
APPENDIX 2C

ENERGY

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ATTACHMENT 1 ENERGY MODEL ASSUMPTIONS

APPENDIX 2C**ENERGY****1. ENERGY SUPPLY AND CONSUMPTION****1.1 Energy Supply and Payment**

The Authority will from time to time as required enter into contracts with Energy suppliers for the supply of Energy to each School, and will be responsible for all payments related to such contracts. Without limiting Project Co's obligations in Schedule 4 [Services Protocols and Specifications], Project Co will administer such contracts, including dealing with suppliers to resolve issues from time to time, and will provide such other reasonable assistance related to such contracts as may be requested by the Authority.

1.2 Recording and Monitoring of Weather Data and Energy Consumption

Project Co will collect Weather Data for each School from the Site Weather Monitoring Station and will install equipment to record and monitor consumption of each type of Energy in each School which will:

- (a) be suitable and properly calibrated to enable the Authority to undertake real time:
 - (1) collection and monitoring of:
 - (A) Energy trends, including current and historic Energy consumption;
 - (B) Energy use breakdown of utility consumption data (e.g. natural gas and electricity for each independent User Space within each School). Sub-metering will collect information in the same units as the utility meters but allow for usage differentiation between each independent User Space;
 - (C) end use breakdown by heating, cooling, heat-rejection, pumps, fans, interior lighting, exterior lighting, hot-water and equipment loads, and including domestic hot and cold water consumption; and
 - (D) all applicable Weather Data from the Site Weather Monitoring Station;
 - (2) analysis of the data collected, including:
 - (A) graphical comparisons to:
 - (i) historical (year over year) consumption;
 - (ii) weather data;
 - (iii) utility bills; and
 - (iv) energy consumption by end use against declared energy targets;
 - (3) provide early warning of malfunctions and deviations from norms;

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- (4) be provided in a readable and editable format consistent with industry practice; and
 - (5) be remotely accessible by the Authority through a web-based browser and portable devices such as smartphones;
- (b) secure all such properly recorded information so that it is not lost or degraded as a result of any equipment or service malfunctions, and will secure such information from any adjustment, modification or loss from any source.

1.3 Energy Consumption Certificate

Promptly after the end of each month following the earliest School Service Commencement Date, Project Co will deliver to the Authority a certificate showing for each School:

- (a) the Energy Consumption by energy source in Gigajoules for that month with respect to:
 - (1) total Energy Consumption;
 - (2) Targeted Energy Consumption; and
 - (3) Non-Targeted Energy Consumption;
- (b) the peak demand date and hour;
- (c) the Weather Data for that month, including the number of Heating Degree Days and Cooling Degree Days;
- (d) building occupancy; and
- (e) any other variable that affects the Energy Consumption relative to the energy model assumptions set out in Attachment 1 to this Appendix.

2. DESIGN AND CONSTRUCTION ENERGY GUARANTEES

2.1 Monitoring of Energy Consumption

For each School during the Test Period, Project Co and the Authority will monitor Energy Consumption in order to determine the Energy Consumption for the Test Period.

During the Test Period, the Authority and Project Co will cause operable windows to be and remain closed. Project Co shall equip operable windows with a means to prohibit opening (either locks on operable mechanisms, or removal of cranks, levers, or other means of opening such windows).

2.2 Adjustment to Energy Consumption

Within 2 years after Service Commencement, Project Co and the Authority will engage an Independent Energy Consultant to review Energy Consumption data gathered for each School during the Test Period and determine whether and to what extent the Targeted Energy Consumption should be adjusted based

on factors which, in the Independent Energy Consultant's professional opinion, are applicable, including actual climate conditions, occupancy, equipment use and Authority or School Board controlled effects during the Test Period that differ from the factors taken into account in the energy model assumptions set out in Attachment 1 to this Appendix. The adjusted Target Energy Consumption for the Test Period is referred to in this Appendix as the "**Adjusted Target Energy Consumption**". Project Co and the Authority will share equally in the cost of the Independent Energy Consultant.

