Phase I Findings

Prepared for the Consulting Architects of Alberta
by Tantus Solutions Group & SoCo Consulting Group

May 2019

Green Building Definition

While the definition of a green building/design may change between stakeholder groups and goals, there appears to be a consensus among architects that centers around sustainability, stewardship, and social responsibility. Further, a 'green' building can be defined 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 preserve precious natural resources and improve quality of life for the people who occupy and surround them. A key part of this definition is the emphasis on impact reversion, not just reduction.

Throughout our conversation with architects, sustainability consultants, and engineers a number of additional points to add to the definition came up. The nature of these comments centered around ideas that an integrated green building design process is not just intrinsically valuable, but also a **logical alternative** to traditional building design and construction, both from a cost, risk management, and performance perspective. An example of this includes cost savings from using natural resources to generate energy or building materials that offer better insulation.

The second resounding echo from our conversations centered around the **human element** of green buildings and how the nature of one's environment enhances people's lives and contributes to their wellbeing. Air quality (particularly in Alberta due to our resource industry and history of forest fires), reduced toxins, biophilic design and green space are examples of tangible elements that affect the mental and physical health of a building's occupants. Some of the tangible benefits of a healthy human environment include tenant attraction and retention, optimizing performance, and reducing absenteeism/stress/burnout.

Public and international conversation around climate change, the United Nations' Sustainable Development Goals, natural resource & water conservation, and greenhouse gas emissions should also be centered in this definition, in addition to financial sustainability and economy impacts. It was highlighted here that everyone has a stake in the development of green buildings and environmental sustainability at large, and conversations around the green building definition need to become more comprehensive to not exclude any of these elements or create the potential for "green washing."

Building Types, Practices & Standards

Building Types

Commercial office buildings and residential single family homes are the two main primary adopters of green building design, largely due to client uptake and financial feasibility. For larger commercial spaces, the cost of implementing sustainable features and materials is often driven down by economies of scale and a higher return on investment per square foot. These green commercial buildings are more often new-builds, but examples of retrofits include updating mechanical systems, lighting systems, removing toxic materials (lead pipes, asbestos), and renewable energy systems. On the residential side, green technology is becoming more readily accessible and adopted by upper-middle class families who are conscious about bringing healthier materials into their homes and cost savings related to energy efficiency. While this has put additional some pressure on land developers to build more sustainable communities (such as in Riverdale, Windsor Park, and Millcreek) there are still barriers to entry that are further explored under *Sale Process*. Clients under this building type tend to be well-educated and own high-end homes.

Within recent years, Alberta has seen adoption of green design practices in other building types, predominantly public institutional buildings such as schools, libraries, and healthcare facilities. Both the City of Edmonton and City of Calgary have legislation that requires any new buildings the government owns or leases met a LEED Silver or Gold standard. Since the same economies of scale are not realized here compared to larger commercial builds, these changes are largely policy driven.

One building type that has remained relatively unpenetrated are Industrial buildings (warehouses, agriculture). This is due to a lower return on investment, and any sustainability development is usually driven by energy code.

The scalability of green buildings continues to be an important constraint/dependency for further development. This includes technology, sourcing, and the entire supply chain.

Practices and Standards

Integrated design was often mentioned during our interview conversations as an important step in further understanding building objectives and performance, reducing costs

further down along in the project.These design elements can be as simple as situating windows to maximize daylight to more complex systems and processes.

Local Building Materials

During our conversations, there was commentary around underutilized resources and opportunities from not sourcing local. Alberta is home to growing innovation, particularly around agricultural by-products and substitutes for toxic materials. The main barrier here is the difficulty of moving beyond the R&D stage to production, without a solidified contract. Subsequently, these products are not getting exposure or into the hands of owners, architects, contractors, designers and other decision makers in the build process. Rather, these stakeholders often prefer to select materials based solely on price and pre-established relationship--usually sourced from the US or China. Additionally, local suppliers have to jump through hoops to meet green building rating systems and Canadian materials requirements which may be counterproductive against further sustainable development. Transportation costs and environmental damage of this sourcing could be reduced by in-province production, especially with Alberta being landlocked.

