SUSTAINABLE BUILDINGS CANADA

Roadmap to Net Zero

Achieving A Net-Zero Energy, Waste, and Water Performance Level For A High-Density MURB In Toronto

Report on The Results Of An Integrated Design Process Approach

March 21, 2017

TABLE OF CONTENTS

Sustainable Buildings Canada (SBC) accepted the challenge of taking a current condominium design prepared for Tridel Inc. and expected to start construction in mid-2017, and moving the design performance level to meet the goals of Net Zero Operational Carbon, Net Zero Water and Wastewater, One Hundred Percent Waste Diversion from Landfill, and meeting the City of Toronto targets for Resiliency that are planned for the Toronto Green Standard (TGS) III.

In a further effort, SBC convened a group of subject matter experts and government representatives with the goal of identifying the many barriers to achieving these lofty objectives.

SBC would like to recognize the following organizations and individuals for their contribution:

- Tridel for providing building designs and related support staff and each of the guest experts for their time, open dialogue, and contributions to the day.
- Enbridge Gas Distribution and the Ministry of Environment and Climate Change for their financial contribution and the participation of many members of their staff to the discussions.
- The experts who provide their knowledge and experience to the Savings by Design program, and who brought that expertise to this project.
- The many other individuals who contributed to making the project an overall success.

1.0 INTRODUCTION

Sustainable Buildings Canada is pleased to present the findings of two one-day workshops on Achieving Net-Zero Energy, Waste, Water, along with Resiliency, for a high-density Multi-Unit Residential Building (MURB) in Toronto, and the many barriers that would need to be overcome. This project was undertaken with the support of the Ministry of Environment and Climate Change and Enbridge Gas Distribution.

This report provides an account of the two facilitated Integrated Design Process (IDP) workshops that focused on identifying a path to net zero energy, water, and waste, and the challenges associated with achieving those targets using an actual multi-residential building project. The IDP is a way of designing new buildings and houses to achieve higher performance targets through the participation of all stakeholders in a manner that acknowledges the inherent inter-relationships between the function and features of the building and the resulting environmental impacts. Recognizing that these relationships are part of an integrated design activity, opportunities to minimize energy and water use, and other related environmental impacts can be identified and the evaluation of the performance benefits of new design solutions considered.

2.0 WORKSHOP I SUMMARY: ROADMAP TO NET ZERO

The focus of the Net Zero Workshop I (held on November 28, 2016), and the subsequent modeling and studies was to develop a technically feasible approach to the achievement of the net-zero targets for a high-density MURB in Toronto.

Various stakeholders, in addition to the SBD program staff and industry experts, attended the sessions. All participants were invited due to their particular expertise and experience, and all were requested to come prepared to bring new ideas, thoughts, and experiences to the group for discussion.

For each workshop, a plenary session was held, followed by breakout groups, each of which focused on Net Zero Carbon, Waste, and Water respectively. The groups were asked to identify the possible solutions to meeting the targets in Workshop I, and the barriers and possible solutions related to regulatory, economic, and market adoption issues in Workshop II.

2.1. On The Park Project Overview

Figure 2.1 Rendering by Grazziani and Corazza Architects

Subhi Alsayed, Innovation Manager with Tridel, presented an overview of the On the Park mixed-use condominium development. The project is located on the former Inn on the Park site located on east side of Leslie Street, just north of Eglinton Avenue East. It will include three towers with a podium.

- Tower A – 38-storeys
- Tower B – 28-storeys
- Tower C – 44-storeys

The total project will be 1.1 million square feet in total, with approximately 1,100 to 1,200 residential units. These will include Bachelor and 1-3 Bedroom units. The residential towers are multi-terraced.

There will also be 8,000 ft2 of retail space in Tower A.

Amenities provided will include an indoor and outdoor pool.

The grade of the site is challenging because there is an 11-metre slope. A new municipal road and public park will be built.

The project will target LEED Gold and Toronto Green Standard (TGS) Tier 2. A green roof will be used as part of the stormwater management water balance requirements.

2.2. Energy Modelling

Craig McIntyre and Samantha MacHardy of Provident Energy Management Inc. prepared the results of the energy performance simulation model developed using specifications provided by Tridel in advance of the IDP Workshop. Calculations were achieved using e-Quest v3.64 to build the Reference case energy model. The e-Quest v3.64 energy performance simulation program calculates energy consumption for each source every hour of the year using weather data called CWEC (Canadian Weather for Energy Calculations), occupancy rates and schedules and internal loads that are provided in the software as appropriate for the building type.

Following the SBD modelling protocol, a Reference Building was created that just meets the current Ontario Building Code. The guidelines in ASHRAE 90.1-2013 Section 11 as modified by Supplementary Standard SB-10 Division 3, Chapter 2, were followed in generating the reference and baseline models. A number of assumptions had to be made with respect to the modelling inputs for the Baseline Building. The model uses the effective R-value in its simulations.

Building Overview – Key Features Of On The Park Tower B

- Building footprint – 1,500 m^2
- Modeled Area[1]: 24,586 m^2
- Gross building area – 23,275 m^2
- 28-storeys
- 280 suites
- Occupancy – 756
- WWR – 60% (overall):
  - North: 63%
  - South: 61%
  - East: 61%
  - West: 58%
- 5.7 LPM sinks, showers, lavatories

Figure 2.2 Statistics and rendering by Grazziani and Corazza Architects

2.3. Savings By Design Energy Discussion

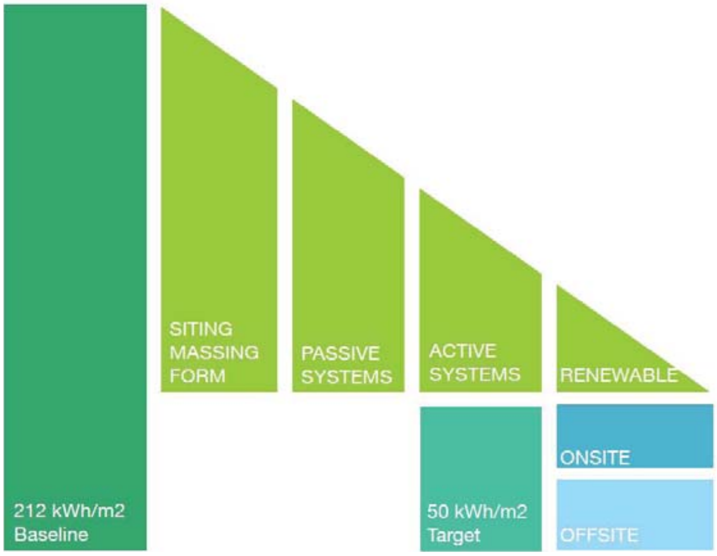

Figure 2.3 :The Wedge" describing the strategy to Zero Energy, by RWDI

Mike Williams of RWDI led the Energy Team discussion. The Baseline Building performs 15.1% better than the Reference Building (i.e. the Code building), which already exceeds the SBD Program Goal of 15% better than OBC SB-10-2017 and represents a very good energy performance given that the new building Code has also increased energy performance requirements above the previous Code by approximately 13%. The Energy Team explored measures towards the goal of Net Zero Energy/ Carbon in a step-by-step approach, as presented in the graphic above.