2.3 Failure to Achieve Adjusted Target Energy Consumption

At each of the Schools, if the Energy Consumption for Targeted Energy Consumption during the Test Period exceeds the Adjusted Target Energy Consumption, then Project Co will do one of the following:

- (a) modify the School as required so that the annual Energy Consumption for Targeted Energy Consumption will not exceed the Adjusted Target Energy Consumption, subject to compliance with the Design and Construction Specifications and the approval of such modifications by the Authority, not to be unreasonably withheld or delayed; or
- (b) pay to the Authority (for each School) a lump sum amount that the Authority agrees, acting reasonably, represents the lesser of \$500,000 and the net present value of the cost to the Authority during the 30-year Operating Period of the amount by which Energy Consumption for Targeted Energy Consumption during the Test Period exceeds the Adjusted Target Energy Consumption, on the assumption that the excess in the Test Period will continue for the balance of the expected life of the School, and if this Section 2.3(b) is applied the provisions of Schedule 9 [Compensation on Termination] will be amended as necessary to ensure that the Authority will not, as a consequence of the application of this Section 2.3(b), face any additional liability upon early termination of this Agreement.

3. ENVIRONMENTAL CREDITS

3.1 Entitlement to Environmental Credits

Project Co will use commercially reasonable efforts to assist the Authority in achieving the maximum Environmental Credits available related to the Schools and their operation. The Authority will be entitled to any and all Environmental Credits. Over the term of the Project Agreement, where Project Co assists the Authority in achieving Environmental Credits, Project Co will be entitled to 50% of the value of the Environmental Credit.

ATTACHMENT 1**ENERGY MODEL ASSUMPTIONS****1. General Requirements of Energy Models And Simulations**

Project Co. will use one of the following eligible energy modelling software tools for each energy model (the “**Energy Model**”):

- (a) eQUEST;
- (b) Energy Plus;
- (c) DOE 2.1e;
- (d) EE4; or
- (e) IESVE.

Project Co will use a single energy modelling software for each School at all stages of the Project.

Project Co may:

- (a) use additional supplementary software tools, such as RetScreen or Excel, in conjunction with one of the above eligible energy modelling software tools; and
- (b) modify the underlying simulation code for the purposes of modeling systems and energy efficiency measures not managed by the modelling software, in which case Project Co will fully describe and justify any such changes to the Authority.

Project Co will retain an individual on the CaGBC Experienced Modellers List to prepare each Energy Model.

2. Energy Model Assumptions

Project Co will use the following energy model assumptions for each School to determine the Target Energy Consumption:

- (a) Take-Offs:
 - (1) Use interior wall dimensions for determining building areas. Wall heights will be full floor-to-floor height. Window areas will represent the total area of the rough opening.
- (b) Location and Weather Files:
 - (1) Set Saskatoon SK CWEC for facilities located in Saskatoon, Warman and Martensville, and Regina SK CWEC for facilities located in Regina, as the selected location and use the associated EE4 default weather files.

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- (c) Energy Unit Prices:
- (1) Electricity Consumption:
 - (2) Monthly Electricity Demand:
 - (3) Fuel Oil Consumption:
 - (4) Propane:
 - (5) Natural Gas:
- (d) Occupancy Load and Operating Schedules:
- (1) Define peak occupancy loads in accordance with Schedule 3 [Design and Construction Specifications]. Where a range of occupancy is stipulated, use the average value. Where Schedule 3 [Design and Construction Specifications] does not define peak occupancy, define peak occupancy loads in accordance with the default MNECB occupancy values, assigned by space type. Where the given space type does not exactly match an MNECB space type, select the MNECB space type that is most similar.
 - (2) Occupancy fractional schedules will be in accordance with the following:
 - (A) Classrooms, Learning Spaces and Child Care: shall follow MNECB Fractional Schedule 'D' Occupants.
 - (B) Gymnasias: shall follow MNECB Fractional Schedule 'I' Occupants.
 - (C) Resource Centres: shall follow MNECB Fractional Schedule 'C' Occupants.
 - (D) Arts/Science – General Spaces: shall follow MNECB Fractional Schedule 'D' Occupants.
 - (E) Area Arts/Science – Industrial Arts: shall follow MNECB Fractional Schedule 'D' Occupants.
 - (F) Administrative and Staff Spaces: shall follow MNECB Fractional Schedule 'A' Occupants.
- (e) Fan Schedules:
- (1) For all zones, fans schedules are to be set to “on” for all occupied hours (i.e. schedule value equals 100% for all occupied hours).
- (f) Cooling Thermostat Setpoint Schedules:

