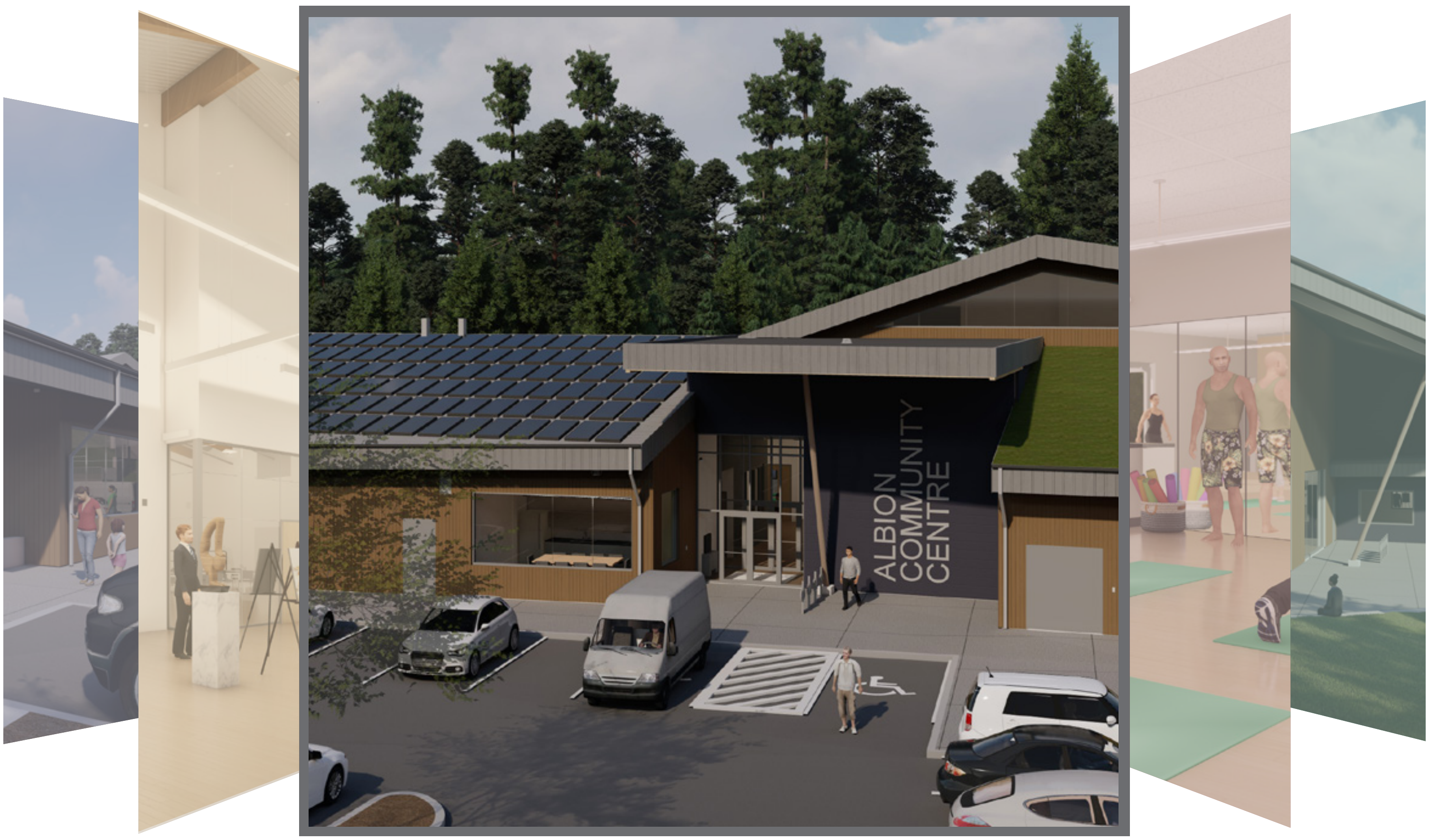
C H P ARCHITECTS
Architecture • Landscape Architecture

# ALBION COMMUNITY CENTRE

## SUSTAINABILITY FEASIBILTY STUDY




PROJECT NUMBER: 17114
DATE: NOVEMBER 2018

**FINAL**

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# 1.0 EXECUTIVE SUMMARY

CHP Architects was engaged by the City of Maple Ridge to complete a sustainability feasibility study to determine appropriate sustainability initiatives in the design of the new South Albion Community Centre.

The South Albion Community Centre is a new one-storey 1900 m². facility which includes a grand hall, community kitchen, gallery space, several multipurpose/fitness rooms, a community art room, and a child care centre. The project is in a developing suburban Maple Ridge neighbourhood and immediately surrounded by an extensive riparian and creek network. The centre is adjacent to the new South Albion Elementary school and has been designed in conjunction with the school for joint use by the students and public.

The consultant team consisted of Kane environmental, Rocky Point mechanical and energy modeling, Jarvis electrical and CHP Architectural. The team reviewed several approaches including: Passive House, LEED, Step Code, and Net Zero to determine the most fitting approach for the building function, location and prominent position in eyes of the community.

It was determined that energy use and a reduced carbon footprint were the leading environmental targets for the project, followed by non-energy aspects best articulated through the LEED program. The study was narrowed to examine the measures necessary for a full net zero facility and what extent of these measures could be implemented within the budget.

The team concluded a full net zero facility would involve: a super-insulated building envelope and hi gh performing windows and doors, wood frame construction with minimal thermal bridging, geothermal heating and cooling, extensive solar photovoltaics (PVs), efficient centralized air source heat pumps, heat recovery and sophisticated lighting and HVAC controls.

Through energy modeling and extensive costing analysis a reasonable compilation of the above measures were designed into the project to achieve a performance of a 61.6% reduction in energy use as compared to a building meeting code minimum standards. The systems were also designed to allow for additional net zero measures to be added easily in the future should future funding allow.

As a secondary measure to ensure ‘non-energy’ related environmental aspects such as water use and sustainable materials were included, the project was designed to a LEED Silver level. The relatively remote project location made LEED Gold unattainable due to the lack of easily obtainable points due to the more urban setting.

In addition to energy and LEED aspirations, the community centre was designed to display green educational initiatives to the community through measures such as a feature green roof, exposed solar PVs, vehicle charging stations, and water treatment gardens with storm connections to the nearby creek. The centre will serve as a major node to natural trail connections in the surrounding riparian area.

The feasibility study has informed the design of a community centre with aggressive but reasonable environmental features that may be easily expanded upon in the future. The centre will be a sustainability educational resource for both the community and the adjacent elementary school.

# 2.0 PROJECT OVERVIEW


## 2.1 Project Team

CHPA has three LEED accredited professionals in our office and has designed and coordinated numerous LEED certified projects. Along with coordinating, CHPA designed the architectural components of the project while implementing sustainable practices.