The following section highlights the discussion points from Workshop I.

2.3.1. Climate Change

To set the stage for the Energy Team discussion, Mike presented an overview of climate considerations and presented the results of "Toronto's Future Weather and Climate Driver Study." While Toronto is a heating dominated climate, the number of cooling degree-days is expected to rise. Mike showed that changes are happening at a much faster rate than a linear graph would predict. Solutions should address immediate linear forecasts, and be flexible to meet the challenges of future climate requirements.

Climate data is also important for determining what passive strategies could be implemented for the project. Wind data is important for determining passive cooling; the sun path is important for passive heating strategies – they are both important for occupant comfort.

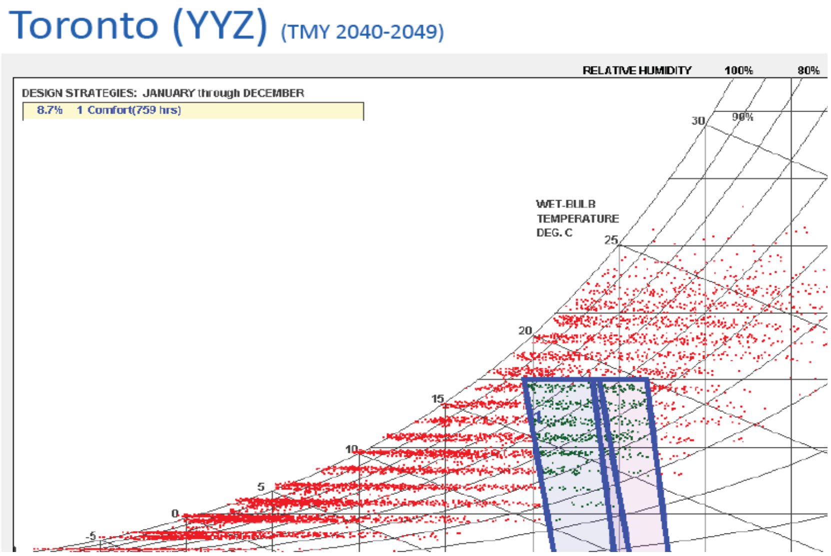

Figure 2.3.1 Psychometric Chart describing ranges for occupant thermal comfort, by RWDI

2.3.2. Further Architectural Explorations

Both before and after the charrette, the architectural team led by Michelle Xuereb of Quadrangle Architects Limited continued to explore opportunities for potential energy savings inherent in architectural design. This section describes the process for the development of the design options using energy savings as a catalyst. It should be noted here that the intent was to ensure that a similar density was achieved in the design options, and it was acknowledged that the floorplate efficiency of some of the options would be lower than the original design. Adherence to current building codes was also set aside for the sake of generating broader ideas.

PURPOSE: The point in time at which decision makers (developers, architects and planners) have the greatest opportunity to impact the energy usage of a building is at the concept design stage. A building's massing, orientation and building envelope will impact its energy usage for as long as the building is standing and in use. Finding ways to increase the dialogue around massing, orientation and building envelope in a way that promotes good decision making is key to improving long term energy performance and the only way to achieve high standards such as net zero energy and carbon.

Though regulations such as the Ontario Building Code state requirements for the thermal characteristics of a building envelope, the current code also permits trade-offs between the building envelope characteristics and the mechanical systems to reach energy efficiency targets. The original intent behind this strategy was to allow architects to have design freedom and to promote collaboration between architects and engineers. Unfortunately, the result has been to permit high efficiency mechanical systems with building envelopes that have poor thermal value and permit excessive air infiltration. A low quality building envelope can result in thermal discomfort for occupants, condensation leading to mould and a building envelope that is expensive to maintain.

There is a growing suite of tools at our disposal for testing the energy impacts of a building at the earliest design stages. Part of the architectural exercise before, during, and after the charrette was to explore ways in which these tools could be used from schematic design through to compliance energy modelling, enabling good design decisions that consider energy impacts throughout the process.

Design Considerations – Energy: The energy usage within a typical residential building can be broken down into thirds:

- Envelope losses,
- Occupant usage, and
- Ventilation.

The design must consider all of these elements when setting out the massing and orientation of the building; when making decisions about where to locate program and projections such as balconies; and when considering the qualities of the building envelope.

Design Considerations – Other Relevant Concerns: Other concerns that were raised throughout the charrette were issues surrounding the current market, peripheral to code compliance, but significant to occupants in the long term. These concepts included resilience, adaptability to climate change, durability and engagement of the occupant. These issues amounted to the creation of additional strategies to guide decision-making.

Resilience is defined by the Rockefeller Foundation as, "the ability of a system, entity, community, or person to withstand shocks while still maintaining its essential functions and to recover quickly and effectively." In the past ten years, we have seen a rise in the number of singular catastrophic shocks such as flooding and power outages as well as continuous and accelerating long-term shocks such as higher temperatures and greater storm intensity. Refer to Figure 2.3-1 below.

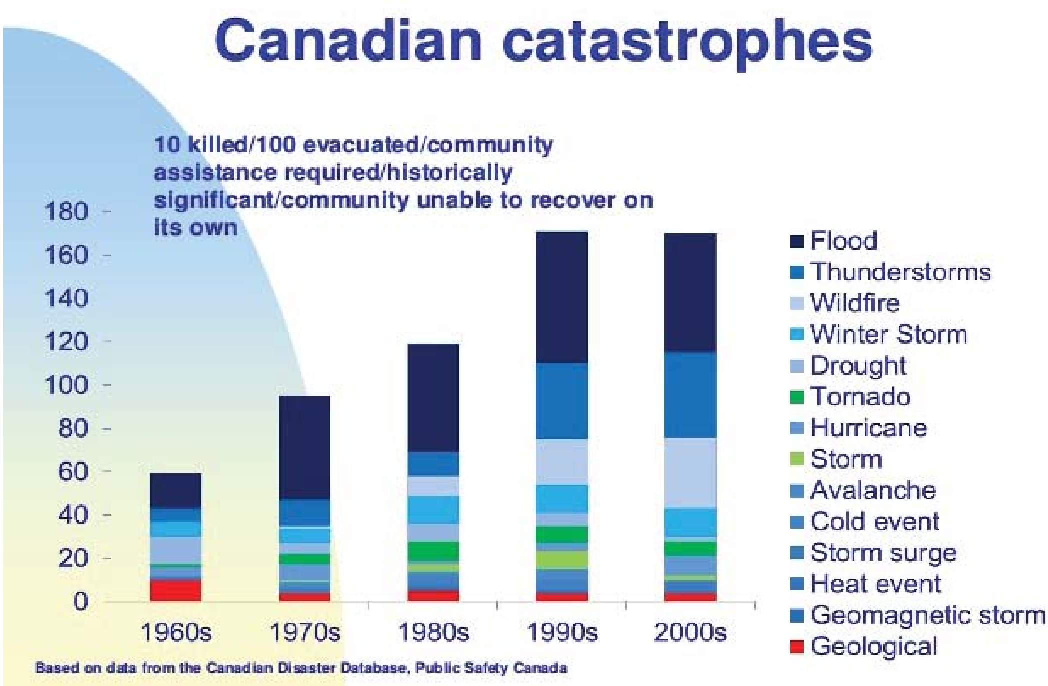

Figure 2.3.2.1: Climate Catastrophes, Canadian Disaster Database, Public Safety Canada

As part of the discussion, attendees considered Toronto's Future Weather and Climate Driver Study which predicts three times the number of days with temperatures above 30 °C, an increased daily maximum temperature of 44°C, five times the number of extended heat waves and four times the daily rainfall maximum (less frequent storms with higher rain volumes) by the year 2050.