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- (1) Set cooling thermostat set-point schedules for all zones at 24°C unless otherwise specified in Schedule 3 [Design and Construction Specifications].
 - (2) If operative temperature defined by ASHRAE 55-2010 is used to provide comfort in lieu of Schedule 3 air temperatures, provide a clear explanation of the adjustment and zones affected, and confirm the same approach is applied to the LEED® reference building. Model zones without cooling based on a cooling thermostat set-point schedule set to 99°C for all hours.
 - (3) Where modeled zones contain spaces with different cooling set-points (based on the requirements set out in Schedule 3 [Design and Construction Specifications]), model the zone using the set-point for the space requiring the lowest set-point temperature.
 - (4) For the purposes of these simulations, “set-back” of cooling temperatures (e.g. during unoccupied hours) is permitted as defined in Schedule 3 [Design and Construction Specifications].
- (g) Heating Thermostat Set Point Schedules:
- (1) Set heating thermostat set-point schedules for all zones at 22°C unless otherwise specified in Schedule 3 [Design and Construction Specifications].
 - (2) If operative temperature defined by ASHRAE 55-2010 is used to provide comfort in lieu of Schedule 3 air temperatures, provide a clear explanation of the adjustment and zones affected, and confirm the same approach is applied to the LEED® reference building.
 - (3) Where modeled zones contain spaces with different heating set-points (based on the requirements set out in Schedule 3 [Design and Construction Specifications]), model the zone using the set-point for the space requiring the highest set-point temperature.
 - (4) For the purposes of these simulations, “set-back” of heating temperatures (e.g. during unoccupied hours) is permitted as defined in Schedule 3 [Design and Construction Specifications].
- (h) Lighting, Receptacle, and Service Water Heating (“SWH”) Schedules:
- (1) For all zones, set the lighting schedules to the best matching MNECB Schedule based on space function.
 - (2) Classrooms, Learning Spaces, and Child Care: Receptacles shall be assumed to require 5 W/m² of power and shall follow MNECB Fractional Operating Schedule ‘D’ Receptacles. Service water heating shall be assumed to require 65 W/person and shall follow MNECB Fractional Operating Schedule ‘D’ Hot Water.

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- (3) Gymnasias: Receptacles shall be assumed to require 1 W/m² of power and shall follow MNECB Fractional Operating Schedule 'I' Receptacles. Service water heating shall be assumed to require 90 W/person and shall follow MNECB Fractional Operating Schedule 'I' Hot Water.
 - (4) Resource Centres: Receptacles shall be assumed to require 1 W/m² of power and shall follow MNECB Fractional Operating Schedule 'C' Receptacles. Service water heating shall be assumed to require 90 W/person and shall follow MNECB Fractional Operating Schedule 'C' Hot Water.
 - (5) Arts/Science – General Spaces: Receptacles shall be assumed to require 5 W/m² of power and shall follow MNECB Fractional Operating Schedule 'D' Receptacles. Service water heating shall be assumed to require 65 W/person and shall follow MNECB Fractional Operating Schedule 'D' Hot Water.
 - (6) Arts/Science – Industrial Arts: Receptacles shall be assumed to require 10 W/m² of power and shall follow MNECB Fractional Operating Schedule 'D' Receptacles. Service water heating shall be assumed to require 100 W/person and shall follow MNECB Fractional Operating Schedule 'D' Hot Water.
 - (7) Administrative and Staff Support Spaces: Receptacles shall be assumed to require 10 W/m² of power and shall follow MNECB Fractional Operating Schedule 'A' Receptacles. Service water heating shall be assumed to require 90 W/person and shall follow MNECB Fractional Operating Schedule 'A' Hot Water.
- (i) Additional equipment Loads:
- (1) Where additional loads beyond the receptacle load densities estimated in Section 2(h) of this Attachment 1 are anticipated for equipment listed in the Design and Construction Specifications or Room Data Sheets (e.g. exterior lighting, server rooms, etc.) or for Project Co Procured Equipment and Furniture, use equipment information to model the effect of equipment on energy usage and, if the equipment is located within the conditioned building envelope, any effects on interior heat gain. Plug, non-regulated loads, or process loads for equipment located outside of the building envelope are to be calculated separately if not supported as an exterior load within the modelling environment. Any energy consumption or energy cost savings claimed for equipment, plug, non-regulated loads, or process loads, must be substantiated by comparison against a recognized third party standard, for example the most current ASHRAE 90.1 standard for exterior lighting or Energy Star Minimums for computer equipment. All annual energy consumption resulting from equipment loads are to be included in the model used to determine the Target Energy Consumption; these loads must be included in the model used to assess effects on Target Energy Consumption while not necessarily forming part of the Target Energy Consumption.