Additional recommendations regarding building materials included using more wood (similar to BC's Wood First Initiative and Charter); producing lower-carbon intensive cement in Lafarge, AB; using straw-bale panels(and other waste resources) for insulation, sound proofing, and fire safety. There are also cheaper alternatives, for example, green walls, which are expensive to maintain, can be substituted by use of natural colors on walls. Green colors on walls tend to give a more calming effect and facilitate creativity as opposed to red colors which can have an overwhelming effect.

When it comes to the further development and use of local building materials, architects mentioned that more advocacy is required to shift public and stakeholder perceptions for further market adoption. Alberta has a wealth of people with experience and expertise in sustainability and green design (Calgary building the first LEED Gold infrastructure in the nation), and these resources can be further tapped into to.

Sale Process

Approaches to pitching green solutions to their clients shift based on customized customer goals and research. Passive designs tend to be easier to sell as they are more durable and offer a longer-term investment with lower maintenance cost, but high up-front capital and less precision (eg. upgraded electrical/mechanical systems). Word of mouth appears to be an effective marketing strategy for green design solutions due to its proof of concept. Stakeholder communications is also an important identified piece, which can be a barrier to a project if everyone's not on the same page. Some communication strategies that were described during out interviews included referring to the end user in conversation, referring to the natural environment, looking at immediate aspects of the environment (eg. adverse health effects), providing clients with tools and space to educate themselves, and working with the engineer team on their sale and communication skills (eg. in conversation with contractors, suppliers).

Stakeholders

Direct clients and stakeholders primarily include property managers, land developers, and municipal/provincial governments.

Land developers are primarily driven by getting in and out of a project as quickly as they can for as little as they can--rather they are driven by the demands of the market and end consumers. Residential developers have a substantial amount of market power and could be effective in pushing green design and practices on consumers if they chose to do so.

Drivers

It was recognized during the interview, that different client and stakeholder group are motivated by different objectives: doing the 'right thing', policy/legislation, occupant health and experience, social standing, consumer pressure, energy efficiency, cost savings, and more. This being said, the majority of green building clients are driven by long term perspectives on sustainability over cost and short term gain.

Many of the conversations with clients stem from the understanding of what they are giving up to gain in return. A large portion of discussions also centered around storytelling and

communications. Depending on priorities and values, the design team must be able to explain the short and long-term benefits of the sustainable approach. On example is green walls, which are lots of maintenance due to humidity levels but offer a positive emotional impact on mental health and well-being. A decision such as this would often come down to budget and communicating an intangible benefit (such as productivity--measured by absenteeism, output, etc.).

Design Concepts

Certain design concepts are easier to sell than others. One significant factor to an element's ability to sell is its tie to mainstream social issues.While conversations around energy performance and efficiency are fairly accepted in Alberta, water reduction and healthy materials occupy less public mind-share which makes for a harder sell. Examples of green design elements that have barriers to sale include gray water systems, geothermal, excessive building envelope, construction time, andchigh-end automated mechanical systems require monitoring and high maintenance while not being an available part of the building occupant's user-experience. On the other hand, rain-shower heads, low-flow toilets, and wall "nest systems" are easier to sell because building owners and occupants can see and use them right away. Some design concepts, such as cogeneration systems, are more effective the more they are set up.

Renewable energy systems were also brought up in discussion as a supplement factor to green design, where once a building has been made energy efficient the next stage is to supplement renewable energy sources (especially because our power grids are carbon intensive). Improvements in renewable energy systems has made them more of an integrated concept, and PVs have proven to be durable in hail storms and poor weather. It's important to mention that other environmental hazards, such as battery waste, are still part of the systems.

Integrated Design & Conversation

The concept of **integrated design** centers around better informed and establish goals and higher success at achieving them. Often when sustainable design is brought in during the early stages of planning, costs of green building features are not much higher, if not the same, as a traditional build. During our conversations, architects recommended bringing a sustainability consultant (or someone knowledgeable about green building--their updated incentives, drivers,

and advancements) to do an upfront evaluation of needs, use, and occupation. This approach ensures that custom solutions for each building project and owner fall in line with the clients goals, climate zone, occupant use, budget, and schedule.