With these predicted increases in temperature fluctuations, a building's ability to maintain an even temperature through outdoor temperature extremes becomes even more critical. The best strategy to achieve this is to maximize the thermal value of the building envelope including opportunities for passive design strategies. This could be done through form, orientation, programmatic placement and the building envelope.

The likelihood of Increased storm events led to recommendations of moving major building services, up and out of potential flood levels and using mould resistant panelized materials that are easily washable. The concept of planning for the inevitable flood has been exemplified at Toronto's Brickworks where building materials, locations of electrical services and mechanical systems were selected and designed in the expectation that there would be a flood.

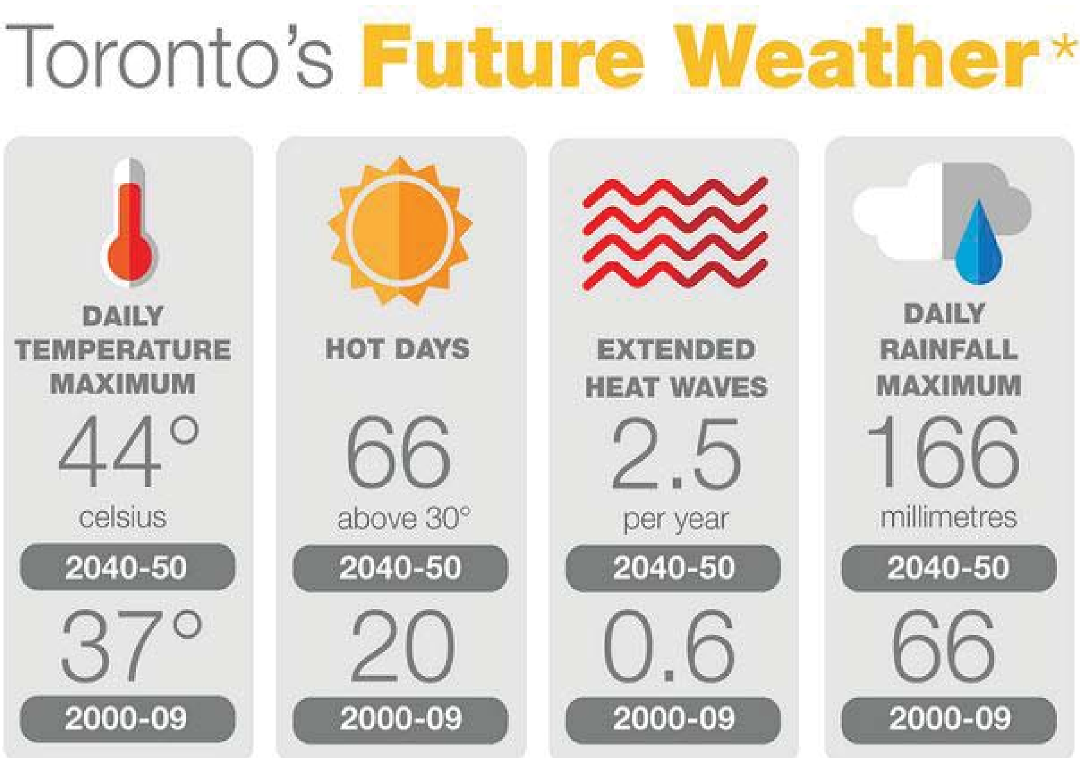

Figure 2.3.2.2: From Toronto's Future Weather and Climate Driver Study, 2011

With occupant usage making up one third of the net zero energy/carbon pie, discussions also took place about how to engage occupants in the dialogue of net zero through the actual building design. Concepts for building community and ongoing real time communication were developed as part of this strategy.

Design Considerations – The Site: Tridel's "On the Park" project, which was in the design development phase was provided as a base project to model and explore.

- The site is a 5.3 acre site at Leslie and Eglinton;
- The site is adjacent to Sunnybrook park to the west, providing excellent opportunities for protected solar access;
- The site will have access to transit with the new Sunnybrook Park stop on the Eglinton Crosstown planned for the corner of Leslie and Eglinton;
- In early discussions, it was determined that, for the sake of the exercise, some deviations from the zoning envelope would be allowable to broaden the exploration of passive strategies.

Design Considerations – Preliminary Massing: The preliminary massing provided by Graziani and Corazza Architects:

- Included three buildings and a large underground parking garage;
- For the purposes of the charrette, Building B, a 26,000square meter, 28 storey residential condominium was considered;
- The building, as designed was oriented with its long axis in the east west direction, and was flanked by a 38 and a 48 storey tower to its west and east respectively;
- Proposed a shared central green space.

Tower B, as designed, had:

- 323 Residential Units;
- Four levels of U/G parking with 354 parking spaces;
- A window to wall ratio of 60%;
- An effective building envelope thermal value of R4.3, and;
- A glazing has a heat transfer value of U1.82 W/m2-°K.

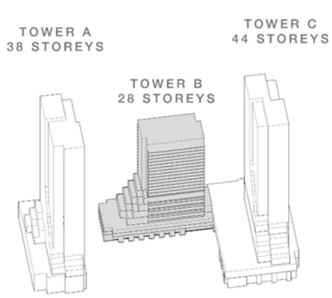

Figure 2.3.2.3 Sketches describing the existing form as designed by Grazziana and Corazza Architects

The cladding is a standard window wall system with double glazed insulated glazing units that is typical for buildings of this typology in the City of Toronto. A typical double loaded corridor with central service core is proposed. Large strip balconies are understood to be proposed for all faces of the building.

The preliminary energy model demonstrated an energy use intensity of 212 ekWh/m2, approximately four times the target EUI set for this high performance building to achieve net zero energy and carbon.

Design Considerations - Wind: Ventilation air makes up one third of the energy pie. Promoting natural ventilation is one way to reduce energy requirements. Wind is a natural source of energy that exists on the site. Some ways that form can take advantage of the existing wind:

- Rotate the building to align with the site conditions;
- Optimize the building form to channel air naturally through the building and create opportunities for natural ventilation;
- Curve the façade to create a 'lift' effect that will drive airflows into the building; akin to the way a sail or wing creates lift;
- Roughen the façade to scoop and capture wind.

The following sketches describe ways to optimize building form in response to wind.

