Zero Carbon Building – Design Version 4

Energy Modelling Guidelines

June 2024

1. INTRODUCTION

This document provides guidance for the energy modelling required to support Zero Carbon Building – Design (ZCB-Design) Standard™ certification. An energy model reflecting the chosen design must be prepared to demonstrate compliance with the requirements of the *ZCB-Design Standard v4*. A reference building energy model may also be required. The expectation is that energy models used for compliance to the *ZCB-Design Standard v4* will be developed to represent the actual anticipated operation of the facility for all energy uses on site. Stipulated conditions such as schedules, occupancy, receptacle loads, and domestic hot water loads shall be based on actual intended operational conditions for the facility in question. It is expected that the energy modelling professional will communicate with the client and facility operations staff to understand building operations as best as possible so that anticipated hours of operation and equipment run times are reflected in the energy model rather than relying on arbitrary defaults from software or applicable code or standards.

2. ENERGY MODELLING

2.1 General

The documentation submitted for ZCB-Design v4 certification must include sufficient detail to demonstrate the simulation process undertaken to arrive at the projected energy model results being claimed. Output files or detailed reports generated by the energy model software along with any spreadsheets for exceptional calculations conducted outside of the main energy model are also required. Further details on documentation requirements can be found in the *ZCB-Design v4 Workbook*.

Outputs from the chosen building energy model shall be used to calculate TEDI and populate the *ZCB-Design v4 Workbook*, which will automatically determine EUI, peak demand, and exported renewable energy.

2.1.1 Energy Modelling Software

The energy modelling software or simulation program shall be tested according to ASHRAE Standard 140 (except Sections 7 and 8). This includes, but is not limited to, DOE-2 based modelling programs (eQUEST, CanQUEST, Energy Pro, Visual DOE), IES, HAP, TRACE, EnergyGauge, and Energy Plus.

Software limitations shall not excuse the limitation of accuracy of energy modelling to show compliance with the Standard; consultants are expected to overcome any software limitations with appropriate engineering calculations. Modelling inputs not discussed in these guidelines shall follow accepted industry best practice.

2.1.2 Process Loads and Tenant Spaces

Process loads and tenant loads must be calculated based on reasonable estimates and included in the energy model. Canada's *National Energy Code of Canada for Buildings (NECB) 2020* Table A.8.4.3.2(2) should be followed where applicable if reasonable operational predictions are not obtainable.

A narrative and calculations with sufficient detail will be required to demonstrate how the tenant and/or process loads are derived.

2.2 Onsite Combustion Limit for Space Heating

The onsite combustion limit for space heating requirements must be demonstrated through energy modelling and/or relevant design information. The *ZCB-Design v4 Workbook* lists the following documentation requirements to satisfy the onsite combustion limit for space heating:

- All projects must include modelling outputs indicating the building and space heating loads.
- Projects with some onsite combustion for space heating must include:
  - For space heating technologies whose performance is directly affected by outdoor air temperature (e.g., air source heat pumps):
    - Calculations and/or documentation that verifies the non-combustion heating equipment can meet the maximum space heating load at an outdoor air temperature of -15 C (or the project's heating design outdoor air temperature, whichever is higher).
    - Sequence of operations ensuring that combustion equipment does not operate at or above -15 C.

  - For space heating technologies whose performance is not directly affected by outdoor air temperature (e.g., ground source heat pumps, electric resistance):
    - Calculations showing that the heating equipment satisfies the same fraction of the annual heating demand as a non-combustion-based system that is supported by onsite combustion at outdoor temperatures below -15 C (or the design temperature, whichever is higher).
    - Sequence of operations demonstrating how the different heating equipment is designed to operate.

