefit from extensive natural light and heating. It also allowed for a 25kW solar array to be seamlessly incorporated into the design of the home.

Community + Element of Siting: The project is located within 500m of the University of Alberta, the North Saskatchewan River and an LRT station. To adhere to the principles of increased density within the urban core and to provide high quality student accommodation, we incorporated a secondary suite on top of the garage.

Site ecology: Existing trees were kept on the property wherever possible. Bushes, plants and flowers were salvaged, planted temporarily off site and were brought back after construction was completed. The seeds of existing trees were harvested in the fall, planted indoors in winter and brought back outside in spring. Additional native plants were planted as well.

Light and air: Expansive windows light and heat the home and create the feeling of being outside and connected to nature. Appropriately-sized roof overhangs regulate the amount of sun entering the home depending on the season. 100% of the lighting in the home is LED. Heat recovery ventilation (including washroom fans) is controlled by a Venmar HE3000 HRV which provides 306 CFM(cubic feet per minute) of fresh air.

Water conservation: All plumbing fixtures are low-flow. The residual heat in wastewater is collected through a single stack drain that is connected to a Drain Water Heat Recovery System. The foundation's sump pump is equipped with a valve to allow for watering of the yard. Annual water consumption of the home is 140,000 litres; 28,000 litres per occupant per year or 76.7 per occupant per day while the average consumption per person per day is 230 litres. (Source: Edmonton Green Home Guide, City of Edmonton)

Demolition waste management: Prior to demolition of the old home, the following items were salvaged: windows and doors, hardwood floor, trim, kitchen cabinets, appliances and a 12x12' sunroom. All clean waste lumber was saved and used to heat the new home with a high-efficiency wood burning fireplace. All recyclable materials were hand sorted and brought to a recycling depot.

New building materials:

1. Fibreglass-framed windows
2. All MDF (medium density fiberboard) materials in the home are formaldehyde-free
3. Low-VOC(Volatile organic compounds) paints
4. FSC(Forest Stewardship Council) Certified engineered hardwood floors

Building life cycle considerations: The home features a secondary suite that is currently used for student housing but in the future could be used for aging family members, or the current homeowners when their children and their families live in the home.

Education and information sharing: We have opened up the home to the public annually since 2015 for the Eco Solar home tour; so far over 800 people have viewed the home. This annual tour shows Edmonton's most energy efficient homes and is run by volunteers, operating since the late nineties. It is this tour that showed us how other people lived a greener lifestyle and inspired us to do the same. Now, many years later, it is our turn to close this circle and inspire others.

5.2 Commercial

5.21 Small (Mixed Use/Office)

1. MOSAIC CENTER[38]

Project Owner/Developer: Dennis Cuku and Christy Benoit

Architect: Manasc Isaac

LEED Consultant: Eco Ammo[39]

Key Take-Aways: Integrated Project Delivery Approach (IPD), combined active (solar panels, geothermal wells) and passive (south-facing windows, rainwater retention) design.

Location: Edmonton

Description: a three story, 30,000 sq.ft. mixed-use building providing office space for 110 people, including: childcare facility, restaurants, wellness center, game-room, and large atrium. Known as Alberta's first net-zero, LEED platinum certified (Oct. 2017) commercial building.

Objective: "Lead by example and build Alberta's first attempt at a net zero energy commercial building"[40]

Cost: $10.5 million

Timeline: 1.5 years[41]

[38] Image Source: https://www.construction21.org/case-studies/h/mosaic-centrefor-conscious-community-and-commerce.html

[39] Canadian Green Building Council, *PriMED Mosaic Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/primed_mosaic_centre.aspx.

[40] ""

[41] ""

Performance[42]:

DP - Envelope Op Runs							
Glazing	R5.26			R7.72			R16
Design #	1	2	3	4	5	6	7
Envelope Level	R10/R30/R50	R20/R40/R60	R30/R50/R70	R10/R30/R50	R10/R30/R50	R30/R50/R70	R30/R50/R70
Heating Load [kW]	277 kW	274 kW	272 kW	268 kW	268 kW	263 kW	250 kW
Cooling Load [kW]	119 kW	117 kW	116 kW	110 kW	110 kW	108 kW	109 kW
Heat Demand [kWh/a]	84455 kWh	77381 kWh	72345 kWh	77733 kWh	77733 kWh	65620 kWh	48505 kWh
Cool Demand [kWh/a]	20180 kWh	20593 kWh	21060 kWh	18801 kWh	18801 kWh	19670 kWh	22299 kWh
Lighting Demand [kWh/a]	27532 kWh	27532 kWh	27532 kWh	27532 kWh	27532 kWh	27532 kWh	27532 kWh
Equipment Demand [kWh/a]	151340 kWh	151340 kWh	151340 kWh	151340 kWh	151340 kWh	151340 kWh	151340 kWh
Total Demand [kWh/a]	283507 kWh	276846 kWh	272277 kWh	275405 kWh	275405 kWh	264162 kWh	249676 kWh
Heat Intensity [kWh/m2a]	30.8 kWh	28.2 kWh	26.4 kWh	28.3 kWh	28.3 kWh	23.9 kWh	17.7 kWh
Cool Intensity [kwh/m2a]	7.4 kWh	7.5 kWh	7.7 kWh	6.9 kWh	6.9 kWh	7.2 kWh	8.1 kWh
Site Intensity [kWh/m2a]	103.3 kWh	100.9 kWh	99.2 kWh	100.4 kWh	100.4 kWh	96.3 kWh	91.0 kWh
Envelope Cost	$ 1,681,032	$ 1,849,882	$ 2,026,495	$ 2,138,812	$ 2,138,812	$ 2,484,274	$ 2,876,657
PV Size	303 kW	296 kW	291 kW	294 kW	294 kW	282 kW	267 kW
PV Cost	$ 1,210,575	$ 1,182,130	$ 1,162,623	$ 1,175,979	$ 1,175,979	$ 1,127,972	$ 1,066,117
Env + PV Cost	$ 2,891,607	$ 3,032,013	$ 3,189,117	$ 3,314,791	$ 3,314,791	$ 3,612,246	$ 3,942,773

Table 2: Summary of the comparative impact of improving envelope assembly performance on the Mosaic Center designed as per DP drawing. R-values are denoted as slab/wall/roof. Semi-transparent elements were included in the model, using the R18 Solera product.

LEED SCORE CARD

Certification Level:	Platinum
Rating System:	LEED Canada for New Construction and Major Renovations
Total Points earned:	82
Sustainable Sites:	16 out of 26
Water Efficiency:	7 out of 10
Energy & Atmosphere:	31 out of 35
Materials & Resources:	5 out of 14
Indoor Environmental Quality:	13 out of 15
Innovation in Design:	6 out of 6
Regional Priority:	4 out of 4

[42] **Image (Top, Left)**: *The Mosaic Centre for Conscious Community and Commerce: Design Development Report* . 27 Sept. 2013, https://www.primedmosaiccentre.com/wp-content/uploads/2016/03/2013-09-27_MosaicCentre_DD_Report.pdf. **Image (Bottom, Right)**: Advanced Solutions International, Inc. *PriMED Mosaic Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/primed_mosaic_centre.aspx.

Green Design:[43]

a. Sustainable Sitting (Passive Design)

- Large south facing windows. Windows are designed to be south-facing as this is the best-direction for solar day-lighting in the northern hemisphere.
- This helped reduce electricity load, particularly by replacing many overload light fixtures with natural light, and only using task lighting where/when necessary.
- 30 % edible landscape - the use of food plants as design features, for aesthetic value and consumption.

b. Energy Efficiency (Active Design)

- Powered by solar panels/photovoltaic panels with a capacity of more than 213 kW. Excess electricity in seasons of high sunlight is stored and fed back into the power grid for fall/winter.
- Heated/cooled by 32 geothermal wells running 70 m deep. Other options were explored (including air source heat pumps) but after detailed feasibility studies, it became clear that you simply can't beat the efficiency of a geothermal system which reduced the size of the PV system by 40kW ($cost savings of $150,000). The payback for the geothermal was better than the immediate--$80,000 cheaper! One of the lessons learned from this project was that a geothermal system is essential in achieving Net Zero.

c. Water Efficiency (Passive Design)

- 26,500-litre rainwater retention tank
- 30 % edible landscape

d. Building Materials & Resources [Recycling/Waste Disposal]