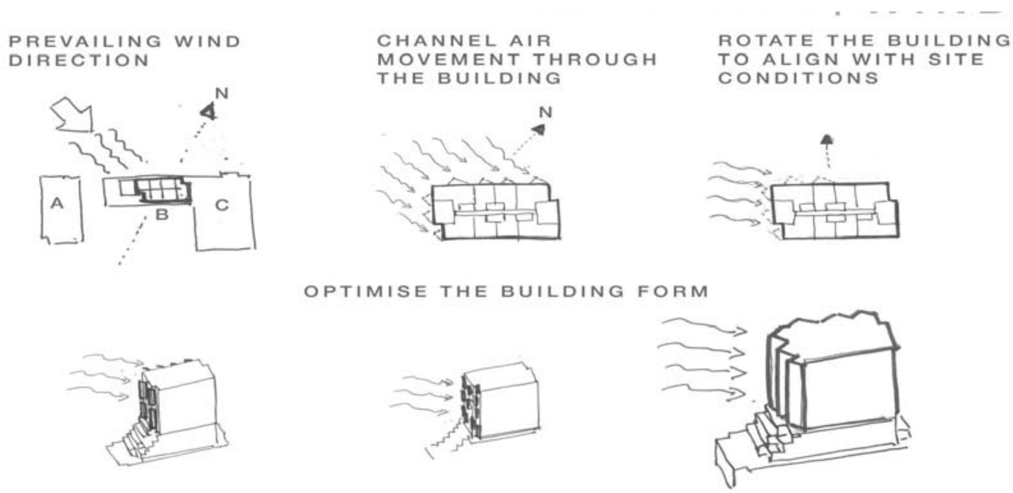

Figure 2.3.2.4 Sketches describing strategies for harnessing wind energy through built form, by Quadrangle Architects Limited

Design Considerations - Sun: To maximize opportunities for controlling daylighting and solar heat gains, glazing should be focused on the North or South faces:

- Mass and form the building to optimize potential for daylight and views;
- Use light shelves to bounce natural light deep into spaces;
- Locate projections such as balconies on the south side and optimize the depth of the balcony to permit thermal gain in the winter and to protect from thermal gain in the summer months;
- Consider balconies as semi-treated spaces, and use this area to preheat incoming air.

The following sketches describe passively preheating the air before it enters the building.

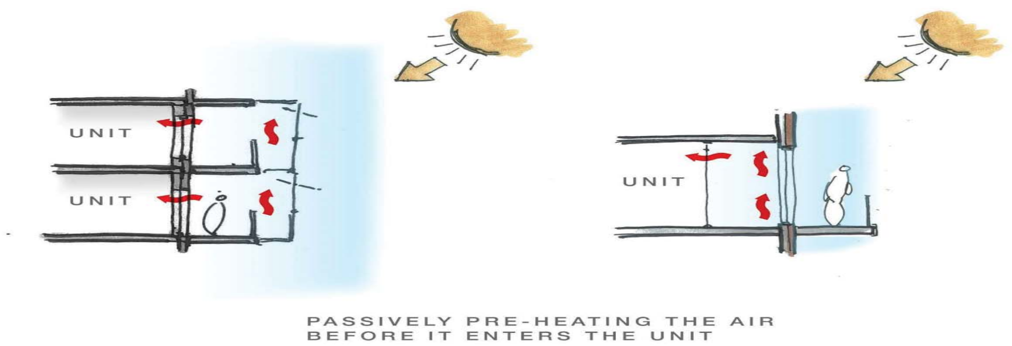

Figure 2.3.2.5 Sketches describing strategies for harnessing solar thermal energy through built form, by Quadrangle Architects Limited

- Adjust heights of buildings to better control access to solar radiation;
- Orient the building and site to maximize potential for active solar systems e.g. PV & solar thermal;
- Maximize the harvest of solar energy passively through translucent building elements;

The following sketches describe ways to optimize access to solar through distribution of height.

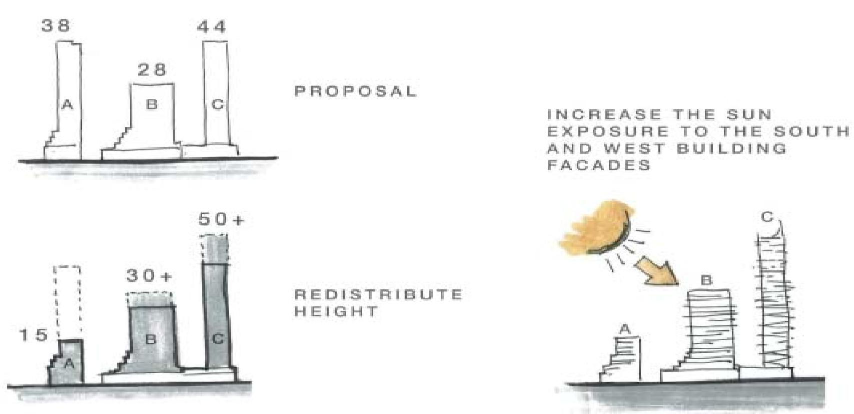

Figure 2.3.2.6 Sketches describing harnessing solar energy through height distribution, by Quadrangle Architects Limited

- “Stretch” the form to a single loaded corridor arrangement to maximize southern exposures and allow opportunities for natural ventilation;
- Select glazing with characteristics that are specific to the cardinal direction that the windows face;
- Vary window to wall ratio based on cardinal direction to provide access to daylight while also controlling thermal losses (lower window to wall ratio);

Options for orienting the building to maximize potential for active systems, and/or stretching the form to a single-loaded corridor arrangement to maximize southern exposure and maximize opportunity to capture natural breezes, are presented below.

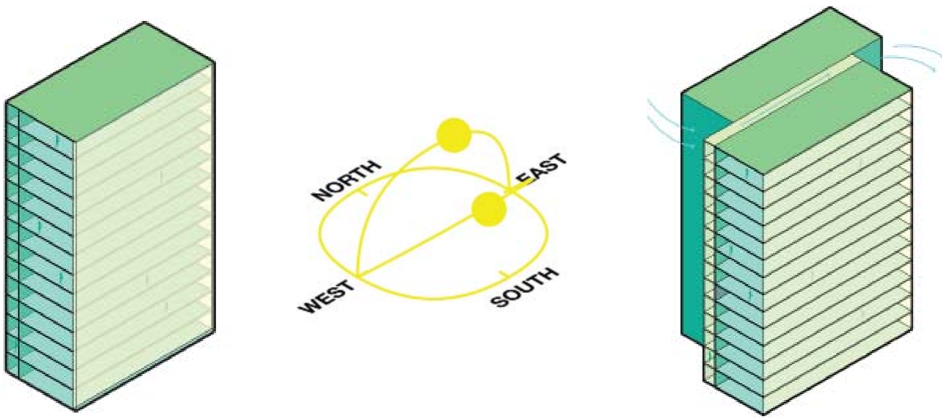

Figure 2.3.2.7 Sketches describing harnessing solar energy through orientation, by Quadrangle Architects Limited

- Compartmentalize the building vertically to limit potential stack effect. Locate atria on south.

