APPENDIX 1: SAMPLE ENERGY MODELLING REPORT

Below is a sample energy modelling report to be submitted to the CaGBC for review or to a 3rd party reviewer. Additional information that may be included in an appendix for this report has not been included here in this guidance document. This sample report is not a template, as it does not fully follow the format identified or provide all the information referenced in this guidance document. It is provided as guidance only.

Project Name: Sample Building XYZ
CaGBC project #: #####
Rating System: LEED Canada-NC 1.0
Baseline: MNECB 1997 baseline
Date: YYYY-MM-DD
Simulator(s): Name of simulator(s)
[Signature of simulator(s)]

Energy Performance: XX%
Energy Cost savings: XX%

Simulation Files:

SampleBuildingXYZ-Pro.* - Energy performance simulation files for Proposed Design
SampleBuildingXYZ-Ref.* - Energy performance simulation files for MNECB-CBIP Baseline Case

Overview:

The following list of building characteristics provides a side-by-side comparison of the building characteristics for the Proposed Design versus the MNECB+CBIP Baseline using EE4v1.7. In summary, the following are the key design characteristics which provide for superior energy performance as compared to the Baseline Case:

- Exterior wall R-value nearly 80% higher than the Baseline
- Roof R-value about 40% higher than the Baseline
- Overall window conduction about 16% lower than the Baseline
- Overall lighting load about 40% lower than the Baseline, including credit for occupancy and daylighting controls
- In-floor radiant heating
- Variable-speed control of main air handling unit, providing for air delivery below minimum 0.4 cfm/sf level of the Baseline
- Heat wheel exhaust air heat recovery at 72.9% effectiveness
- Sea-water source heat pump system providing heating at a seasonal efficiency of COP-3.9 and cooling at over EER-26.
- Sea-water source heat pump system providing service water heating at a seasonal efficiency of COP-4.0.
- Low-flow faucets and showerheads providing 73% lower service water load than for the Baseline.

All MNECB mandatory requirements have been met or are not applicable to the proposed design. See attached signed MNECB checklists.

Table 1. Summary of Models

Baseline Case (MNECB - Region C)	**Proposed Design**
Modeling Software: Proposed design completed in DOE2.1e (release Ec133), using EE4 to set up about 95% of the initial Proposed Design. EE4 used exclusively for the Baseline Case. **Schedules:** Schedules are identical between the Baseline and Proposed Design cases, using MNECB default schedule 'A', which is fairly representative of what is expected for small office type of use. **Space Use Classification:** By space function **Principal Heating Source:** Per MNECB Code Supplement, "heat pump" is the principal heating source. **Conditioned Floor Area:** 10837 sf (1007 m²)	
Building Envelope	
Exterior Walls • From Table 3.3.1.1.A MNECB, Opaque exterior walls at R_o-7 (fossil or heat pump heating).	***Exterior Walls*** • R_o-13 (RSI-2.3) for wood stud walls with 3" rigid polystyrene insulation with Z-girts. • R_o-18 (RSI-3.1) for concrete block walls with 3" rigid polystyrene insulation.
Roof • From Table 3.3.1.1.A MNECB, Type III roof at R_o-12.1 (fossil or heat pump heating).	***Roof*** • R_o-16.9 (RSI-3.0) for metal roof type and with 3" polyiso insulation, mostly with Z-girt thermal bridging.
Glazing • Window area same as for proposed design, up to a fenestration-to-wall ratio (FWR) limit of 0.40, including skylights in calculation of FWR. • From Table 3.3.1.2 MNECB, windows at $U_o = U_o$-0.56 for fixed windows and U_o-0.60 for operable.[1] • From 5.3.5.5, CS, window shading coefficient set to be same as proposed, instead of set at 0.74 as allowed by the MNECB to weigh benefit of beneficial solar gains versus comfort issues. • From 5.3.5.5, CS, window shading coefficient is adjusted by 80% derating for internal shading, dirt, etc. • No overhangs or fins; self-shading same as for proposed (although EE4 does not provide for).	***Glazing*** • Glazing at 21.7% of vertical wall area • Windows input at overall U-value of 0.45 for a mix of $^2/_3^{rds}$ fixed and $^1/_3^{rd}$ operable windows with thermally broken aluminum framing (determined using FramePlus). Garage door window at – double glazing in non-thermally broken aluminum frames at $U_o = 0.70$. • SHGC at 0.50 for clear low-e windows including frames; garage door windows at 0.51. • Overhangs not included for same reasons as for setting shading coefficient same in baseline and proposed; that is, overhangs provide for comfort but shows an inappropriate penalty because building is not cooled.