Data & Resources

Cost and Performance

General trends: *materials cost going down in price. There is still upfront capital cost, but more proof of concept regarding human performance and energy performance results.*

Many of the performance and cost savings of green design elements stem from an integrated design approach that recognizes how one green solution can create indirect efficiencies. For example, an more efficient boiler system means smaller ducts are required, which shifts (and evens out) cost. Usually when a commercial green building project costs more than a traditional building project, it is when the design wasn't planned out early enough or was changed mid-way through.

Technology and artificial intelligence also drive cost reduction in green buildings. While AI integration needs to keep in mind that people like to be in control, it is advantageous from an energy standpoint (eg. automated heat/energy generation controls).

Additional identified ways to minimize costs in Alberta include using heavy timber (quick and reduces construction costs, low carbon intensive) and local resources such as straw bales.

Real-life Examples

There were a couple examples around clients who didn't realize they were achieving certain green standards (eg. LEED) as they thought it was financially unattainable, but ended up meeting the requirements unintentionally which showed them it was more attainable than they had originally thought. Other examples included projects with a very heavy cost load, driven purely by legislation.

Policy & Incentives

There are a number of government incentives supporting green design development, including Energy Efficiency Alberta solar and renewable energy grants, the City of Calgary's rebate program for switching water fixtures to low flow, PACE program for building owners to funding sustainable measures and technology (vs. bank loan), Energy Wise's educational programs, provincial building LEED policy and NACB building codes.

Additionally, urban development and planning tends to be inherently sustainable (eg. renewing a downtown centre by reviewing public transportation options, green spaces, water usage, and storm water retention). There is potential and opportunities for municipalities to borrow and share information with one another regarding urban and sustainability practices.

The carbon tax, and potential removal of funding was brought up as policy concern. Currently, municipal funding is fairly established and driven green building standards, grants, and community incentives in Alberta's urban centres.

During discussions, architects did not that while incentives were a good start to incentive interested, they are not long term solutions or drivers.

Alberta-Based Trends & Challenges

Some additional Alberta-based trends and challenges were brought up during the discussion:

- Many hours of direct sunlight, even in winter months.
- Our windows are smaller and walls thicker.
- Snow--currently and underutilized design resource, and could be better used for roof insulation.
- Single family homes tend to be developer driven (rather than design driven).
- People are buying larger houses on smaller lots, losing green space.
- Alberta offers relatively affordable living.
- There have been sustainability leaders both in our two main municipalities but also rural communities.

- Political landscape may be a barrier (eg. removing Carbon tax and replace it with nothing to fund the sustainability piece). Also, currently have restricted legislation of the use of grey water for toilets as well as our procurement policy.

Further Comments

Architects mentioned that they would like to see a comprehensive resource list of organizations and resources to reach out to for sourcing materials or consulting services, as well as having an online tool (to the tune of a Dummy's Guide/checklist) that tangibly helps architects work with their clients to identify values and solutions.

Proposed Phase II Deliverables

Taking what we learned from Phase I, we will be moving forward to work on the following deliverable (pending approval): a resource guide and decision trees for architects to refer to during the early stages of client interactions regarding building designs. This guide will cover residential (single family, multi-family, towers), commercial (small, tower, industrial) and institutional (government and private) building types--both retrofit and new build. Resources available under each type will outline common green industry practices, expected benefits and costs, stakeholder concerns, further resources and links to contacts, grants, incentives, and Alberta-based local examples.

Attached below is an example of the resource template for residential single family homes:

Residential: Single Family Home (New-Build)

Common Practices

Expected Benefits

Stakeholder Concerns

Maintenance

Costs

Resources

Incentives

Grants

Key Questions

Local Examples

ALBERTA CASE STUDIES

Selection Criteria:

Selection is partly based on highlighted case studies by Habit Studio. Plus other unique case studies either based on affordability, high certification or unique building material(s) used.

THE PISA (Edmonton)

- New - Single Family House

The lowest cost net-zero buildings in Canada

- Launched in 2018, it currently has models in 7 different communities here in Edmonton and some are selling for as low as $325,300 (In Marple Crest community).
- This new price point means the goal of making all new homes net-zero by 2030 is now a practical potential reality. Landmark Homes had already built 25-30 net-zero homes by the launch of this models(2018) and company founder **Reza Nasseri** has long had his eye on making net-zero affordable.
- Reza is a process engineer who started building homes in a *partially-automated Edmonton factory* years ago. Using *a process called* ***panelization***, workers and robots built a home in one day with almost no waste, at very low energy cost and to exceedingly high levels of tolerance.
- The Pisa is so efficient it requires 60 per cent less energy than a conventional/code - built home. In fact, it doesn't even need gas for heating.