2.3 Onsite Combustion Limit for Service Hot Water

The onsite combustion limit for service hot water requirements must be demonstrated through energy modelling and/or relevant design information. The *ZCB-Design v4 Workbook* lists the following documentation requirements to satisfy the onsite combustion limit for service hot water:

- Modelling outputs indicating the building and service water heating loads.
- Projects with some combustion for service hot water must include:
  - Calculations and/or documentation that verifies the system can meet the partial electrification requirements of the ZCB-Design v4 Standard:
    1. Service hot water is heated to at least 45 C without combustion; or,
    2. At least 70% of the service hot water annual heating load is provided without combustion.
  - Sequence of operations demonstrating that non-combustion service hot water heating equipment is designed to operate to the partial electrification requirements.

Projects with significant service hot water needs, other than multi-unit residential buildings or long-term care facilities, should refer to the ZCB Interpretation Database for guidance on whether a hybrid approach is permissible or contact CAGBC at zerocarbon@cagbc.org.

3. UNDERSTANDING AND CALCULATING ENERGY USE INTENSITY

Energy Use Intensity (EUI) is the sum of all site (not source) energy consumed on the project site (e.g., electricity, natural gas, district heat), including all process energy without accounting for any renewable energy generated onsite, divided by the building modelled floor area per year.

$$EUI\ \left[\frac{kWh}{m^2 year}\right] = \frac{\sum Site\ Energy\ Use\ [\mathrm{kWh/year}]}{Modelled\ Floor\ Area\ [m^2]}$$

This metric shall be based on direct outputs of the energy model, with required adjustments (such as exceptional calculations) clearly demonstrated. Energy use types and amounts must be entered into the *ZCB-Design v4 Workbook*, which will calculate the EUI of the building using the modelled floor area.

3.1 Energy Efficiency Approach 1: Flexible Approach

Projects pursuing Energy Efficiency Approach 1: Flexible Approach are required to demonstrate a minimum level of EUI performance. This may be demonstrated using a minimum improvement relative to a NECB 2020 reference building, or by achieving an EUI target. Refer to the ZCB-Design Standard v4 for more information on the paths and eligibility available under Approach 1: Flexible Approach.

3.1.1 Path 1: Improvement Against Reference Building

Projects meeting the EUI requirement by demonstrating a site EUI that is at least 25 percent better than Tier 1 of NECB 2020, without accounting for renewable energy, are required to produce a reference building energy model according to NECB 2020 Part 8, Building Energy Performance Compliance Path in addition to the chosen building energy model. The chosen building must demonstrate an EUI improvement when compared to the NECB 2020 reference building with the following additional conditions:

1. Apply supply air temperature reset controlled based on the warmest zone for VAV systems (NECB System 6) consistent with NECB 2020 Article 5.2.8.9.(1).
2. The reference building air leakage rate shall be the prescribed default rate stated below in section 4.2.4 Air Leakage.
3. The chosen building ventilation rates should be per design airflows. The reference building ventilation rates should be per design airflows unless these airflows are more than 5% than required by code. Where a project team has specified up to 5% more total ventilation air than required, code airflows should be used.
4. Where the chosen building uses more than one pump in a given hydronic system, the sum of the power for all pumps divided by the design flow to calculate the chosen building's pump power rate (W/(L/s)) shall be used to determine the pumping power for the reference case (rather than matching the peak shaft demand, in W, between the chosen and reference buildings).
5. Service hot water (SHW) savings can be claimed by modelling the reference building SHW rates using the rates in NECB 2020 section 6.2, which are listed in the table below. SHW rates in the chosen building energy model shall reflect the design.

Fixture Type	NECB 2020 SHW flow rate
Shower Heads	7.6 L/min
Lavatory (public)	1.9 L/min
Lavatory (private)	5.7 L/min
Kitchen Faucet	5.7 L/min

3.1.2 Path 2: Energy Use Intensity

Projects pursuing the EUI target path are required to produce a proposed building energy model. The proposed building EUI must not exceed the EUI targets established in Section 6.1.2 of the *ZCB-Design v4 Standard*.

Projects pursuing this path are not required to create a reference building energy model.