For the Albion Community Centre's design and feasibility study, CHPA partnered with other sustainability leaders within the province.

Kane Consulting is an environmental consulting firm that works with owners, architects and facility managers to define, prioritize and realize their sustainability objectives. Kane focuses primarily on implementing a strategy to compare the various sustainable initiative and also navigated the score sheet to determine the viability of LEED pathways.

Jarvis Engineeing has looked at the electrical systems in the project and how to reduce their energy consumption. They have also provide a recommendation on the photovoltaic panels for the roof of the building.

Rocky Point Engineering (RPE) provided the energy model for the building to conduct the analysis of projected building performance to baseline. RPE have also designed the mechanical and plumbing system. Building systems design has been derived from the requirements identified in net-zero and LEED guidelines to achieve a balance of productivity and efficiency.

## 2.2 Building Overview

The proposed Albion Community Centre is set to become the social heart of a budding community in Maple Ridge. The 20,000 SF, one-storey building takes advantage of a unique site adjacent to an elementary school that was designed concurrently with the co-located community centre. This allows for the ability for indoor and outdoor program space to be shared with minimal redundancies for the community and user groups. The building takes inspiration from the traditional community hall typology, similar to one recently torn down in the area, but modernizes the form to enhance and optimize building performance.

The building is aiming for a net-zero energy target using passive and active energy saving strategies implemented from the onset of schematic design. As this public building is to be a showpiece of the community's commitment to sustainable practices measures will be taken within the architectural design to display the implemented technologies and strategies, essentially creating an actively-working educational resource for all users.

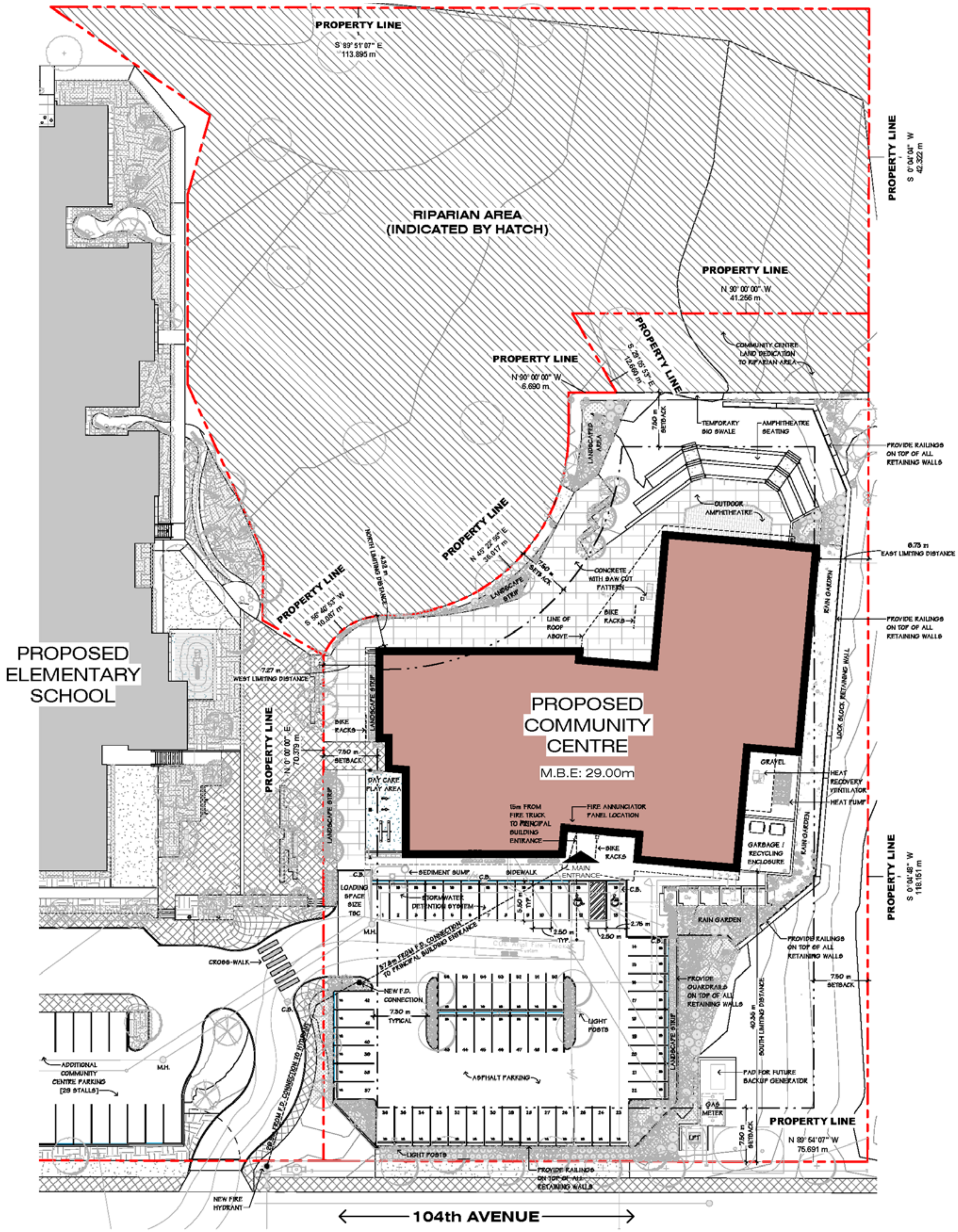
With these energy strategies the building will blend with the amazing natural setting within which it resides it. Landscaping will form part of the program through an amphitheatre and community garden. Natural exterior materials and a green roof will make the building appear to rise out of the earth itself.

The program itself focuses around flexible multi-use spaces that can be used for everything from an art-room to yoga studios. This includes one large great hall that can hold bigger events and community arts productions. These multipurpose rooms are located at the perimeter of the social heart of the building. This heart is where people from the community can gather without being active in specific programs within the facility.

VIEW FROM AMPHITHEATRE LOOKING TOWARDS THE BUILDING

VIEW DOWN THE MAIN CORRIDOR AS IT IS BEING USED AS A GALLERY


FLOOR PLAN OF THE PROPOSED ALBION COMMUNITY CENTRE




SITE PLAN OF THE PROPOSED ALBION COMMUNITY CENTRE

# 3.0 SUSTAINABILITY PROGRAMS

## 3.1 Sustainability Programs

The approach for CHPA to design an efficient building relies on their experience with similar projects in scope and priorities. Sustainability was a factor from the early stages of schematic design. Kane Consulting was also consulted early the project for their expertise in sustainable design. CHPA along with Kane and other consultants reviewed site and architectural aspects in relation to existing standards of green building to inform the design process.

To determine the best program to follow as a guideline for the environmental aspect of the community centre project the team investigated four highly reputable programs in place for the advancement of green building. The four programs are LEED BC+D Version 4, Passive House, BC Energy Step Code, and Net Zero building.