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- (2) Classrooms, Learning Spaces, and Child Care: Additional equipment shall follow MNECB Fractional Operating Schedule 'D' Receptacles.
 - (3) Gymnasias: Additional equipment shall follow MNECB Fractional Operating Schedule 'I' Receptacles.
 - (4) Resource Centres: Additional equipment shall follow MNECB Fractional Operating Schedule 'C' Receptacles.
 - (5) Arts/Science – General Spaces: Additional equipment shall follow MNECB Fractional Operating Schedule 'D' Receptacles.
 - (6) Area Arts/Science – Industrial Arts: Additional equipment shall follow MNECB Fractional Operating Schedule 'D' Receptacles.
 - (7) Administrative and Staff Spaces: Additional equipment shall follow MNECB Fractional Operating Schedule 'A' Receptacles.
- (j) Ventilation Rates:
- (1) The Design will comply with current ASHRAE 62 or superseding standard ventilation requirements as required.
 - (2) For the purposes of modeling LEED[®] energy performance, the ventilation rates will be the same in the proposed and reference cases except as follows. Designs that utilize ventilation rates in excess of the relevant standard (i.e. 20% or more above the required rates as defined in ASHRAE 62 or superseding standards) will be modeled with the energy penalty described in the most recent version of the "LEED[®] Canada 2009 Supplementary Energy Modelling Guidelines".
 - (3) Demand controlled ventilation (DCV) will only be used as an energy efficiency measure where permitted. Model designs using DCV in accordance with the CaGBC's most recent version of the "LEED[®] Canada 2009 Supplementary Energy Modelling Guidelines".
- (k) Windows, Glazing, Curtainwall and Spandrel Walls
- (1) In accordance NRCan's "Modeling Guide for EE4 Version 1.7" (February 2008)", the U-value for windows, glazing, curtainwall or spandrel walls must include the thermal bridging impacts of framing.
- (l) Motor Power:
- (1) Modelling of motors must be representative of the predicted power draw, run time, load conditions and performance efficiencies likely to be experienced throughout the year.
- (m) Fixed Parameters:

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- (1) lighting area factor (must be 1.00);
 - (2) desired winter temperature;
 - (3) desired summer temperature; and
 - (4) any EE4 inputs marked by the “non-compliance input” symbol (i.e. red circle and slash).

eQUEST or other software inputs will follow the same intent as EE4 fixed parameters.

(n) Miscellaneous Modeling Requirements:

- (1) Where redundant equipment capacity has been provided, only model or calculate for the number of pieces of equipment intended to operate under normal conditions.
- (2) For simulation purposes only, no zone is permitted to have unmet heating or cooling load hours in excess of 100 per year (excluding zones with no cooling requirements).
- (3) Operable windows will be simulated as closed at all times during the modeled year.

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