Mixed-use buildings may choose to meet either of the following EUI targets:

a. An area-weighted average of the EUI targets for each space type; or,
b. The EUI target of the predominant space type, provided the specified space type accounts for at least 75% of the building's modelled floor area.

4. UNDERSTANDING AND CALCULATING THERMAL ENERGY DEMAND INTENSITY (TEDI)

The use of a thermal energy demand intensity (TEDI) metric requires building designers to optimize building characteristics related directly to heating. Orientation, solar access, building envelope performance, and other passive design measures must be addressed to ensure a low TEDI. Efficient delivery and heat recovery of ventilation air are also captured by the TEDI metric and are measures that are most easily implemented in new construction and major renovations. Strategies to minimize TEDI should address both architectural and ventilation measures.

The methodology should be used in all cases to determine or calculate TEDI from energy models to ensure consistency, regardless of HVAC system type used. TEDI is intended to represent the heat delivered to the building, including any extra heat that may be required due to the use of inefficient HVAC systems (e.g., reheat energy in VAV systems). It also includes any heat provided by waste heat sources (e.g., recovered heat from cooling systems, waste heat supply from cogeneration, etc.) as part of the heating requirement of the building. The sequence of operations must demonstrate any heat or energy recovery defrost temperature to corroborate TEDI modelling.

$$TEDI\ \left[\frac{kWh}{m^2 year}\right] = \frac{\sum Space\ and\ Ventilation\ Heating\ Output\ \left[\frac{kWh}{year}\right]}{Modelled\ Floor\ Area\ [m^2]}$$

When measured with modelling software, TEDI is the amount of heating energy delivered to the project that is outputted from any and all types of heating equipment, per unit of Modelled Floor Area. Heating equipment includes:

- Electric, gas, hot water, or DX heating coils of central air systems (e.g., make-up air units, air handling units, etc.);
- Terminal equipment (e.g., baseboards, fan coils, heat pumps, VRF terminals, reheat coils, etc.), and/or;
- Any other equipment used for the purposes of space conditioning and ventilation.

The heating output of any heating equipment that uses a source of heat that is not directly provided by a utility (electricity, gas or district) must still be counted towards the TEDI.

For example, heating from heating coils of any type that use a heat source derived from waste heat (e.g., from a cooling system or process such as a heat pump or VRF terminal unit, cogeneration waste heat that serves a building hot water loop connected to those heating coils) or a renewable energy source (e.g., solar thermal hot water collectors) must still be counted towards the TEDI. Humidification is excluded from the TEDI calculation.

While every type of software has different reporting features, TEDI can be calculated by summing up the heating output of all the heating coils in the building. Below are some methodologies to determine TEDI when using some commonly used programs:

- IESVE: Instructions to calculate TEDI can be found in the IES Support section online.
- eQUEST: Heating loads can be summed up using the “SS-D Building HVAC Load Summary” report.
- EnergyPlus: The total building heating load is available via the following output from the HTML Output file: “Energy Meters” report > “Annual and Peak Values – Other” > “HeatingCoils:EnergyTransfer” and “Baseboard:EnergyTransfer”.

Specific examples of heating energy that would not be included in the TEDI calculation include, but are not limited to:

- Maintaining swimming pool water temperatures;
- Outdoor comfort heating (e.g., patio heaters, exterior fireplaces);
- Humidification;
- Gas-fired appliances (stoves, dryers); and
- Heat tracing.

The *ZCB-Design v4 Workbook* lists the following TEDI documentation requirements:

- Calculations for the TEDI performance of the building and a narrative explaining the calculations, including data reports from the energy model.
- A narrative describing how TEDI has been reduced including how building heating loads have been reduced using heat recovery strategies and/or passive design strategies.
- Sequence of operations demonstrating any heat or energy recovery defrost temperature to corroborate TEDI modelling.