The team provided a thorough investigation of each option including a full energy model and completing a LEED scorecard to evaluate the best route forward.

## 3.2 LEED BD+C Version 4

LEED® is a third-party certification program and an internationally accepted benchmark for the design, construction and operation of high performance green buildings. It provides building owners and operators the tools they need to have an immediate and measurable impact on their building's performance. LEED rating systems encourage and accelerate the global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.

LEED certification is achieved with the help of a LEED consultant who creates a strategy that aligns with the extensive requirements of the program. The certification relies on points given for environmental strategies implemented in a project. When the LEED points are calculated the total number will determine whether the project is LEED certifiable at the ascending levels of Certified, Silver, Gold, or Platinum. The points awarded fall into the following separate categories:

- Location and Transportation
- Sustainable Sites
- Water Efficiency
- Energy & Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation
- Regional Priority

The proposed community centre does well in many of the categories that would be designed into the architecture of the building and the site. However, there are many points specific to the site and location of the project the program tends to reward projects in high density urban environments. The remoteness of the site and the infancy of the neighbourhood reduce the potential sum of points making it difficult to achieve LEED Gold or above. As the area gets developed and more amenities and transportation become available the community centre may fall into the LEED Gold category if reevaluated. For now, it is expected to fall well within the LEED Silver categorization. It is expected that the certification of the LEED Silver building would be approximately $130,000 in soft costs.

## 3.3 Passive House

Passive House (Passivhaus) is a rigorous voluntary energy-based standard that focuses on the building envelope and thermal transfer through the exterior walls of the building. It sets forth a standard of how to develop the envelope details of the building to minimize thermal transfer especially at the problematic corners of a building. The effect of air-tight and heavily insulated building envelopes allows very little energy to heat a space efficiently. Once the high efficiency envelope is established, energy sources are then considered. Active and passive energy strategies can be considered. Passive strategies include implementations such as orientation of windows to maximize or minimize solar gain based on the seasons or calculating and incorporating the heat output of a light bulb in the building. Active sustainable strategies would be implementing solar panels or wind turbines on the building to provide the energy to the building.

The international Passive House Standard requires:

- Space heat demand max. 15 kWh/m2a OR heating load max. 10W/m2
- Pressurization test result at 50Pa max. 0.6 Air Changes per Hour (ACH) both over-pressure and under-pressure)
- Total Primary Energy Demand max. 120 kWh/m2.

While there are excellent takeaways from the strategies of the Passive House program it does not align with the design and values to be prioritized for the community centre. The sought after 'connection to nature' through the design of the building is detrimental to achieve a Passive House certification. Because there are so many openings to the natural environment through overhead doors and sliding walls the airtightness required for certification would not be achievable. It is recommended to not proceed with Passive House certification.

## 3.4 BC Energy Step Code

The BC Energy Step Code is a voluntary provincial standard enacted in April 2017 that provides an incremental and consistent approach to achieving more energy-efficient buildings that go beyond the requirements of the base BC Building Code. It does so by establishing a series of measurable, performance-based energy-efficiency requirements for construction that builders can choose to build to, and communities may voluntarily choose to adopt in bylaws and policies. The goal of the program is to have all new construction in BC to be "net-zero energy ready" by 2032.

There are five steps in the step code ranging from a baseline of Step 1, which is the minimum standard set forth by the BC Building Code (BCBC), up to Step 5 which is a net-zero energy ready building. Net zero energy means buildings produce as much clean energy as they consume. Net zero energy ready means that the building has been designed to a level of performance that with the addition of solar panels or other renewable energy sources could achieve net-zero performance. To achieve even Step 1, buildings need to undergo a whole-building energy model to calculate the energy use of a building as well as an air-tightness test. The results of these test will determine which Step a building would fall under. For example, in Climate Zone 4, which Maple Ridge falls within, to achieve Step 5 a house would need all of the following:

- ≤1.0 Air Changes per hour at 50Pa pressure differential
- Mechanical energy use intensity ≤25kWh/m$^2$ · year
- Thermal energy demand intensity ≤15kWh/m$^2$ · year or peak thermal load ≤10W/m$^2$

There is a major problem with Albion Community Centre trying to fall into one of the steps of the Step Code. So far, the Step Code has only defined parameters for BCBC Part 3 residential houses and BCBC Part 9 wood frame residential, concrete residential, and commercial. Institutional projects do not have a standard in which to strive towards. It would next to impossible to meet the standards set froth by the Step Code in an institutional project that has large open spaces. Like the Passive

House standard, institutional projects have a very difficult challenge for meeting strict air tightness and mechanical use requirements because of the volume of traffic in and out of a building and the large volume of air needing to be conditioned and exchanged.

There could be future version of Step Code that defines standards for institutional projects at some point but at this time there is no category for a community centre to classified in. It would not be possible for the Albion Community Centre to proceed with the BC Energy Step Code certification.

## 3.5 Net Zero Building

A Net Zero or Net Zero Energy Building is a building where the total yearly energy consumption is offset by renewable energy sources such that the amount of energy used by the building is equal to the renewable energy produced.

Current renewable energy technology for commercial buildings which were reviewed by the design team include;

- Photovoltaic Solar Power Generation
- Solar Thermal Water Generation
- Wind Power Generation
- Biomass Heating Generation

Designing a Net Zero building begins with designing the most energy efficient building possible and then implementing renewable energy sources to offset the buildings energy consumption.

The design team optimized the building energy performance by looking at building envelope, mechanical, lighting and control system options through energy modelling. Many of these high level energy saving measures, based on current utility rates, have a significant capital cost.

### The Path to Net Zero

It was important for the design team to achieve a building design that is on a path towards Net Zero in the future. This means the building should be designed to be easily adaptable to future renewable resources and be able to “plug in” in the future.

The heating system for example is designed to utilize low temperature heating water sources so that future more energy efficient and renewable strategies and technologies such as geothermal or bio-mass could be easily implemented.

Photovoltaic Solar power cells are being incorporated into the current building design and located on the roof with allowance for significant future expansion. Future Photovoltaics can simply be added to the existing building and integrated into the building’s electrical system and deliver power back to the utility grid even when the building is not occupied.