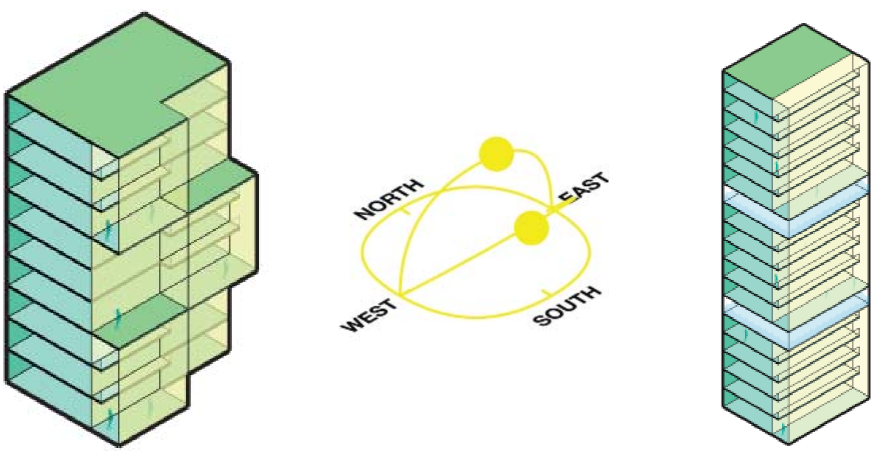

Figure 2.3.2.8 Sketches describing minimizing stack effect through building form, by Quadrangle Architects Limited

The concept of compartmentalizing the building vertically provides opportunities to create vertical neighbourhoods and distributed shared amenities. This would not only provide passive energy reduction solutions, but also introduce conditions that might encourage engagement in how the building functions.

Vertical compartmentalization also offers the opportunity to capture greywater from suites above and filter and reuse it for sewage conveyance on floors below, moving the water via gravity rather than mechanical means.

These massing options were explored in principle only. Current compliance energy modelling software is not sophisticated enough to easily model many of these passive design concepts. For the purposes of this two day exercise, attendees felt that it remained important to address and document these concepts.

Design Considerations – Programming: The concept of locating programmatic function based on the time of day that the space is used and the cardinal direction that it faces was also raised. Such a concept may have us reimagining our building forms altogether. Designing sill heights to match indoor programing functions is another way to "right-size" window openings.

The following charts demonstrate Program distribution via cardinal direction.

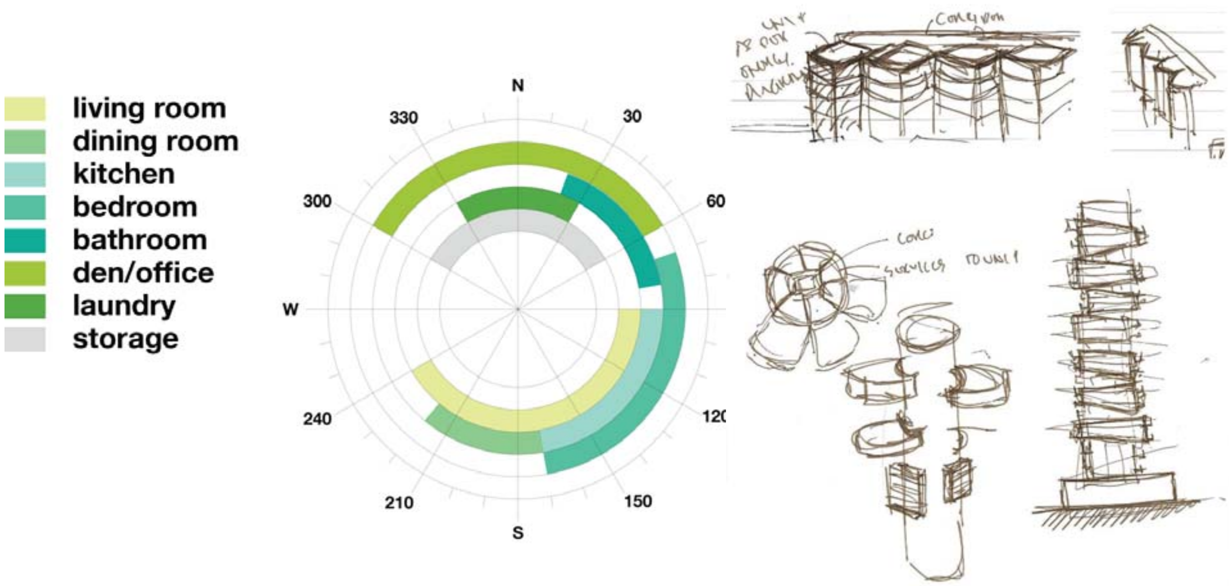

Figure 2.3.2.9 Sketches describing strategies for programming based on solar orientation, by Quadrangle Architects Limited

Design Considerations – Occupant Engagement: Load factors which rely heavily on the engagement of the occupant include heating, lighting, and plug loads. Providing motivation to the tenant of the building is key to improving these values. Some key energy reducing habits that would benefit from occupant education and engagement included:

- Considering how tenant expectations may vary as a result of being provided greater control over their space e.g. through the provision of operable windows;
- Expanding the definitions of thermal “comfort”.
- Reducing/increasing the temperature set-points within their suites and in common areas in winter/ summer respectively;
- Encouraging seasonally appropriate clothing;
- Turning off the lights when not in use;
- Providing excellent access to daylight to reduce the need for lighting;
- Encouraging purchase of low impact devices;
- Smart thermostats in all suites.

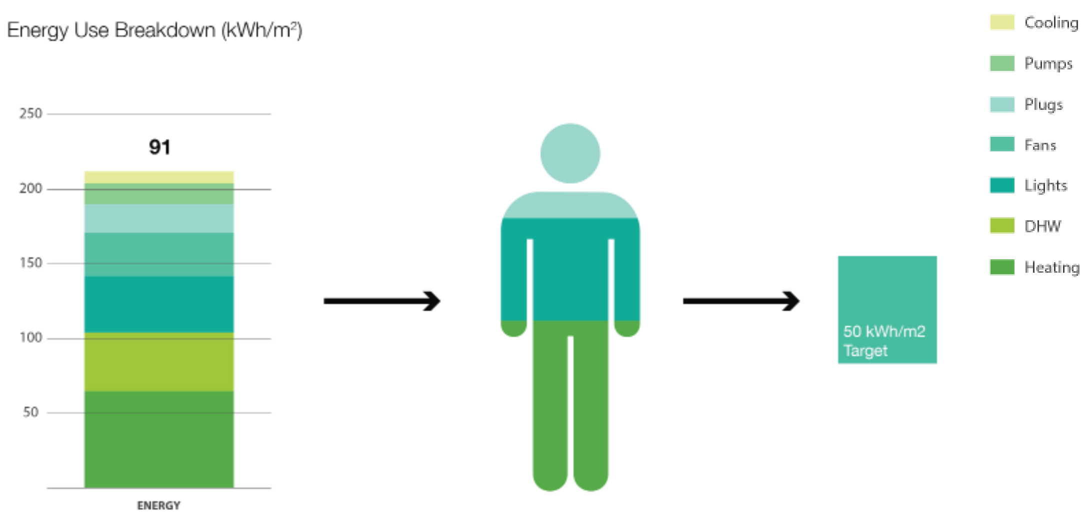

Figure 2.3.2.10 Sketches describing strategies for minimizing energy usage through occupant engagement, by Quadrangle Architects Limited

Offering passive design elements to occupants provides opportunities for these buildings to be less reliant on mechanical systems making them inherently more resilient in the face of rising energy costs, rolling power outages and extreme weather events. Engaging the occupants in education programs that empowers them in how to maximize their success with these systems is also encouraged.