4.1 Internal Heat Gains

Incidental heat gains from lighting, receptacle loads, pumps, fans etc. shall be included in the energy model and reflect the design of the building. Operational schedules for these incidental heat gains should reasonably reflect the expected operations of the building and should be developed in consultation with the building owner and/or operator. This effectively means that these internal heat gains become credits in the TEDI that will automatically be calculated by the energy modelling software.

4.2 Calculating Building Envelope Heat Loss

The *ZCB-Design Standard v4* requires buildings to achieve a specific performance limit in TEDI, which is primarily a representation of the annual heating load required to offset envelope heat loss and ventilation loads. Choosing TEDI as a target helps to encourage energy efficient building envelopes.

Project teams must adhere to NECB 2020 for calculating building envelope heat loss. Building envelope thermal bridging elements that can have a significant impact on heat loss and have historically been underestimated or unaccounted for include:

- Assemblies with thermal bridging elements that are not quantified by codes or standards, such as those with various types of cladding attachments (girts, clips, etc.) and spandrel panels;
- Floor slab thermal bridges, including balcony slabs, window wall slab by-pass and connection details, shelf angles, etc.;
- Window to wall transitions;
- Parapets;
- Corners and interior wall intersection details;
- At-grade transition details; and
- Structural penetrations.

With the recent addition of industry resources that support more efficient and accurate calculations of building envelope heat loss[1], assemblies and associated thermal bridging elements must be accurately quantified for the purposes of complying with the Standard, according to the requirements below.

4.2.1 Opaque Assemblies

The overall thermal transmittance of opaque building assemblies shall account for the heat loss of both the Clear Field performance, as well as the heat loss from Interface Details. Additional heat loss from Interface Details is to be incorporated in the modelled assembly U-values, according to the provisions below.

Overall opaque assembly U-values can be determined using any of or a combination of the following hierarchy of approaches:

a. Using the performance data for Clear Fields and Interface Details from the Building Envelope Thermal Bridging Guide (BETBG), and the calculation methodology as outlined in 3.4 of the BETBG. A detailed example is provided in section 5 of the BETBG and a supporting calculation spreadsheet is available from bchydro.com/construction, titled “Enhanced thermal performance spreadsheet”;
b. Using the performance data for Clear Field and Interface Details from other reliable resources such as ASHRAE 90.1-2022, Appendix A, ISO 14683 Thermal bridges in building construction – Linear thermal transmittance – Simplified Methods and default values, with the methodology described above in a;
c. Calculations, carried out using the data and procedures described in the ASHRAE Handbook – Fundamentals;
d. Two- or three-dimensional thermal modelling, or;
e. Laboratory tests performed in accordance with ASTM C 1363, “Thermal Performance of Building materials and Envelope Assemblies by Means of a Hot Box Apparatus,” using an average temperature of 24±1°C and a temperature difference of 22±1°C.

Except where it can be proven to be insignificant (see below), the calculation of the overall thermal transmittance of opaque building envelope assemblies shall include the following thermal bridging effect elements:

- Closely spaced repetitive structural members, such as studs and joists, and of ancillary members, such as lintels, sills and plates;
- Major structural penetrations, such as floor slabs, beams, girders, columns, curbs or structural penetrations on roofs and ornamentation or appendages that substantially or completely penetrate the insulation layer;
- The interface junctions between building envelope assembles such as: roof to wall junctions and glazing to wall or roof junctions;
- Cladding structural attachments including shelf angles, girts, clips, fasteners, and brick ties; and
- The edge of walls or floors that intersect the building enclosure that substantially or completely penetrate the insulation layer.

[1] See, for example, the Building Envelope Thermal Bridging Guide (BETBG), Version 1.4. https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/business/programs/BETB-Building-Envelope-Thermal-Bridging-Guide-v1-4.pdf

The following items need not be taken into account in the calculation of the overall thermal transmittance of opaque building envelope assemblies:

- Mechanical penetrations, such as pipes, ducts, equipment with through-the-wall venting, packaged terminal air conditioners or heat pumps;
- The impact of remaining small unaccounted for thermal bridges where the expected cumulative heat transfer though these thermal bridges is so low that the effect does not change the overall thermal transmittance of the above grade opaque building envelope by more than 10%.