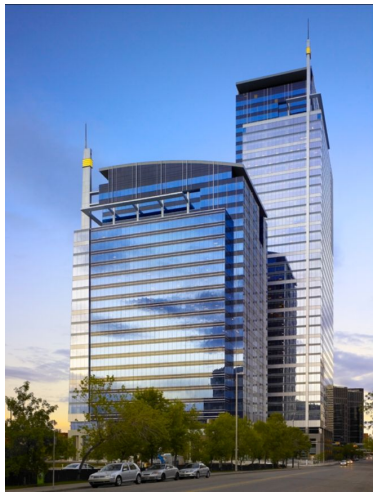
- Wood was the main material used for construction
- 95% of materials diverted from landfill during construction. The diversion goal was a minimum of 75% landfill diversion during construction. As part of this goal, the project's design team was given the task of creating furniture and artwork using wood scraps from the building's structure. This was so successful that they actually ran out of scrap material and had to purchase waste from others to complete the commissioned pieces. The initial goal was exceeded with 95% of all materials diverted from the landfill.
- On-site composting - using wood waste in ways that keeps most of the organic material in its original ecological system and enhances conservation.
- The project achieved an innovation point with more than 40 % in regional materials.
- Utilizing local resources was a key focus and as such all project team members were from Alberta, 99 % from Edmonton.

e. Healthy Indoor Environmental Quality

- Three-story "living wall" (vertical garden) in foyer/lobby
- Use of increased ventilation and low-emitting materials to enhance interior air quality

[43] Canadian Green Building Council, *PriMED Mosaic Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/primed_mosaic_centre.aspx.

5.22 Towers[44]



CENTENNIAL PLACE

Project Owner: OMERS Realty Corporation
Developer/Manager: Oxford Properties Group
Architect: WZMH Architects
Key Take-Away: tenant engagement, combined active (motion-sensored lights) and passive (green roofing, greywater and rainwater reuse, curtain wall passive cooling) design.
Location: Downtown Calgary
Description: A LEED platinum certified, 1.3 million square foot, two tower (23 & 39 stories) office complex. One of the largest commercial building in Canada to attain this certification.
Cost: $320 million [45]
Timeline: Tower 1 - 4 years (2006-2010)[46], Tower II - 3 years (2007-2010)[47]

[44] Image Source: https://upload.wikimedia.org/wikipedia/commons/7/71/Centennial_Place_2010.jpg
[45] "CENTENNIAL PLACE: WZMH Architects." *Archello*, https://archello.com/project/centennial-place.
[46] *Centennial Place I, Calgary - SkyscraperPage.com*, http://skyscraperpage.com/cities/?buildingID=47964.
[47] *Centennial Place II, Calgary - SkyscraperPage.com*, http://skyscraperpage.com/cities/?buildingID=47965.

Performance:[48]

LEED SCORE CARD

Certification Level:	Platinum
Rating System:	LEED Canada for Existing Buildings: Operations & Maintenance 2009
Total Points earned:	84
Sustainable Sites:	19 out of 26
Water Efficiency:	11 out of 14
Energy & Atmosphere:	29 out of 35
Materials & Resources:	5 out of 10
Indoor Environmental Quality:	10 out of 15
Innovation in Operations:	6 out of 6
Regional Priority:	4 out of 4

[48] Canadian Green Building Council, *Centennial Place*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/Centennial_Place.aspx.

Green Design

a. Sustainable Sitting

- Proximity to public transit – 72 % of occupants either bike, walk or take public transit to work daily
- Combined heat and power generation system on site
- Underground parking (5 level parkade with 793 stalls)

b. Energy Efficiency (Passive Design)

- A "green" roof with 30% of its surface planted: Reflective white roof/green roof areas to reduce urban heat island effect.
    - **"***Mitigation of the urban heat island effect can be accomplished through the use of green roofs and the use of lighter-colored surfaces in urban areas, which reflect more sunlight and absorb less heat.*"
- Extensive energy sub-metering to better understand opportunities for continuous improvement.
- Fine-tuned operation of building systems to achieve industry-leading energy efficiency.
- "Use of curtain wall technology." It's "*clad in a high performance glazed façade that minimizes solar ingress and heat gain."*[49]
- Demand controlled ventilation to optimize outdoor air delivery

c. Energy Efficiency (Active Design)

- *"Motion sensors on lighting controls*" = "Occupancy sensors on all base building light fixtures".[50]
- *"A high-efficiency heating and cooling plant"* = Cooling tower water management.

d. Water Efficiency (Passive and Active Design)

- *"Rainwater collection and grey water reuse for irrigation"= "Landscape vegetation which requires no potable water use for irrigation."* [51]
- *"Low-flow plumbing fixtures" = "*Water-efficient washroom fixtures"

e. Building Materials & Resources [Recycling/Waste Disposal]

- MAIN BUILDING MATERIALS were Glass, Aluminium and Granite
- Industry leading comprehensive Recycling Program to divert 75 % of waste from landfills.

f. Healthy Indoor Environmental Quality

- Active engagement of tenants to understand and contribute to green building initiatives.
- Demand controlled ventilation to optimize outdoor air delivery

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[49] "CENTENNIAL PLACE: WZMH Architects." *Archello*, https://archello.com/project/centennial-place.
[50] Canadian Green Building Council, *Centennial Place*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/Centennial_Place.aspx
[51] "Greywater Reuse." *Greywater Action*, https://greywateraction.org/greywater-reuse/.