Design Considerations – Building Envelope:

Addressing the quality of the building envelope is key to creating high performance buildings. Impacts of building envelope improvements can be easily studied in a standard energy model. Key building envelope improvements that are not currently typical within the Toronto condominium market, but were recommended to meet the target energy use intensity included:

- Reducing the window-to-wall ratio to 35%;
- A punched window approach in lieu of an aluminum window wall system;
- Improving the quality of the windows to triple glazed units with low E coatings on surfaces 2 and 5 and a USI value of 1.4 W/m2;
- High performance frames with a low thermal transmission factor (fiber-glass);
- A precast concrete wall assembly with 125mm continuous insulation (Effective R-13.7);
- Thermally broken balconies;
- Overall Effective Envelope Value of R-10, including windows.

It should be noted that this improvement was made solely based on the envelope changes. No mechanical design changes were made to make up for the passive offsets.

Other Key Recommendations:

- Establish and enforce target metrics for building envelope thermal values through the OBC. Demonstrate how to step these metrics to achieve zero, similar to the strategy for Architecture 2030;
- Create targets for both new and existing buildings and incorporate these into the OBC;
- Separate mandatory building envelope metrics from mechanical system metrics to incentivize high performance envelopes;
- Fund the creation of easy to use tools to model passive design solutions;
- Make thermally broken balconies mandatory so that they become common practice;
- Fund innovation from product manufacturers who create unitized wall systems that are high performance and easy to assemble and disassemble;
- Employ a high end marketing company to create a marketing and education strategy about climate change and net zero to the public – needs to have the same kind of power as the Sick Kids “VS” campaign.

2.4. Key Results for Workshop I

The first objective of the Energy discussion was to examine alternative designs and technologies that could achieve 15% better than the Ontario Building Code (OBC) 2017 SB-10, while concurrently identifying technologies, designs and process for achieving Net Zero Energy (NZE),1 which means the project will generate as much energy from onsite generation as the buildings on the site consume on an annual basis.

The energy modeling determined that energy performance for the SBD Building2 – Tower B is 50.4% better than the OBC, which impressively exceeds the goal set by the Savings By Design program of 15% better than Supplementary Standard SB-10 - 2017. The cumulative annual energy cost savings are expected to be $21,041 with a reduction in total greenhouse gas (GHG) emissions of 645,937 kg CO2Eq.

The measures incorporated into the SBD Building to reduce the energy use include:

- Overall Effective R-10 Envelope:
  - Glazing upgrade – U-0.86 W/m2·°K (U-0.15 Imp), SHGC 0.30
  - Precast assembly with 125 mm continuous insulation, fully insulated slab edges and thermally broken balconies, no continuous thermal breaks (R-13.7 effective)
- CO_2 sensors throughout building, controlled with a Building Automation System (BAS)
- Electric Space Heating and Service Hot Water Boilers
- LED lighting and high efficiency lighting design including controls in common areas and suites (estimate at 10% reduction in lighting power density (LPD) over ASHRAE 90.1-2010)
- In-slab Variable Refrigerant Flow (VRF) Heating (COP 5.5) and Cooling (COP 4.7)
- ENERGY STAR Appliances

The key results for the Energy team are summarized below:

1 Net Zero has defined by the Canadian Green Building Council
2 Incorporates the upgrades selected during the IDP Workshop – representative path towards SBD Program goal

Model Simulation Results Summary

Overall Energy Performance

Modeled Area: 264,542 ft² 24,586 m²	Total Annual Projected Energy Consumption	Energy Utilization Intensity (EUI)	Annual Electricity Consumption	Annual Natural Gas Consumption	Energy Performance as Compared to OBC
	ekWh/yr (GJ/yr)	ekWh/ft²-yr (ekWh/m²-yr)	kWh/yr	m³/yr	%
OBC Reference Building[2]	5,811,877 (20,927)	23.2 (236)	2,270,304	327,576	
Baseline Building[3]	4,937,380 (17,779)	19.7 (201)	2,514,235	224,128	15.1%
Savings By Design Building	2,883,256 (9,841)	11.5 (117)	2,883,256	0	50.4%

Table 2.4.1 Overall Energy Performance, by Provident

A host of potential activities, technologies, and opportunities, which Tridel might consider as part of the On the Park condominium project, were identified. The incorporation of the upgrades significantly reduced the EUI of the SBD Building from 23.2 ekWh/ft2; to 11.5 ekWh/ft2; however, the identified MOECC3 target is 4.9 ekWh/ft2 (50 ekWh/m2) consistent with a net zero target. The approach for a NZE building needs to consider all the aspects of the building early in the design stage.

More than half of the performance improvement was a result of an upgraded mechanical design. The workshop showed that NZE buildings will require a much “higher- performing” enclosure, with an opaque assembly that has a thermal R-value of approximately double that of the upgraded On the Park SBD Building. On-site renewable energy is a critical factor in NZE building solutions. Building integrated solar PV, at the scale required to completely offset the electricity loads, is not possible as the building/project site is currently planned.

In addition to the thermal performance of the enclosure, other passive building strategies will include an assessment of the building form, particularly height. It is more challenging for tall multi-storey towers to achieve NZE. Few tall/multi-storey NZE buildings have been built to date. Products to achieve effective R-values of >R-20 is limited, and may not be suitable for large towers.

Further discussion and analysis will identify the policy and regulatory barriers to the implementation of the design for a Net Zero solution.

3 Ministry of Environment and Climate Change

Other Key Considerations Include:

- To achieve aggressive target like net zero, it is best to start with a clean slate, not a building that has already been designed. Net zero requires "out of the box" thinking that must be done at a conceptual stage. This will also serve to minimize the potential cost impacts.
- It is important to establish performance targets at the beginning of the project, and where there are multiple targets such as for "On The Park,"
- An integrated approach is required to identify critical elements of the building architecture to meet the established performance targets. There may need to be "trade offs" of certain elements within each target in support of other targets.
- "Everything impacts everything" – a strategy related to reducing energy use may affect more than just the design of the building. It could also affect indoor air quality, waste streams, water reduction etc. An integrated design approach is critical.
- Construction protocols and practices must support the design and intent and meet performance targets
- The human element is critical. Human behaviour can undermine the best designs or greatest innovations and intentions. A true understanding of the building occupants and building use is required.

3.0 WORKSHOP II – SUMMARY: BARRIERS TO NET ZERO

The focus of Workshop II (held on January 17, 2017) was on the barriers that are impeding the achievement of net-zero, outside of what is technically possible. In other words, assuming that the technologies exist to develop buildings to a net-zero level of performance, what regulatory, economic, and/or market adoption barriers still exist, and what would need to happen to remove these barriers?