4.2.2 Fenestration and Doors

The overall thermal transmittance of fenestration and doors shall be modelled according to their intended actual performance, including the impact of framing for the actual or anticipated window sizes used in the design. The general approach for determining performance shall be in accordance with National Fenestration Rating Council (NFRC) 100, “Determining Fenestration Product U-factors”, with the following limitations:

- The thermal transmittance for fenestration shall be based on the actual area of the windows and not the standard NRFC 100 size for the applicable product type. It is acceptable to area-weight the modelled fenestration U-value based on the relative proportions of fixed and operable windows and window sizes. It is also acceptable to simplify the calculations by assuming the worst case by using the highest window U-value for all fenestration specified on the project.

- If the fenestration or door product is not covered by NFRC 100, the overall thermal transmittance shall be based on calculations carried out using the procedures described in the ASHRAE Handbook – Fundamentals, or Laboratory tests performed in accordance with ASTM C 1363, “Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus,” using an indoor air temperature of 21±1 C and an outdoor air temperature of -18±1 C measured at the mid-height of the fenestration or door.

4.2.3 Additions and Attached Buildings

Projects with physically attached buildings, such as an addition to an existing structure, should model the physical connections, such as walls, as adiabatic.

4.2.4 Air leakage

Infiltration shall be modelled at 0.25 L/s/m² or 0.05 cfm/ft² of total above-ground gross wall area (i.e., walls and windows). This default infiltration rate is intended to be representative of a 5 Pa pressure differential across the assembly.

The use of a value lower than the above default rate – a targeted air leakage rate – is permitted but must be substantiated. In this case, two proposed building energy models, one using the default air leakage rate and one using the targeted air leakage rate, are required. Refer to the *ZCB-Design v4 Workbook* for a list of documentation requirements.

If the targeted air leakage rate is not at a pressure differential of 5 Pa, it must be converted to 5 Pa for comparison with the default rate. Projects should use the methodology from NECB 2020 Article 8.4.2.9 provided below if the targeted air leakage rate is at a pressure differential of 75 Pa. Other conversions are allowable using suitable engineering calculations.

NECB Article 8.4.2.9. Air Leakage

[1] The energy model calculations shall account for air leakage through the *building envelope*.
[2] The air leakage rate of the *building envelope* shall be adjusted using the following equation:

$$I_{AGW} = C \times I_{75Pa} \times \frac{S}{A_{AGW}}$$

where

I_{AGW} = adjusted air leakage rate of the *building envelope* at a typical operating pressure differential of 5 Pa and relative to the area of the above-ground walls, in L/(s·m^2),

C = (5 Pa / 75 Pa)^n, where n = flow exponent, which shall be 0.60, if no whole *building* test result is available, or the calculated value, if whole *building* testing is carried out in accordance with Article 3.2.4.2. and a series of tests are conducted at different differential pressures,

I_{75Pa} = assumed or measured normalized air leakage rate of the *building envelope* at a pressure differential of 75 Pa, in L/(s·m^2),

where the measured air leakage rate at a pressure differential of 75 Pa is calculated as I_{75Pa} = Q/S,

where Q = volume of air flowing through the *building envelope* when subjected to a pressure differential of 75 Pa, determined in accordance with ASTM E 779, "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization," in L/s, *(Note by CAGBC: ZCB-Performance uses ASTM E 3158-18 "Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building" which is a more recent version of ASTM E 779 and may be used instead),* and

S = total area of the *building envelope*, as per Sentence 3.2.4.2.(1), in m^2, and

A_{AGW} = total area of above-ground walls, in m^2.