-

Read more on the features here and watch a video here

-The timing of Landmark's affordable net-zero couldn't be better. Edmonton announced in 2018 that work was beginning on **Blatchford**, the city's carbon-neutral neighbourhood, that will someday be home to 30,000 people.
About 75 per cent of this potentially world-class sustainable neighbourhood could achieve its goals using affordable net-zero homes. As it turns out town homes are actually an economic sweet spot for net-zero homes.
The price difference between a standard Landmark home and the net-zero home is not that much. The choice could be as simple as choosing a 1,200 sq. foot net-zero home or a slightly larger 1,500 sq. foot home for close to the same price. But only one model has its utilities paid for life!

RIVERDALE NET-ZERO HOUSE (Edmonton)

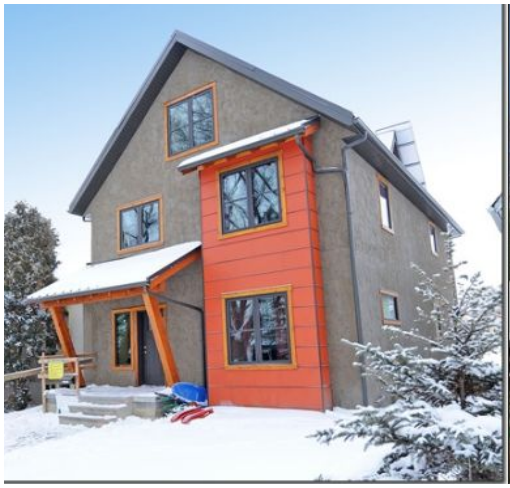
Source 1; **Source 2** ;**Source3** ; **Source 4**; **Source 5**, **summary**
Analysis
The first net-zero home in Northern Alberta

MILL CREEK NET-ZERO HOME (Edmonton)

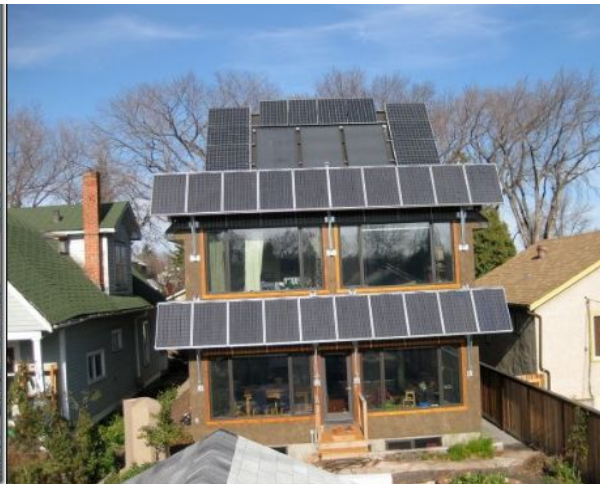
- Retrofit - Single FamilyHouse

Source 1: Source 2: (Designer with other green houses in Edm,) Source 3

Edmonton's second net zero energy home



Front View



Back View(Windows on south-facing side)

- A 1954 bungalow
- Initial work to get to an Energuide rating of 71(Rating Typical of a conventional new house-*between 66 and 74-see graph on page 2*) involved:
    - 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.
- The Owner/Designer attributes over 85% of the success to a net zero project to :
    - -A thick wall (16 inch) -Passive
    - - Insulation -Passive
    - - Big South-facing windows -Passive
    - - Concrete floors - Passive

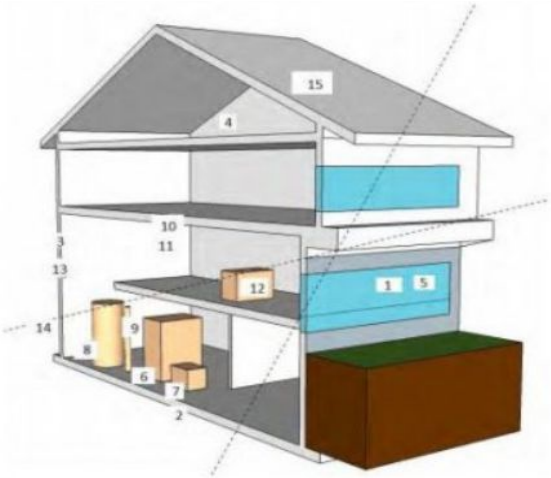
(**NOTE**: *The big windows and concrete floors work in tandem to regulate heating & cooling during the day & night. The concrete absorbs excess heat during the day and radiates the heat at night)*