### The Building Compared to Net Zero

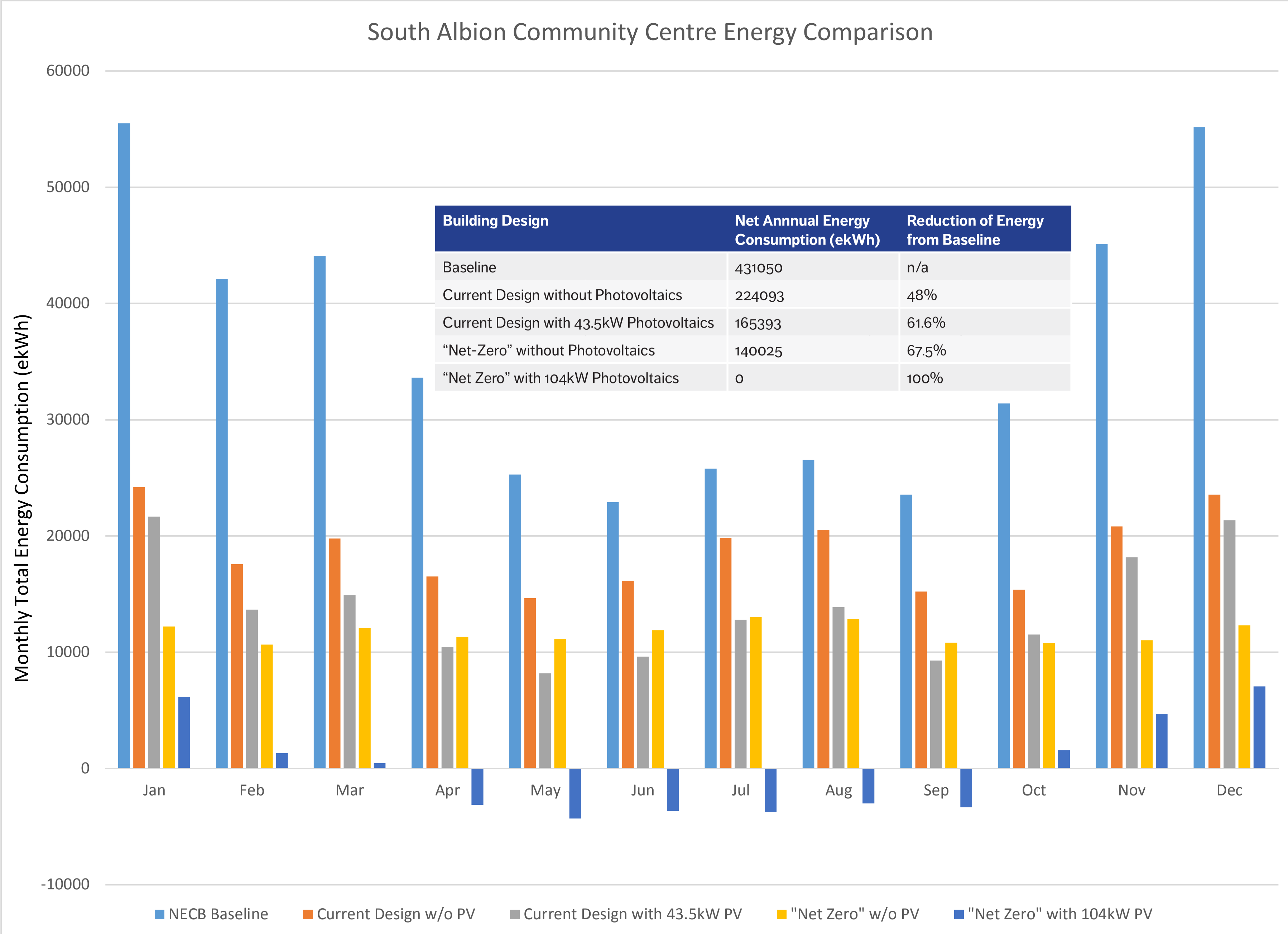
Energy modelling was carried out to determine how the building compared to both a code minimum building and a Net Zero Energy Building. NECB 2015 (National Energy Code for Buildings) which is a Canadian Standard was used as the baseline comparison.

The future BC Building Code 2018, about to be released on December 10th, 2018 allows a building to be constructed to either ASHRAE 90.1-2016 or NECB 2015. NECB was chosen since it is a more stringent and national standard in use across Canada.

Below is a comparison of 4 building types;

- NECB Baseline Building Design (Code minimum building)
- Current Building Design
- Current Building Design + 40 KW of Photovoltaic Panels
- Net Zero Building Design + 180 KW of Photovoltaic Panels *

* The Net Zero Energy Building design would require in addition to 800 square meters of photovoltaics; geothermal heating, enhanced envelope insulation, triple glazing, and enhanced air-tightness. The photovoltaic panels would be required to produce 140,000 KWhr annually to achieve a zero energy balance.




| Building Design | Net Annnual Energy Consumption (ekWh) | Reduction of Energy from Baseline |
|---|---|---|
| Baseline | 431050 | n/a |
| Current Design without Photovoltaics | 224093 | 48% |
| Current Design with 43.5kW Photovoltaics | 165393 | 61.6% |
| “Net-Zero” without Photovoltaics | 140025 | 67.5% |
| “Net Zero” with 104kW Photovoltaics | 0 | 100% |

## Comparison of Pathways to Net Zero Upgrades:

| | Code Minimum Building | Current Design - LEED Silver Building | Net Zero Building |
|---|---|---|---|
| **ARCHITECTURAL** | | | |
| Walls | • 2x6" Stud wall with batt insulation, rainscreen cladding on furring strips.<br>• Effective U-Value = 0.040 (R18)<br>• Deduct $75,000 | • 2x6" Stud wall with spray insulated cavities, 2" exterior rigid insulation, rainscreen cladding on thermal clips.<br>• Clear wall U-Value = 0.0360 (R28)<br>• Payback 347 years. | • Additional 2" of Roxul insulation (6 inches total)<br>• Add $68,000<br>• Payback 636 years. |
| Roof | • 89mm Polyiso roof insulation<br>• Effective U-Value = 0.040 (R25)<br>• Deduct $90,000 | • 178mm Polyiso roof insulation in alternating purlin cavity. Double layer of alternating z-girts.<br>• Effective U-Value = 0.0371 (R27)<br>• Payback 1084 years. | • Additional 3" rigid insulation (R44)<br>• Add $90,800<br>• Payback 319 years. |
| Windows | • Double glazed, argon filled, low-e coated windows.<br>• Deduct $17,100 | • Thermally broken, double glazed, low-e coated high performance curtainwall.<br>• Payback 80 years. | • Triple glazing<br>• Add $45,600<br>• Payback 351 years. |
| **MECHANICAL** | | | |
| HVAC | • Standard Roof Top Unit for each space with overhead ductwork distribution.<br>• Standard Exhaust fans<br>• Deduct $275,000 | • VAV air handling units for community spaces and unit ventilator to the daycare | • Add geothermal system to supplement air source heat pump. Water to water heat pumps buffer tank, and 120 bore holes.<br>• Add $450, 000 |
| HVAC | • Central boiler, air source heat pump and chilled and heating piping would be removed<br>• Deduct $550,000 | • Central boiler, air source heat pump and heat recovery for washroom exhaust. | • Add (TempEFF) heat recovery to main air-handling system and exhaust.<br>• Add $180,000 |
| Solar Hot Water | | | • Add a solar hot water system with evacuated tube collectors and solar water storage tank.<br>• Add $75,000 |
| **PLUMBING** | | | |
| Plumbing | • Standard low flow plumbing fixtures to meet code.<br>• Pressure assist flush tank toilets<br>• Deduct $45,000 | • Infrared flush valve fixtures in public areas is being provided.<br>• Infrared on toilets, urinals, and lavatories with hard wired fixtures. | • Add a storm water collection system and grey water system for flushing toilets. Separate water piping to toilets.<br>• Add $125,000 |
| **ELECTRICAL** | | | |
| Lighting | • Code minimum lighting power density (LPD) to ASHRAE 90.1 - 2010<br>• Deduct $25,000 | • LED lighting controls providing 40% reduction in LPD | |
| Solar Power | • No solar photovoltaic panels<br>• Deduct $130,000 | • 43.5 kW grid connected solar photovoltaic system. | • Additional photovoltaic cells providing 180kW of solar generated power.<br>• Add $550,000 |
| Electric Vehicles | • No electric vehicle charging<br>• Deduct $30,000 | • Two dual level 2 electric vehicle charging stations | |
| **TOTALS** | | | |
| | • Deduct $1,237,100 | | • Add $1,584,400 |