4.3 Energy Efficiency Approach 1: Flexible Approach

4.3.1 Path 1: No Onsite Combustion

Projects located in climate zone 4, 5, or 6, must demonstrate that the seasonal coefficient of performance (SCOP) of space heating is at least 2 to be eligible for the No Onsite Combustion path. This path requires all projects use non-combustion-based technologies for all space heating. Projects that meet these requirements are not required to meet a TEDI target. TEDI must still be reported.

SCOP of space heating is calculated by dividing the total annual space heating load of the building by the total annual energy usage of space heating equipment, as determined by good energy modelling practices. This calculation could be based on hourly modelling analysis.

$$SCOP_{Space\ Heating} = \frac{Total\ Modelled\ Annual\ Space\ Heating\ Load\ of\ the\ Building\ [ekWh]}{Total\ Modelled\ Annual\ Energy\ Use\ for\ Space\ Heating\ [ekWh]}$$

Projects should follow good energy modelling practices to determine the SCOP of space heating, which includes considerations such as:

- Equipment performance curves for part loads: Although the equipment performance curves for part-load are inherently accounted for in the energy model and guidelines, projects should ensure it is accounted for and follow best modelling practices.

- Simultaneous heating and cooling: In buildings where equipment serves both heating and cooling needs, such as with heat pumps or integrated HVAC systems, it is crucial to accurately model the seasonal performance. The model should reflect realistic operational profiles, including periods of simultaneous heating and cooling demand within the building, to accurately capture the system's performance across different seasons and operational scenarios. When the equipment operates in both modes simultaneously, energy modellers should apply good energy modelling practices to allocate energy consumption between heating and cooling. This could involve allocation based on demand proportion or operational hours attributed to each mode.

4.3.2 Path 2: ZCB-Design TEDI Target

Projects pursuing a TEDI target are required to produce a proposed building energy model. The proposed building TEDI must not exceed the TEDI targets established in section 6.1.1 Path 2: ZCB-Design TEDI Target of *ZCB-Design Standard v4*.

Projects pursuing this path are not required to create a reference building energy model.

4.3.3 Path 3: Adjusted TEDI Target

This methodology shall be used for projects pursuing an adjusted TEDI target, which is determined by area-weighting the TEDI requirements as follows:

a. Identify all spaces with unique heating/ventilation loads. Model an NECB 2020 reference building for the spaces based on all applicable prescriptive requirements of NECB 2020 sections 3.2, 4.2, 5.2, 6.2, and 7.2. Extract the reference building TEDI(s).

   Note that the reference building assemblies shall not exceed the overall thermal transmittance values (U-values) of the NECB 2020 (Tables 3.2.2.2-4. and 3.2.3.1). As indicated in Note A-8.4.4.4.(1) of NECB 2020, “The building envelope assemblies should follow the layer structure of the proposed building's assemblies (type and order), but the insulation thickness should be varied to match the U-value of Part 3”. To determine the reference building U-value, NECB 2020 Tables 3.2.2.2, 3.2.2.3, 3.2.2.4, and 3.2.3.1 must be used, which already take into account thermal bridging factors. For further guidance, refer to section 6 “Inputting Thermal Values into Energy Models” of the Building Envelope Thermal Bridging Guide, which is a listed resource in the ZCB-Design Standard v4.

b. Determine the ZCB-Design TEDI target for the remaining spaces.

c. The adjusted TEDI target shall be based on the floor area-weighted average of the NECB 2020 reference building TEDI value(s) and the ZCB-Design TEDI target value. The *ZCB-Design v4 Workbook* will calculate the adjusted TEDI target using values from (a) and (b) above.

Refer to section 6.1.1 Path 3: Adjusted TEDI Target of *ZCB-Design Standard v4* for all requirements that must be met under this path.