5.3 Institutional

5.31 Public

ATCO CENTRE (Retrofit)[52]

Project Owner/Developer: HOOPP Realty Inc. | Canada Post Corporation

LEED Consultant: WSP Canada Inc.

Key Take-Away: introduction of 11 new best-in-class sustainable operations policies, LEED EB:O&M Gold certification (67 points)

Location: Downtown Edmonton

Description: Constructed in 1983 & located west of the central downtown core in Edmonton. In September of 2016 (about 33 years after construction), the 20 storey, class A office building achieved LEED® EB:O&M Gold certification. Triovest Realty Advisors Inc. has managed the property since January 2009, at which point the owners and managers made a commitment to their employees, tenants, and investors to take a proactive and aggressive approach to incorporating sustainable business practices in the operations and management of their buildings. Energy conservation practices are considered a top priority for both the ATCO Center's owners and Triovest as third party property management. Due to their ongoing focus on sustainability, energy efficiency and environmental risk reduction, the property is ranked as the most efficient in the owner's portfolio. In the fall of 2015, five year targets were set for ATCO Centre versus a 2014 baseline. In comparison to the baseline of 2014, energy has now decreased by 28% and water by 38%.

- "*With Alberta's Climate Change Leadership Plan and associated carbon tax, it is forecast that Alberta's most energy efficient buildings will see an additional $0.30 per square foot in 2017 and an additional $0.45 per square foot in 2018*," says Ms. Julio.
- "*A carbon price of $20 per tonne will be applied to all electricity consumed in 2017 and $30 per tonne in 2018*."
- "*With the high energy efficiency rating of ATCO Centre, the impact of this carbon tax will be minimal, and initiatives like LEED EB:O&M certification will further offset this impact through improved operations and higher building performance standards*."

Cost: $230,000[53]

Timeline: 2 year retro-commissioning process[54]

[52] Canadian Green Building Council. *ATCO Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/ATCO_Centre.aspx., Image Source: "ATCO Building, Edmonton, 2003." *A Portrait of Canada*, 1 Dec. 2011, http://www.aportraitofcanada.ca/?p=2820.

[53] Paradis, Richard. "Retrofitting Existing Buildings to Improve Sustainability and Energy Performance ." *WBDG*, https://www.wbdg.org/resources/retrofitting-existing-buildings-improve-sustainability-and-energy-performance.

[54] ""

Performance:[55]

LEED SCORE CARD

Certification Level:	Gold
Rating System:	Rating System: LEED Canada for Existing Buildings: Operations & Maintenance 2009
Total Points earned:	67
Sustainable Sites:	15 out of 26
Water Efficiency:	8 out of 14
Energy & Atmosphere:	25 out of 35
Materials & Resources:	3 out of 10
Indoor Environmental Quality:	7 out of 15
Innovation in Operations:	5 out of 6
Regional Priority:	4 out of 4

[55] Canadian Green Building Council. *ATCO Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/ATCO_Centre.aspx.

LEED EB:O&M Certification:[56]

With LEED EB:O&M certification comes multiple benefits to staff, tenants, owners and the local community, including:

1) A 260 CO2e tonne reduction in GHG emissions per year, which equates to taking 55 cars off the road for a year--cuts on Carbon Levy.

Energy Efficiency

2) Energy savings of 270 eMWh per year, equivalent to the energy use of 27.5 single family dwellings.
3) ENERGY STAR score of 98 – performing better than 98% of similar facilities nationwide (updated monthly as Triovest receives the utility billings).

Building Materials & Resources [Recycling/Waste Disposal]

4) 86% of waste diverted from landfill.

Healthy Indoor Environmental Quality

5) High Efficiency Air Filtration to promote improved indoor air quality.
6) Green Cleaning Program to protect occupants from harmful chemical toxins.

In addition to energy conservation and environmental risk benefits, LEED EB:O&M certification provides an evolving benchmark against which to maintain the building's energy efficiency through ongoing commissioning and re-certification every 5 years.

7) $18,000 lowered annual operations costs predicted resulting in more capital available for further building improvements--cuts on operational expenses.

[56]Canadian Green Building Council, *ATCO Centre*, https://www.cagbc.org/Archives/EN/CaGBC_Green_Building_Case_Studies/ATCO_Centre.aspx.

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