## 3.6 Options Comparison

| | LEED v4 BD+C | Passive House | BC Energy Step Code | Net Zero |
|---|---|---|---|---|
| Certifiable | • Yes, it's probable that the community centre would achieve LEED Silver Certification. | • No, its unlikely that the envelope would meet the requirements of Passive House certification. | • No, there is no category of certification for institutional buildings. | • No, there isn't a certified program the building could adhere to. It would be a matter of meeting self prescribed energy targets. |
| Scope | • Broad. Most all encompassing when it comes to the idea of sustainability in terms of more than just energy targets. It also considers site, water usage, transportation, etc. | • Medium. It focuses on the systems to reduce energy consumption but it also takes into account occupant comfort through acoustic and thermal comfort and indoor air quality. Does not address things like site or water consumption. | • Narrow. Step Code is about energy reduction and creating a pathway to net zero. It addresses mechanical systems and envelope only as ways to reduce energy consumption and improve airtightness. | • Narrow. The only thing that is accounted for is energy used versus energy produced. |
| Perception | • LEED is a globally recognized program that most people associate with sustainability stewardship. | • Popular in Europe and moving more into North America. It's a newer program and meeting the requirements may be a challenge as certain trades require certification from Passive House. | • Brand new and only for BC. As meeting various steps will become mandatory in time, the program will be less about pushing boundaries of individual projects and more about adherence across the province. | • Net-zero is a buzzword term and idealized for most construction projects striving to be sustainable. It's a goal within itself that is more than a single program. Even the Step Code and Passive House programs recognize that net zero is the ultimate goal. |
| Align with Priorities | • High. LEED looks at the project and site and how it aligns with on a spectrum of sustainability. The project wants to be sustainable in various ways, not just energy consumption. It was to be a showcase of sustainability for the community and the various LEED implementations allow it to be. | • Medium. It addresses the priority of a reduction in energy costs by improving airtightness and thermal barrier. Accommodates alternative low consumption heat sources and the opportunity for renewable resources. | • Medium-Low. It addresses the priority of a reduction in energy costs through performance requirements of mechanical systems and building envelopes. | • Medium. It addresses the priority of a reduction in energy costs essentially by any means possible. Renewable resources are required to offset energy consumption. |
| Capital Investment | • $130,000 in soft costs with current design. | • Not achievable with current design | • Not achievable with current design | • Additional $1,584,400 over current design for true net-zero. |

# 4.0 CONCLUSION

## 4.1 KEY FINDINGS

Based on the results of the assessment of the four environmental programs, LEED addresses the greatest number of project priorities. However, it doesn't address everything completely. Due to the limitation of available points because of the remote location a LEED Silver certification is likely as high as the building can achieve. If LEED is used in conjunction with aspects of Net Zero the project could be better and meet the project priorities better than any program could achieve on its own. LEED addresses the reduced carbon footprint and non-energy aspects of the project and the energy modelling and implementation of architectural aspects on a pathway to a Net Zero building would address the energy aspects of the project.

Net zero is used as a target guideline considering a fully net zero building would be cost prohibitive. The team has come up with a percentage of net zero using the baseline building of the minimum building code requirement as a datum to see how much of an energy reduction can be achieved in the current design. Using this formula current design use 61.6% less energy than the baseline building designed to minimu code standards.

The path to net zero proposes super insulated building envelope, high performance windows and doors, minimal thermal bridging, centralized air source heat pump, wood framed construction, and solar photovoltaics. These are all component required to achieve a net zero rating but are not taken to the full requirements of a net zero building. Instead they will stop at a point where costing analysis says the energy reduction benefit doesn't outweigh the costs by analyzing capital costs, life cycle costs, and payback period. To achieve a true Net Zero building these aforementioned components should be brought further in efficiency (ie. adding more photovoltaics or adding and additional 2" of insulation to the roof) plus adding other systems like geothermal heating and cooling. The systems were also designed to allow for additional net zero measures to be added easily in the future should future funding allow.

In addition to energy and LEED aspirations, the community centre was designed to display green educational initiatives to the community through measures such as a feature green roof, exposed solar PVs, vehicle charging stations, and water treatment gardens with storm connections to the nearby creek. The centre will serve as a major node to natural trail connections in the surrounding riparian area. Much of these components with be visible and heighten the profile of the sustainable aspects of the building. It is anticipated that the building inspires other people and projects to pursue green initiatives in the future.

# APPENDIX A:
## SUSTAINABLE DESIGN STRATEGY
PREPARED BY KANE CONSULTING

KANE CONSULTING

October 19, 2018

**Sustainable Design Strategy**

Project: South Albion Community Centre, Maple Ridge

To Whom It May Concern:

The new South Albion Community Centre is pursuing LEED® Silver Certification under LEED Canada for New Construction (LEED-NC) v4 Rating System.

The Team decided to pursue LEED as the Third-Party certification provides accountability and transparency, verifying the project is designed, build and operating as intended.

Accompanying this submission is our preliminary LEED Scorecard outlining how the proposed certification level will be achieved. The scorecard shows the project incorporates numerous sustainable strategies that would achieve 55 points (50 points are required for Silver) including 16 Optimize Energy Performance points and 3 Renewable Energy Production points. Several more points are potentially available and will be confirmed, as the design is refined.

The possibility of achieving higher levels of certification was analyzed. The limiting factor is the project location. This project is being located in the heart of a new/upcoming community within Maple Ridge. The accompanying infrastructure, such as Surrounding Density, Multiple Transit Opportunities, Bicycle Network (bike paths), is a work-in-progress. This limits the LEED scoring in the section Location and Transportation. Fast-forwarding 10 years, once the community is built up, this project would most likely score well into Gold.