<u>Example of adjusted TEDI target calculation:</u>

A building of 1,100 m^2 located in climate zone 5, comprised of 1,000 m^2 of office space and 100 m^2 of commercial kitchen space.

a. Modelled NECB 2020 reference building TEDI for commercial kitchen: 55 ekWh/m^2/yr
b. ZCB-Design TEDI target for climate zone 5: 32 ekWh/m^2/yr
c. Adjusted TEDI target for entire building:

$$TEDIadjusted = \frac{\sum(\,TEDI\ [\mathrm{ekWh}/m^2 year]\ \times Modelled\ Floor\ Area\ [m^2]\,)}{Total\ Modelled\ Floor\ Area\ [m^2]}$$

$$TEDIadjusted = \frac{55\,\frac{ekWh}{m^2 year} \times 100\ m^2 + 32\ \frac{ekWh}{m^2 year} \times 1000\ m^2}{1100\ m^2}$$

$$TEDIadjusted = 34\,\frac{\mathrm{ekWh}}{m^2}/\mathrm{year}$$

4.3.4 Path 4: Detailed TEDI Analysis

Projects pursing the Detailed TEDI Analysis path are required to produce a proposed building energy model. As noted in the Standard, building assemblies in the proposed building energy model shall not exceed the overall thermal transmittance values (U-values) of NECB 2020 (Tables 3.2.2.2, 3.2.2.3, 3.2.2.4, and 3.2.3.1).

Projects pursuing this path are not required to create a reference building energy model.

Projects must also include a report to demonstrate the main elements contributing to TEDI and the aggressive strategies used to minimize TEDI. Refer to section 6.1.1 Path 4: Detailed TEDI Analysis of *ZCB-Design Standard v4* for all requirements that must be met under this path, including the reporting requirements.

4.4 Energy Efficiency Approach 2: Passive Design Approach

4.4.1 Passive Design Approach TEDI Target

Projects pursuing a lower TEDI target are required to produce a chosen building energy model. The chosen building TEDI must not exceed the TEDI targets established in section 6.2.1 TEDI Requirements of *ZCB-Design Standard v4*.

Projects pursuing this path are not required to create a reference building energy model.

4.5 Energy Efficiency Approach 3: Renewable Energy Approach

4.5.1 Renewable Energy Approach TEDI Target

Projects pursuing the Renewable Energy Approach are required to produce a chosen building energy model. The proposed building TEDI must not exceed the TEDI targets established in section 6.3.1 TEDI Requirements of *ZCB-Design Standard v4*.

Projects pursuing this path are not required to create a reference building energy model.

5. ADDITIONAL CALCULATION AND REPORTING GUIDANCE

5.1 Climate Zone Selection

Projects have some flexibility in selecting their climate zone, but it must be consistent with the project's basis of design.

Project teams may determine HDD based on the local building code (authority having jurisdiction), the latest CWEC weather file from the location closest to the project site, or location most representative of the annual weather conditions.

Project teams must report the weather file that is used in the basis of design in the *ZCB-Design v4 Workbook.*

NECB 2020 Table 3.2.2.2 specifies the following ranges of HDD taken at 18 C applicable to each climate zone:

- Zone 4: < 3000
- Zone 5: 3000 to 3999
- Zone 6: 4000 to 4999
- Zone 7A: 5000 to 5999
- Zone 7B: 6000 to 6999
- Zone 8: ≥ 7000

5.2 Grid Citizenship

5.2.1 Peak Demand Reporting

The modelled summer and winter peak demand of the building, including dates and times will be automatically derived in the *ZCB-Design v4 Workbook* based on the hourly electricity data entered.

Refer to section 9 Grid Citizenship of *ZCB-Design Standard v4* for additional information.

5.2.2 Impact and Innovation Strategies

1. Reduce peak electrical demand by 10% using onsite renewables and/or energy storage.

   This strategy may be based on exceptional calculations, requiring two hourly electrical profiles to be created. One load profile with the applicable peak demand reduction measure(s), and the second load profile without the demand reduction measure(s). Projects may choose to demonstrate the 10% has been met by demonstrating a 10% peak electrical demand reduction relative to a reference building without onsite renewables and/or energy storage.