[1] Note that EE4 does not set the window U-value and does not match intended value in DOE2, but the discrepancy is consistent between Baseline and Proposed.

Infiltration • From 5.3.5.9 Code Supplement, background infiltration rate of 0.05 cfm/ft^2 of gross wall area, applied 24 hours/day to exterior zones.	***Infiltration*** • Same as for baseline. Note that EE4 erroneously doesn't apply infiltration to unconditioned spaces, which I have corrected.
Lighting	
• Lighting density based on function of zone. Average lighting density is 1.45 W/sf (15.6 W/m²). • 3 kW exterior lighting load, per SSc8.	• Average adjusted space lighting density at 0.87 W/sf (9.3 W/m²), including credit for occupancy sensors and daylighting controls. • 2 kW exterior lighting load.
Appliances and Plug Loads	
• Equipment density based on function of zone. Average daily peak diversified equipment density from MNECB defaults is 0.32 W/sf (3.5 W/m²). • Additional diversified process loads added to server and electrical rooms.	• Must be same as the baseline. • Process loads same as the baseline.
HVAC Equipment.	
System • For multiple zone system (effectively defined by source of ventilation), central VAV with reheat modeled as baseboards. • Single zone systems with constant volume systems	***System*** • AHU-1: Variable volume central air handler serving induction diffusers (except for meeting and boardrooms), with terminal in-floor radiant heating. • Remaining systems not served by AHU-1 as constant volume single zone systems.
Supply and Ventilation Air • Supply air for AHU-1 sized by EE4 at just over 4600 cfm (2200 l/s) based on taking the larger of (1) the outside air requirements or (2) minimum required 0.4 cfm/sf. • Minimum flow rate set at 0.4 cfm/sf after final sizing completed. • Minimum design outside air level same as for proposed. • For multiple zone systems without hydronic cooling (AHU-1), 3.0" for supply and 0.6" for return. Single zone with DX or without cooling (FCU-2), 1.3" for supply and no return; with hydronic cooling (FCU-3), 2.0" for supply and 0.6" for return. • For multiple zone systems without hydronic cooling, 45% for supply efficiency and 25% for return efficiency. Single zone with DX or without cooling, 40% for supply (no return); with hydronic cooling, 50% for supply and 25% for return. • For VAV, use of the appropriate type of fan curve. • No exhaust air heat reclaim.	***Supply and Ventilation Air*** • Supply air flow for AHU-1 at nearly 5900 cfm (2800 l/s) overall. • Minimum supply air rate at 60% of peak supply. • Minimum outside air (O/A) at ASHRAE 62 levels, controlled at 100% of supply (although FCU-1 served by AHU-1 technically may provide for some minor amount of mixed air in simulation). • Fan power at 3.8 kW, based on performance specs (shop drawings) for main AHU-1 and mechanical schedules for remaining fan coils and unit heaters. • Variable speed drive on AHU-1. • Exhaust air heat recovery at 72.9% overall effectiveness for heat wheel, including adjustment for amount of exhaust returned to AHU-1 (see notes).