The Standards considered for this project included BC Energy Step Code, Passive House and LEED. It was quickly determined that there are limiting factors of Step Code and Passive House, leading us to LEED as the preferred path forward.

BC Energy Step Code: The BC Energy Step Code was just being rolled out at the time of this project being kicked-off. Soon after, we realized that this specific occupancy type, a community centre, is not addressed in Step Code. There are categories for residential, business and personal services and mercantile. While we anticipate that there will be a future metric for this building type, no such matric is available at the time of tis study. It would be an unrealistic metric to compare our project against the other occupancy types.

Passive House: There are challenges of applying the Passive House Standard to this building occupancy type. Sourcing of products such as premium Heat Recovery systems

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KANE CONSULTING

and rolling doors from Europe, combined with and an estimated 20-25% cost premium for construction, were limiting factors to applying this program.

LEED: The rating system recently was upgraded to LEED v4, raising the benchmark of sustainability. The product delivers a holistic approach to sustainability including Energy, Sites, Water, Materials and Indoor Environmental Quality. The LEED brand is also the most recognized in building sustainability. From a community outreach and education perspective, the sustainability strategies are broad and have a familiar language, enabling the general public and users of the facility to understand concepts.

Based on this investigation, LEED quickly became the obvious choice for this facility.

We look forward to seeing this project through construction and into operation. It will be a great addition to the community. We are pleased to be part of the team.

Yours truly,

Daniel Roberts
LEED AP BD+C, CaGBC Faculty
Partner

KANE CONSULTING

**Supplemental Information:**

**About the Canada Green Building Council (CaGBC)**
The CaGBC (www.cagbc.org) GBCI Canada are the leading national organizations dedicated to advancing green building and sustainable community development practices.

**About LEED® Certification**
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(https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/energy-efficiency/energy-step-code)

# APPENDIX B:
## LEED V4 BD+C SCORECARD
PREPARED BY KANE CONSULTING

# Albion Community Centre
## Feasibility LEED V4 BD+C Scorecard
**Last update: October 19, 2018**

KANE CONSULTING

| Y | Y? | N? | N | Total Project Score & Rating | SILVER | Possible Points 110 |
|---|---|---|---|---|---|---|
| 55 | 9 | 17 | 30 | | | |

| Y | Y? | N? | N | | | |
|---|---|---|---|---|---|---|
| | | | 1 | Credit | Integrative Process | 1 |

| Y | Y? | N? | N | | Location and Transportation | 16 |
|---|---|---|---|---|---|---|
| 2 | 1 | 1 | 13 | | | |
| | | | | Credit | LEED for Neighborhood Development Location | N/A |
| 1 | | | | Credit | Sensitive Land Protection | 1 |
| | | | 2 | Credit | High Priority Site | 2 |
| | | | 5 | Credit | Surrounding Density and Diverse Uses | 5 |
| | | | 5 | Credit | Access to Quality Transit | 5 |
| | | | 1 | Credit | Bicycle Facilities | 1 |
| | 1 | | | Credit | Reduced Parking Footprint | 1 |
| 1 | | | | Credit | Green Vehicles | 1 |

| Y | Y? | N? | N | | Sustainable Sites | 10 |
|---|---|---|---|---|---|---|
| 3 | 2 | 2 | 3 | | | |
| Y | | | | Prereq | Construction Activity Pollution Prevention | |
| | | 1 | | Credit | Site Assessment | 1 |
| | 1 | | 1 | Credit | Site Development - Protect or Restore Habitat | 2 |
| | 1 | | | Credit | Open Space | 1 |
| 2 | | 1 | | Credit | Rainwater Management | 3 |
| | | | 2 | Credit | Heat Island Reduction | 2 |
| 1 | | | | Credit | Light Pollution Reduction | 1 |

| Y | Y? | N? | N | | Water Efficiency | 11 |
|---|---|---|---|---|---|---|
| 6 | | 1 | 4 | | | |
| Y | | | | Prereq | Outdoor Water Use Reduction | |
| Y | | | | Prereq | Indoor Water Use Reduction | |
| Y | | | | Prereq | Building-Level Water Metering | |
| 1 | | 1 | | Credit | Outdoor Water Use Reduction | 2 |
| 4 | | | 2 | Credit | Indoor Water Use Reduction | 6 |
| | | | 2 | Credit | Cooling Tower Water Use | 2 |
| 1 | | | | Credit | Water Metering | 1 |

| Y | Y? | N? | N | | Energy and Atmosphere | 33 |
|---|---|---|---|---|---|---|
| 24 | 1 | 5 | 3 | | | |
| Y | | | | Prereq | Fundamental Commissioning and Verification | |
| Y | | | | Prereq | Minimum Energy Performance | |
| Y | | | | Prereq | Building-Level Energy Metering | |
| Y | | | | Prereq | Fundamental Refrigerant Management | |
| 3 | | 1 | 2 | Credit | Enhanced Commissioning | 6 |
| 16 | 1 | | 1 | Credit | Optimize Energy Performance | 18 |
| | | 1 | | Credit | Advanced Energy Metering | 1 |
| | | 2 | | Credit | Demand Response | 2 |
| 3 | | | | Credit | Renewable Energy Production | 3 |
| | | 1 | | Credit | Enhanced Refrigerant Management | 1 |
| 2 | | | | Credit | Green Power and Carbon Offsets | 2 |

| Y | Y? | N? | N | | Materials and Resources | 13 |
|---|---|---|---|---|---|---|
| 2 | 3 | 6 | 2 | | | |
| Y | | | | Prereq | Storage and Collection of Recyclables | |
| Y | | | | Prereq | Construction and Demolition Waste Management Planning | |
| | | 3 | 2 | Credit | Building Life-Cycle Impact Reduction | 5 |
| | 1 | 1 | | Credit | Building Product Disclosure and Optimization - Environmental Product Dı | 2 |
| | 1 | 1 | | Credit | Building Product Disclosure and Optimization - Sourcing of Raw Materials | 2 |
| | 1 | 1 | | Credit | Building Product Disclosure and Optimization - Material Ingredients | 2 |
| 2 | | | | Credit | Construction and Demolition Waste Management | 2 |

| Y | Y? | N? | N | | Indoor Environmental Quality | 16 |
|---|---|---|---|---|---|---|
| 10 | 2 | | 4 | | | |
| Y | | | | Prereq | Minimum Indoor Air Quality Performance | |
| Y | | | | Prereq | Environmental Tobacco Smoke Control | |
| 2 | | | | Credit | Enhanced Indoor Air Quality Strategies | 2 |
| 2 | 1 | | | Credit | Low-Emitting Materials | 3 |
| 1 | | | | Credit | Construction Indoor Air Quality Management Plan | 1 |
| 1 | 1 | | | Credit | Indoor Air Quality Assessment | 2 |
| 1 | | | | Credit | Thermal Comfort | 1 |
| 2 | | | | Credit | Interior Lighting | 2 |
| | | | 3 | Credit | Daylight | 3 |
| 1 | | | | Credit | Quality Views | 1 |
| | | | 1 | Credit | Acoustic Performance | 1 |