3.1. Key Results for Energy

3.1.1. Regulatory barriers

- Alignment is needed between different regulatory bodies. The Conservation First framework encourages electricity reduction. MOECC encourages carbon reduction. These may not be consistent goals.
- Fuel Switching: Incentives need to be meshed.
- Electrical product regulations: Storage units are not approved in the Canadian market at this time. There are available technologies, but not approved here yet.
- Condominium context: Regulations around Section 112 of the Condominium Act have had the unintended consequence of becoming a regulatory barrier. Developers will not invest in the most energy efficient systems since condominium boards are not obligated to adhere to contracts established during the construction phase.
- Generating off site: There are barriers around how to become a generator.
- The Building Code is a base level with no incentive to go beyond except where municipalities add them.
- Scale: The grid is a place to store energy. If people go off grid it makes it less reliable in the long term. It is necessary to continue to go from building scale out to community scale.
- Definition: What does Net Zero mean within the boundary of a building? Where the boundary starts and stops is somewhat arbitrary. Should it include the entire site etc?
- Unintended consequences – refrigerants used in HVAC systems can be very efficient, but they are powerful ozone depleting substances.

3.1.2. Energy: Economic barriers

- Price of gas vs. electricity presents a challenge – gas is significantly cheaper
- First cost technologies – paybacks are too long – especially if the incumbent technology is natural gas
- There are few incentives for building above code. The SBD program is unique but is not available to all projects.
- The Condominium Act is one of the largest investment barriers – it does not permit higher costs to be amortized over time.
- Green loans. When units are sold with green loans attached, condo fees are increased, which is not desirable.
- If a developer does get a green loan, there is sometimes backlash from purchasers.
- Developers say if that if everyone had to do it, if there were a level playing field, it would make sense economically. Raise the Building Code to also help with implementation.
- In UK, 20% of energy had to be met by renewable energy. They got the whole supply side cost reduced.
- Voluntary targets lead the Building Code. Developers and designers are out in front of the market first.
- Education of the consumer. Consumers do not even know if they want some things that look good but do not save energy (e.g. Apple computer). How does the education happen? Benchmarking – use a rating system like appliances.

3.1.3. Energy: Market adoption barriers

- Consumer knowledge. Consumers do not know what net-zero means.
- Benchmarking. Buildings should be benchmarked and labeled. EUI should become part of MLS listings.
- Education must be suited to different market groups.
- Dynamic energy pricing could be part of an upgrade package for buyers.
- Risk for builders and buyers needs to be shared.

3.2. Key Results for Waste

3.2.1. Waste: Regulatory barriers

- Primitive language in the Building Code.
- Lack of useful data.
- Policy is very prescriptive.
- No performance-based solution.
- No equivalencies for design in waste strategy.
- Metering on waste is not widespread.
- Location of waste disposal infrastructure.
- New territory (fear of innovation).

3.2.2. Waste: Economic barriers

- Cost of adding a green loan to a condo purchase.
- Condominium Act and Leasing Prohibition will prohibit leasing for condo management.
- Risk for developers.
- No incentives available.
- Waste disposal is relatively inexpensive and can be passed along to the homeowner.

3.2.3. Waste: Market Adoption barriers

- Lack of education for buyers.
- Knowledge of the design, construction, operation, and development communities.
- Technical language may be challenging for buyers.
- Costs associated with new technologies.
- Lack of availability of products.
- Policies disallowing waste from neighbouring buildings.

3.3. Key Results for Water

3.3.1. Water: Regulatory barriers

- Lack of data on consumption from a building level, and the watershed as a whole. No individual suite water usage data available.
- Lack of good information on embodied energy of water. From a metrics perspective: volume and energy inputs – in Ontario the volume of water depends on your region and water supply.
- Addition of an energy load to a system when city water is added.
- Cost of sub-metering. Data is important. Recommendation: Make sub-metering mandatory.
- Lack of building benchmarks. Building reporting should be mandatory so good data can be obtained by building type, instead of just a prescriptive code around efficiency. (It is noted that mandatory reporting requirements are coming for some buildings.)
- Stormwater: Responsibility of dealing with stormwater on the building footprint can be challenging. Community-wide options need to be considered when looking at opportunities to offset water.
- Consumption regulations are not effective. Ontario has stronger water consumption regulations than most districts, with high standards and codes, but consumption is higher than places that do not have the codes.

3.3.2. Water: Economic barriers

- Education on the cycle of water and the true cost of water.
- Cost of water is too low in Ontario; however, water rates have been increasing dramatically in the past few years
- Lack of data on usage and consumption.
- Lack of incentives for onsite treatment.
- Cost of dual plumbing systems for potable and non-potable water.

3.3.3. Water: Market Adoption barriers

Ideas:

- Change the colour of toilets so that re-used grey water is not as apparent.
- Controllability of water flow – high flow rate vs. low flow rate where low flow is standard in kitchen sinks. High flow would only be needed when filling a pot
- Showers – would showers take less time if the shower stall were heated?
- Timed showers with changing pressures. Nebia created an atomizer showerhead that uses 70% less water (but it costs $400).
- Instead of running taps to get to a warm temperature, the heat pump could be activated until pipes are hot, and then turn on water. Water recirculation pumps already exist for this function; however, they do require electricity use.

4.0 PRIORITY IDENTIFICATION

In a plenary session, the group discussed priorities for identifying and removing barriers to Net Zero.

Energy Use Intensity (EUI)

EUI is not an ideal solution. It cannot be complicated. The concept should look like the sticker on a refrigerator.

EnerGuide should be the number for the whole building. Energy Star for Buildings has a defined way for arriving at EUI. There will soon be Energy Star for Multi Family buildings only. It exists in the U.S. Natural Resources Canada is bringing it to Canada – a new program. A building has it or does not have it. It is not a number. It trades on the Energy Star brand. MOECC is moving ahead with audits for large buildings – benchmarking. It involves voluntary reporting.

In the Office Sector there is a move to have a level 2 audit, which gives a number of answers, including GFA. It is to arrive at a lot more information, predominantly to arrive at an EUI for that particular building.

Getting the information out there is a great first step. Knowing EUI is valuable. People will not care about it until it is available.

Differential pricing for different units

Energy Star would not certify individual suites. A builder install triple pane windows into a suite and expect a performance benefit. There is a limit to how effective an upgrade would be for individual suites. There is a potential for retrofitting, but maybe not to net-zero.

Energy labeling

Benchmarking could be as simple as getting MLS to put that line on the listing – like the walkability score. If it is third party certified the consumer does not have to think about it.

Incentives

CMHC and other mortgage suppliers have incentives to buy homes with higher efficiency. CMHC Green Home offers a premium refund of up to 25% to borrowers who buy, build, or renovate for energy efficiency using CMHC-insured financing.

Alternative utility (energy) pricing – tangible steps

Currently there is time of use (TOU) pricing. Hydro One proposes modeling different prices. Customers may choose from 12 options. There must be a difference of at least 3X between on-peak and off-peak. Hydro One designed different buckets for different regions of the province.

- Critical peak pricing: there is a certain low rate across the year.
- Variable peak pricing.
- Real time pricing.
- Block pricing – the first block at one price, the second at another.

There is an app to tell inform consumers what the price will be.

4.1. Energy Group Priorities

- Energy label – Energy Star is a premium label. Ask MLS to put an Energy Star yes or no on the sales listing.
- Alternative utility pricing. Hydro One is looking at four different rate structures.