- He also places the overall cost in the range of CAD 20,000-25,000 which is significantly lower compared to the cost of buying/constructing a new house.

WINDSOR PARK NET ZERO HOUSE (Edmonton)-Retrofit

- 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.

Source 3:



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

Source 1:

- The Objective: was to design and build a net zero energy home for a family of 4.
- The home was designed and constructed using mechanical equipment/technologies that were simple, locally accessible and able to be installed by local trades people.
- 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 *[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]* and two electric vehicles.

The designing principles entailed:

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.

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 Ecosolar 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.

STRAW-BALE HOUSES (Edmonton)

Source 1; Source 2; Source 3; Source 4

- The first documented structure was a schoolhouse built in 1896, which was eaten by cows. However, pioneers in the Nebraska Sandhills were undeterred and began using plaster over their bales. They built 70 straw-bale structures between 1896 and 1945, some of which are still standing.
- Albertans are building straw-bale houses to achieve R40 (Insulation on the r-chat) from mostly natural, locally sourced materials.
- Advantages of straw-bale insulation:
  - It's natural
  - It's local and readily available in Alberta (from
  - Offers a breathable wall system-because there's no need for a plastic vapour barrier, the walls breathe. That effect wicks away moisture and avoids the common problem today of mouldy walls and sick building syndrome.
  - It uses a recyclable material (that was in the past wasted in the fields)
  - It can be of economic benefit to local farmers if straw-bale construction caught on,since,unlike hay, straw is mostly a waste material on many farms
  - It's non-toxic
  - Warm in the winter
  - Cool in the summer
  - Sound-proof
  - It can reach an amazing insulation level of R57 when an insulated exterior wall, sheeting and plaster is added
  - Houses are reasonably durable
  - They have fire ratings of "2 hours" which is one of the best ratings for buildings
  - Houses are aesthetically pleasing.

- Listen to Rob Alvis (UofA Eng. Alumni) offer his Engineer's perspective on straw-bale walls
  - They have very thick insulative walls
  - R- values are wide ranging from R20 to R-40 (In extreme cases R-57)

- On each side of the wall are 2-3 inches of cob(Clay,sand,silt+straw) to coat the walls. This creates a high thermal mass which allows for smooth temperature changes inside.
- Thermal Insulation(Straw Bale and wall cladding) and Thermal mass(Cob Coating) work hand in tandem to regulate heat. If you just have thick walls with no insulation then you end up with a "medieval castle"(giant walls that are cold inside).
- You need good "hats" and "boots" to keep water away from the straw bale wall. The 'hats' are a good roof and overhang to keep rain from the top of the wall and 'boots' are a good foundation with the straw bale being elevated above the ground to avoid water uptake from beneath and keep away rodents
- Contrary to popular myths straw-bale walls are not flammable. The bales are too tightly compacted to allow for combustion-forming an oxygen deficient matrix. Straw-bale walls, in fact, are far more fire resistant than standard construction. If they caught fire it would be more of a smolder as opposed to combustion.
- Maintenance is mainly around the cob coating
- Overall it's a great building material for the northern hemisphere where it's really cold in the winter and it can get quite hot and dry in summer. It's also readily available especially in AB.

➢ Sustainable Works, which has built more than 100 straw-bale homes in British Columbia and Alberta.

➢ Examples:

- Nora Bumanis is a harpist for the Edmonton Symphony Orchestra and she wanted a soundproof home where she could practice. She now lives in a straw-bale triplex in Edmonton, next door to the conductor of the orchestra-and can still practice with some peace of mind.
- Lance and Wendy Olson net-zero home built of straw near Buffalo Lake, Alberta.
- Caroline Clarke and Dave Gieg's straw-bale home , Edmonton.