Control • Heating setpoint at MNECB defaults of 22° / 18°C for zones served by radiant heating[2] (AHU-1); setpoints and schedule same as proposed for remaining zones. • Cooling setpoints, setback temperatures, and schedules same as proposed design. • Enthalpy economizer for mechanically cooled zone. • OA scheduled off to zones that do not require OA during unoccupied periods. • Minimum supply air temperature at 55°F, reset based on warmest zone. • No demand ventilation.	***Control*** • Heating setpoints at 20° / 19°C for zones served by radiant heating (see notes on credit for radiant heating); 22°C / 17°C otherwise, except for core open zone which is allowed to float (indirectly conditioned). • Cooling setpoints: 24°C (MNECB default). • Drybulb economizer in the form of hybrid ventilation tied to DDC control, but is not implemented because of how EE4 inappropriately restricts cooling control of non-mechanically cooled zones. Server zone without economizer control. • OA scheduled off during unoccupied periods. • Minimum supply air temperature at 61°F (16°C), with outside air reset. • No demand controlled ventilation, although CO2 sensors installed, but only to monitor indoor air quality and provide alarms if IAQ is unsatisfactory.
Heating Plant • One electric resistance boiler since proposed has 100% GSHP system. Unfortunately, EE4 does not allow the specification of "heat pump" principal heating source in the zone *and* allow for use of an electric resistance boiler. Hence, the baseline had to be modified manually in DOE2. • Temperature drop through the hot water loop of 29°F. • Constant flow hot water circulation. • Hot water circulation same as proposed (40 ft. is default).	***Heating Plant*** • Baseline with sea water source heat pumps (SWHPs), with hot water reset[3], a seasonal average COP of 3.87 from Water Furnace specs. • Temperature drop of 7.2°C • Constant flow hot water circulation • Hot water circulation at 285 kPa head overall, including sea water heat rejection pumping[4].

[2] When a more typical setback schedule is introduced, many of the zones are underheated for more the 100 hours because of having inadequate capacity to handle the pick-up load. As this is not the case for the actual proposed design with a more constant temperature profile, the baseline baseboard capacities are modified as necessary to provide for MNECB-compliant requirements of having <100 under-heated hours in any zone (which ends up conservative compared to proposed design since the reference still has more under-heated hours).

[3] Hot water reset outside of EE4 using DOE2 since it directly provides this capability.

[4] DOE2 requires that all pumps be represented using a single equivalent set of pump characteristics.

Cooling • Central reciprocating chiller at COP 3.8 for hydronic cooling. Temperature rise of 5.6°C. • Circulation head same as proposed. • Constant flow chilled water circulation. • Two cell cooling tower with 85°F – 95°F temperature rise, and a constant speed fan with cycling control and 5.9 hp/1000 MBH. Constant speed tower pump at 60 ft head and combined efficiency of 70%. • Mechanical cooling scheduled off same as for proposed design[5].	***Cooling*** • Cooling at 26.4 EER from sea water-to-water heat pumps. • Temperature rise of 2°C. • Circulation head at 0 feet since pumping from same pumps as for heating (and already accounted for). • Constant flow chilled water circulation. • Only server room mechanically cooled (FCU-3).
Domestic Hot Water (DHW)	
• Since proposed is all electric, then electric resistance. • Load same as Proposed.	• Service water heating provided from sea water source heat pump (WW-5) at COP of 4.0. • Load set corresponding to MNECB defaults, reduced with 0.5 gpm faucets and 1.5 gpm shower (per shop drawings).
Renewable Energy Systems	
• No renewable energy applies.	• Photovoltaic system providing 8800 kWh/year, determined using RETScreen (see EAc2 documentation).
Utility Rates	
• Electricity rate same as Proposed.	• Electricity Rates set at BC Hydro 1220 tariff of 6.8 ¢/kWh.

Additional Simulation Notes:

Roof Air Space: High ceiling is open and exposed to entire first floor and open centre core and the load is effectively ...

Radiant Heating Credit: From the LEED Canada New Construction 1.0 Reference Guide, credit for radiant heating may be provided if "HVAC systems are controlled based on ...

Exhaust Heat Recovery Effectiveness is applied in DOE2 for central (non-zonal) systems using DOE2's heat recovery capability. This adjusts for ...

[5] Note that EE4 does not provide for this, but can be specifically represented in DOE2.