   Refer to the section 5.3 Renewable Energy of this document for additional guidance.

2. Reduce annual peak electrical demand to achieve a target of no more than 18 W/m^2 of gross floor area for warehouses and distribution centres (except cold storage), or 30 W/m^2 for all other buildings.

   Peak electrical demand intensity will be automatically calculated in the *ZCB-Design v4 Workbook* using the modelled summer and winter peak demand on the building based on the hourly electricity data entered.

5.3 Renewable Energy

Renewable energy can be determined using one of the following methods:

1. If the building simulation program is capable of modelling the on-site renewable energy, then those systems can be modelled directly within the design building energy model.
2. If the building simulation program is not capable of modelling the renewable systems, or the modeller prefers to use different software, those systems can be modelled using a renewable energy system model provided that the weather data is consistent with the building simulation.
3. Hourly renewable electricity generation (green power) must be entered into the *ZCB-Design v4 Workbook*.

Refer to section 3.2.2.2 Owned Renewable Energy Systems of *ZCB-Design Standard v4* for additional information.

5.3.1 Exported Green Power

Exported green power will be automatically calculated in the *ZCB-Design v4 Workbook* using the hourly electricity use and green power (renewable electricity) generation values entered.

Refer to section 3.3.1 Exported Green Power of *ZCB-Design Standard v4* for additional information.

GLOSSARY

Clear Field*:* An opaque wall or roof assembly with uniformly distributed thermal bridges, which are not practical to account for on an individual basis for U-value calculations. Examples of thermal bridging included in the Clear Field are brick ties, girts supporting cladding, and studs. The heat loss associated with a Clear Field assembly is represented by a U-value (heat loss per unit area).

Design Flow: The supply fluid from heating or cooling source to all heat transfer devices (e.g., coils and heat exchangers) at design conditions.

Energy use intensity (EUI): The sum of all **site energy** (not source energy) consumed on site (e.g., electricity, natural gas, district heat), including all process loads, divided by the building **modelled floor area**.

Exported green power: Any **green power** that is generated onsite in excess of the building's electricity use at a given time-step.

Green power: Electricity generated from renewable resources, such as solar, wind, geothermal, low-impact biomass, and low-impact hydro resources. **Green power** is a subset of renewable energy but does not include renewable energy systems that do not produce electricity, such as solar thermal systems.

Gross floor area (GFA): Consistent with ASHRAE & LEED, the gross floor area is the sum of the floor areas of all enclosed spaces inside the building. Measurements must include walls and therefore must be taken from the exterior faces of exterior walls. Enclosed parking and access roads are excluded, as are air shafts, pipe trenches, chimneys, and penthouse spaces with headroom height of less than 2.2 meters (7.5 feet).

Interface Details: Thermal bridging related to the details at the intersection of building envelope assemblies and/or structural components. Interface details interrupt the uniformity of a clear field assembly and the additional heat loss associated with interface details can be accounted for by linear and point thermal transmittances (heat loss per unit length or heat loss per occurrence).

Modelled floor area (MFA): The total enclosed floor area of the building, as reported by the energy simulation software, excluding exterior areas and indoor (including underground) parking areas. All other spaces, including partially conditioned and unconditioned spaces, are included in the MFA.

Peak demand: The building's highest electrical load requirement on the grid, measured and reported in kW, reflecting any peak shaving impacts from demand management strategies including onsite renewable energy and energy storage.

Seasonal coefficient of performance (SCOP): A measure of system efficiency calculated by dividing the annual heating load of the building by the annual energy use for space heating.

Service hot water: Heating water for domestic or commercial purposes other than space heating and process application requirements.

Site energy: The amount of energy used on the building site.

Thermal energy demand intensity (TEDI): The annual heat loss from a building's envelope and ventilation after accounting for all passive heat gains and losses, per unit of **modelled floor area**.