4.2. Waste Group Priorities

- People must be convinced of the value proposition.
- Specific working groups and consultation are needed to explore regulatory barriers and financial incentives.
- Pilot projects are needed to explore behaviour.

4.3. Water Group Priorities

- Data disclosure is needed for water – similar to energy.
- There is a need for benchmarking.
- There is a need for performance standards.
- Dynamic target. Upfront development charges should be based on what is done. Pay per use.
- Celebrate savings. Use public parks to stage celebrations.

5.0 CONCLUSION

Workshop I provided a forum for bringing together the ideas of stakeholders and subject matter experts to work interactively and exchange ideas and concerns.

Energy modeling determined that the energy performance for Tridel's On the Park Condominium project is 50.4 % better than the OBC SB-10 2017, which exceeds the goal set by the Savings By Design program.

Issues and considerations were identified, along with realistic solutions and recommendations, for net zero water, waste, and for improvements in overall resiliency.

Additional changes will be required to reach the aggressive target of Net Zero Energy to bring annual energy use down to the point where the addition of energy from renewable sources can close the gap.

Workshop II addressed the many barriers that currently exist that restrain the development sector from marching toward achieving Net Zero and greater resiliency in their projects.

These barriers must be addressed for the very aggressive targets established for energy and carbon to be met over the next several years.

It is critical for government to consider is that many of the issues cross departmental responsibility – Building Code development potentially impacts land development priorities for example. To achieve the fulsome results that net zero implies, it will be incumbent on the various departments to collaborate under a common goal. Piecemeal interventions, regardless of the worthiness of the intent, will not achieve the objectives inherent in the Climate Change Action Plan.

6.0 INVITEES

PLANNING/COORDINATING TEAM		
Larry Brydon	Sustainable Buildings Canada	lbrydon@cricketenergy.com>
Bob Bach	Sustainable Buildings Canada	bbach@energyprofiles.com>
Constantine Eliadis	Sustainable Buildings Canada	celiadis@sbcanada.org>
Jeff Ranson	Sustainable Buildings Canada	jranson@sbcanada.org>
Mike Williams	RWDI	mike.williams@rwdi.com>
Craig McIntyre	PEMI	cmcintyre@pemi.com>
Mayan Hershkovitz	PEMI	MHershkovitz@pemi.com
Marjorie Lamb	Writer in Residence Inc.	writerinres@gmail.com>
Michelle Xuereb	Quadrangle Architects	mxuereb@quadrangle.ca>
Karl Van Es	Quadrangle Architects	kvanes@quadrangle.ca
Andrew Geldard	Quadrangle Architects	Ageldard@quadrangle.ca
Don Armitage	Enbridge Gas Distribution	don.armitage@enbridge.com>
Lisa Prime	Prime Planning Strategy	primeplanningstrategy@gmail.com
Sarah Jones	Sustainable Buildings Canada	sjones@sbcanada.org>
Christopher Marleau	Sustainable Buildings Canada	cmarleau@sbcanada.org>
Hayley Cormick	Sustainable Buildings Canada	hcormick@ryerson.ca>
MINISTRY		
Barb McMurray	Lead Showcasing Water Innovation	Barb.McMurray@ontario.ca>
Katie Zwick	Senior Policy Analyst	Katie.Zwick@ontario.ca>
Jennifer Dillon	Environmental and project management specialist	Jennifer.Dillon@ontario.ca>
Cengiz Kaharamanoglu	Code Advisor, Municipality Affairs and Housing	Cengiz.Kahramanoglu@ontario.ca>
Chris Thompson	Manager (Acting), Building Code Policy Development (Municipal Affairs)	chris.thompson@ontario.ca>
Elizabeth Kay-zorowski	Director (Acting), Public Safety Branch (Government and Consumer Services)	elizabeth.kay-zorowski@ontario.ca>
Dr. Joel Moody	Electrical Safety Authority	Joel.Moody@electricalsafety.on.ca>
Andrea D'Silva	MOECC	Andrea.D'Silva@ontario.ca
Eva Musso	MOECC	Eva.Musso@ontario.ca
Brad McDonald	Senior Policy Advisor, Ontario Ministry of Government and Consumer Services	Brad.McDonald@ontario.ca>
Jason Choy (ENERGY)	Senior Advisor, Ministry of Energy	Jason.Choy@ontario.ca>
Howlan Mullally	Infrastructure Ontario	howlan.mullally@infrastructureontario.ca

Shahriar Ghahremanian	Infrastructure Ontario	Shahriar.Ghahremanian@ infrastructureontario.ca>
Natalie Kehle	Infrastructure Ontario	natalie.kehle@infrastructureontario.ca
INVITEES		
Jamie James	GreenBuild	Jamie@greensoil-investments.com
Warren Ragoonanan	Gardner Miller Law	Warren.Ragoonanan@gmalaw.ca
Shawn Good	BILD	sgood@bildgta.ca>
Paula Tenuta	BILD	ptenuta@bildgta.ca>
Wells Baker	Minto	WBaker@minto.com
Shadi Aghaei	Times Group Corp	shadi@timesgroupcorp.com>
Frank Carnevale	Bridgepoint Group Ltd.	fcarnevale@bridgepointgroupltd.com
Paul Frith	GeoSource Energy	pfrith@geosourceenergy.com
Sam Loggia	CSA Group	sam.loggia@csagroup.org
Jovan Cheema	CSA Group	jovan.cheema@csagroup.org>
Marco Filice	Liberty Developments	mfilice1024@gmail.com
Mike Marchant	Toronto Hydro	mmarchant@torontohydro.com
Sahar Mishriki	Hydro One	Sahar.Mishriki@hydroone.com
Andrew Bowerbank	Ellis Don	abowerbank@ellisdon.com>
Jack Pong	City Core Developments	jack@citycoredevelopments.com
Mario Chiarelli	Cricket Energy	mchiarelli@cricketenergy.com>
Morghain Gibbons	Build Green Solutions	morghain@build-green.com>
Rodney Wilts	Windmill Developments	rodney@windmilldevelopments.com
Richard Laszlo	Quest Canad	rlaszlo@questcanada.org>
Anthony N. Fernando	RESCON	fernando@rescon.com>
Paul De Berardis	RESCON	deberardis@rescon.com
Lisa King	City of Toronto	lking4@toronto.ca
Nicole Risse	OSEA	nicole@ontario-sea.org>
Jennifer Wong	City of Markham	JWong4@markham.ca>
Lenard Hart	Hydro One	lhart@hydroonebrampton.com>
Ralph Williams	Hydro One, Manager of CDM	rwilliams@hydroonebrampton.com
Vladimir Nikolic	Ryerson	nikolic.vladimir@ryerson.ca
Doug Webber	Halsall	dwebber@halsall.com
Mario Angelucci	City of Toronto	Mario.Angelucci@toronto.ca
Derek Satnik	MI Group	dsatnik@mi-group.ca>
Doug King	Metro Group Canada	dougking@metrogroupcan.com>
Tammy Billings	PragmaTech	tammyb@pragmatechltd.com>
TRIDEL		
Luke Johnson	Tridel	LJohnson@deltera.com
Peter Meneguzzi	Tridel	PMeneguzzi@deltera.com

SBC SUSTAINABLE BUILDINGS CANADA