| Y | Y? | N? | N | | Innovation | 6 |
|---|---|---|---|---|---|---|
| 4 | | 2 | | | | |
| 1 | | | | Credit | Innovation: LEED O&M Starter Kit | 1 |
| 1 | | | | Credit | Innovation: LEED O&M Starter Kit part 2 | 1 |
| 1 | | | | Credit | Innovation: Exemplary Performance Renewable Energy | 1 |
| | | 1 | | Credit | Innovation TBD | 1 |
| | | 1 | | Credit | Innovation TBD | 1 |
| 1 | | | | Credit | LEED Accredited Professional | 1 |

| Y | Y? | N? | N | | Regional Priority | 4 |
|---|---|---|---|---|---|---|
| 4 | | | | | | |
| 1 | | | | Credit | Regional priority 1 - Rainwater Mgmt @ 2pts | 1 |
| 1 | | | | Credit | Regional priority 2 - Outdoor Water Use @ 2pts | 1 |
| 1 | | | | Credit | Regional priority 3 - Indoor Water Use @ 4pts | 1 |
| 1 | | | | Credit | Regional priority 4 - Optimize Energy Perf @ 10pts | 1 |

**Legend**

Credit Targeted

Not Attempting

Y Prerequisite (Must Achieve)

# APPENDIX C:
## ENERGY MODELLING STUDY
PREPARED BY ROCKY POINT ENGINEERING

# Energy Modelling Study

## Albion Community Centre

Maple Ridge, BC

*Prepared by:*
Brian Ward, P. Eng., LEED AP BD+C
Rocky Point Engineering Ltd.

RPE File: 17375-M

July 26, 2018

ROCKY POINT
ENGINEERING LTD.

## EXECUTIVE SUMMARY

This study is intended to confirm the energy cost and consumption impacts of a number of energy conservation measures (ECMs) for the proposed community centre at 104th Ave in Maple Ridge, BC. The result is intended to confirm if the proposed building is able to meet a higher step of the new provincial Step Code. The ECMs are modelled in cumulative fashion against a baseline building model that meets most of the prescriptive requirements of NECB 2011. The thermal energy demand intensity (TEDI) and total energy use intensity (TEUI) were tracked for each of the ECMs. After the seven ECMs were modelled, the resulting TEDI was determined to be 79.3 kWh/sqm/year and the TEUI result was 103.4 kWh/sqm/year. The TEDI bundle result does not meet any of the steps of the step code, while the TEUI final result met the performance requirements of the highest step target (Step 3) of 120 kWh/sqm/year. The two primary reasons for the TEDI not meeting a higher step are:

1) The proposed single storey building has higher levels of envelope exposure relative to floor area than a typical multi-storey office or retail building. This increases the amount of heat loss per square metre of floor, directly increasing the TEDI.
2) The occupant densities are higher and the operating schedules are longer than a typical office/retail building. The resulting increased ventilation requirements and longer hours of HVAC operation significantly increase the annual heating load.

The TEUI result is low relative to the TEDI primarily due to the free heat captured by the air source heat pump. Credit for this free heat is included in the TEUI, but not when calculating the TEDI.

The provincial Step Code does not currently apply to an assembly occupancy building such as the Albion Community Centre because appropriate targets have not yet been developed. According to the Office of Housing and Construction Standards of the province of BC, these targets are in development and future revisions to the Step Code will apply these targets to assembly occupancy types.

Using current BC Hydro and Fortis rates, the energy cost savings for all modelled ECMs resulted in $5,392 savings vs a NECB 2011 baseline building, for a total cost reduction of 23.0%. Note that the cost savings shown may seem lower than expected. This is because the baseline contains a stringent NECB 2011 envelope and the heating plant is high efficiency condensing gas boilers. The ASHP, even with the free heat credited during the heating season, still uses electricity, which has a significantly higher cost per unit of energy than natural gas. The benefits of the reduced gas consumption of the ASHP bundle are better seen in the GHG reduction of 72% when compared to the baseline.

The geo-exchange system, with the ECM bundle applied, saved $1,821 in energy cost annually, when compared with the ASHP bundle. The incremental cost of a geo-exchange system when compared with the air-source system would result in an excessive payback period.

| | |
|---|---|
| **Project Name:** | Albion Community Centre |
| **Location:** | 24093 104th Ave, Maple Ridge, BC |
| **Building area:** | 20,253 sqft (1,882 m$^2$) |
| **Energy Modelling Software:** | eQuest v3.65 build 7163 |
| **Date:** | 2018-07-24 |
| **Simulator:** | Brian Ward |
| **Final TEDI/TEUI** | 79.3 / 103.4 kWh/sqm/year |
| **Final Energy Cost Savings** | $5,392 (-23.0%) |
| **GHG Reduction (tonnes / %)** | 35 / 72% |

## TABLE 1: ENERGY CONSERVATION MEASURE DESCRIPTION

The following table describes the baseline and ECM conditions, listing them in the order in which they were applied. Note that for the purposes of this study, the BC Hydro "Building Envelope Thermal Bridging Guide" (BETBG) was not used to determine baseline and ECM effective u-values. The BETBG is normally a requirement when doing Step Code modelling and allows for a full accounting of heat transfer through walls due to thermal bridging.

| Parameter | Baseline | ECM |
|---|---|---|
| Roof | Effective u-value: U-0.040 | **#1**: R-40 insulation in alternating purlin cavity. Effective u-value: U-0.0371 |
| Walls | Effective u-value: U-0.055 | **#2**: R-22 cavity batt in 2X6 wood-framed wall, R-9 continuous exterior insulation. Clear wall u-value: U-0.036. |
| Glazing | Assembly u-value: U-0.42, SHGC = 0.40 | **#3**: Thermally broken low-E high performance curtainwall: U-0.35, SHGC = 0.40 |
| Interior Lighting | NECB 2011 prescriptive lighting power densities (LPDs) using space-by-space method | **#4**: Average interior LPD: 0.60 W/sqft |
| Primary Heating Plant | Condensing gas-fired boiler | **#5**: Air-to-water heat pump, COP = 3.2 |
| Ventilation Air | ASHRAE 62.1-2001 ventilation rates, no ventilation heat recovery | **#6**: ASHRAE 62.1-2001 ventilation rates, ventilation heat recovery to all spaces, Tempeff sensible heat recovery effectiveness = 95.0% |
| Ventilation Air Control | Continuous operation | **#7**: Demand control ventilation via CO2 sensors |
| Geo-exchange system (vertical borefield) | N/A | Geo-exchange modelled with ECMs 1-4, 6 and 7 |

## TABLE 2: CURRENT STEP CODE TARGETS

The following table lists the TEDI and TEUI targets currently in the Step Code, by occupancy type and step level.

| Occupancy | Step | TEDI (kWh/sqm) | TEUI (kWh/sqm) |
|---|---|---|---|
| Residential | 2 | 45 | 130 |
| Residential | 3 | 30 | 120 |
| Business/Mercantile | 2 | 30 | 170 |
| Business/Mercantile | 3 | 20 | 120 |

## TABLE 3: STEP CODE TARGET RESULTS BY ECM

The following table lists the TEDI and TEUI result after modelling each ECM in cumulative fashion. Note that the Geo-exchange heating load as output by eQuest is not suitable for calculating the TEDI. The GHG totals are also included for each ECM. The ASHP bundle is a 72% reduction from the baseline. Further GHG reductions could be made by going to electric resistance water heaters.

| | Heating Load (Btu) | TEDI | Total Electricity (kWh) | Total Gas (Btu) | TEUI | GHG (tonnes) |
|---|---|---|---|---|---|---|
| Initial NECB Baseline | 685338000 | 106.7 | 171683 | 885000000 | 229.0 | 48.4 |
| plus ECM 1: Roof | 674492000 | 105.0 | 171567 | 873500000 | 227.1 | 47.8 |
| plus ECM 2: Walls | 644651000 | 100.3 | 171558 | 842000000 | 222.2 | 46.1 |
| plus ECM 3: Glazing | 624350000 | 97.2 | 171528 | 821000000 | 218.9 | 45.0 |
| plus ECM 4: Lighting | 729772000 | 113.6 | 117976 | 933400000 | 208.0 | 50.4 |
| plus ECM 5: ASHP | 730784000 | 113.8 | 164052 | 338000000 | 139.8 | 19.5 |
| plus ECM 6: ERV | 570983000 | 88.9 | 162229 | 231600000 | 122.2 | 13.9 |
| plus ECM 7: DCV (ASHP Bundle) | 509746000 | 79.3 | 158586 | 222300000 | 118.9 | 13.4 |
| Geo-exchange with ECMs | N/A | N/A | 151392 | 147400000 | 103.4 | 9.4 |

## TABLE 4: ENERGY COST AND SAVINGS BY ECM

The following table lists electricity, natural gas and total energy costs after each cumulative ECM. Also included are the total energy cost savings that each ECM created individually, plus the total energy costs savings and percent cost reduction for all modelled ECMs. The total savings shown are for the "ASHP Bundle".

| | Electricity Cost ($) | Gas Cost ($) | Total Energy Cost ($) | ECM Savings ($) |
|---|---|---|---|---|
| Initial Baseline | $17,754 | $5,698 | $23,452 | |
| plus ECM 1: Roof | $17,742 | $5,627 | $23,369 | $83 |
| plus ECM 2: Walls | $17,741 | $5,434 | $23,175 | $194 |
| plus ECM 3: Glazing | $17,738 | $5,305 | $23,043 | $132 |
| plus ECM 4: Lighting | $12,391 | $5,995 | $18,386 | $4,657 |
| plus ECM 5: ASHP | $17,019 | $2,339 | $19,358 | -$972 |
| plus ECM 6: ERV | $16,808 | $1,686 | $18,494 | $864 |
| plus ECM 7: DCV (ASHP Bundle) | $16,431 | $1,629 | $18,060 | $1,298 |
| Geo-exchange with ECMs | $15,504 | $1,169 | $16,673 | $1,821 |
| | | | | |
| Total ASHP Bundle Energy Cost Savings | | | | $5,392 |
| ASHP Bundle Percentage Cost Savings | | | | 23.0% |

## TABLE 5: ENERGY END USE BY ECM

The following table lists the electricity and natural consumption for each end use, by cumulative ECM.

| | Electricity (kWh) | | | | | | Natural Gas (GJ) | |
|---|---|---|---|---|---|---|---|---|
| | Space Heating | Space Cooling | Interior Lighting | Fans | Pumps | Plug Loads | DHW | Space Heating |
| Initial Baseline | 962 | 21142 | 113771 | 12325 | 7076 | 16408 | 155.5 | 778.1 |
| plus ECM 1: Roof | 953 | 21108 | 113771 | 12279 | 7049 | 16408 | 155.5 | 765.9 |
| plus ECM 2: Walls | 925 | 21157 | 113771 | 12268 | 7029 | 16408 | 155.5 | 732.8 |
| plus ECM 3: Glazing | 903 | 21218 | 113771 | 12285 | 6943 | 16408 | 155.5 | 710.6 |
| plus ECM 4: Lighting | 990 | 19202 | 63362 | 11216 | 6798 | 16408 | 155.6 | 829.2 |
| plus ECM 5: ASHP | 47325 | 19238 | 63362 | 11236 | 6482 | 16408 | 155.6 | 201.0 |
| plus ECM 6: ERV | 42885 | 19237 | 63362 | 13903 | 6435 | 16408 | 155.6 | 88.7 |
| plus ECM 7: DCV (ASHP Bundle) | 38544 | 20152 | 63362 | 13462 | 6659 | 16408 | 155.6 | 79.0 |
| Geo-exchange with ECMs | 15138 | 8729 | 63362 | 26953 | 20803 | 16408 | 155.5 | 0.0 |

## LIMITATIONS

The energy models constructed for this report and the resultant energy consumption estimates have been performed using eQuest v3.65 simulation software that was written and distributed by the U.S. Department of Energy. eQuest calculates hour-by-hour building energy consumption over an entire year (8760 hours) using hourly weather data for the location under consideration. Input to the program consists of a detailed description of the building being analyzed, including hourly scheduling of occupants, lighting, equipment and thermostat settings. Many variables occur in the construction and operation of any building that energy modelling software and the software user cannot account for. These variables include, but are not limited to:

1) Seasonal variations in weather from the weather file used.
2) Locational differences from the weather file and the proposed building.
3) Variations in construction materials and construction quality.
4) Installed equipment usage that may differ from default values used in the software.
5) Variations in occupancy type as well as potential unoccupied tenant spaces.
6) Thermostat settings differing from those modelled.
7) Accuracy limitations inherent in the modelling software.
8) Design changes after energy model construction.
9) Maintenance of installed equipment, or lack thereof.
10) Impacts of neighbouring buildings, mountains, trees, etc that are not accounted for in the energy model.

Due to the numerous variables inherent in predicting energy consumption through energy modelling, Rocky Point Engineering Ltd. shall not be held liable for any variations in actual energy consumption that may differ from the estimated predicted values contained in this report.