

****The content below will be incorporated into the City of Vancouver Energy Modelling Guidelines in 2024. This temporary document is to provide modelling guidance until this time but it is not yet an official Guideline. Please send any questions to Green.Buildings@vancouver.ca****

1. Guidelines for Residential Buildings of 1-3 Storeys and Houses

The City of Vancouver Building By-law (VBBL) Section 10.2.1.5 outlines the energy compliance requirements for the construction of *Residential Buildings of 1-3 Storeys and Houses (excluding Hotels/Motels)*, within the City of Vancouver, including requirements for energy modelling and documentation submittals in Section 10.2.2.20.

The building types covered by this guideline include (but are not limited to) one- and two- family homes, townhomes, row homes, laneway homes, secondary suites and one to three storey stacked multi-family buildings.

1.1. Energy Compliance Pathways

As of January 1st, 2022, there are three pathways for code compliance. For more information on the VBBL pathways for Residential 1-3 Storey Residential Buildings and required modelling documentation, please see the Guide to the Vancouver Building By-law 2022 Update¹ and the New Homes Energy Checklists.²

2. Accepted Energy Models

Unless otherwise specified in these guidelines, modelling conditions will be based on the following:

- (for EnerGuide eligible projects) *EnerGuide Rating System (ERS) Technical Procedures Version 15.10 or later*;
- (for projects using hourly modelling software) *Part 8 of NECB and the City of Vancouver Energy Modelling Guidelines*.
- (for projects pursuing Passive House Certification) *Passive House Standard and PHPP manual*.

2.1. EnerGuide Rating System and HOT2000

For the purposes of the required Code documentation and checklists, ERS modellers must be registered Energy Advisors with NRCan and adhere to all requirements in the technical documentation, including for energy modelling, site verification and data collection, to obtain an EnerGuide rating. For Code compliance for the prescriptive and performance paths, buildings must obtain an EnerGuide rating where *eligible*.

2.1.1. Modelling Buildings Outside of ERS Eligibility

Some buildings that meet the ‘Residential Buildings 1 to 3 storeys’ definition under VBBL Section 10.2.1.5. may fall outside of the ERS program eligibility, and therefore are unable to obtain an official ERS rating.

For compliance purposes within VBBL these special cases can be modelled using hourly modelling software (described below), or they can be modelled using HOT2000 under “General Mode”,

¹ <https://vancouver.ca/files/cov/building-by-law-update-guide.pdf>

² <https://vancouver.ca/files/cov/new-homes-energy-checklist-2022.XLSM>

following additional procedures noted in this document, to obtain the necessary building energy use and GHG emissions information as required to meet the intent of the Code.

2.2. Hourly Modelling Software

Other modelling software and approaches can be used for Residential Part 9 and Part 3 Code compliance, including more robust hourly modelling programs. If hourly modelling software is used, modellers must follow the applicable requirements of Part 8 of the *National Energy Code for Buildings* and the *City of Vancouver Energy Modelling Guidelines*, supplemented by additional information provided here, such as the calculation for MEUI values.

2.3. Passive House Modelling

Projects pursuing Passive House Certification that utilize Passive House Planning Package (PHPP) software will follow the modelling requirements of the Passive House Standard and PHPP manual. Any modelling approaches or supplemental calculations not covered in these official Passive House documents should be confirmed by a Passive House Certifier.

Projects seeking Passive House Certification must still fill out the relevant City of Vancouver energy checklists for permit submissions to demonstrate compliance with the Code.

2.4. Large Homes – Additional Modelling Requirements

For large homes with only one principal dwelling (i.e. with or without a secondary suite, but not a duplex) that exceed 325m² of conditioned floor area, the Code requires additional modelling to show these homes will not exceed a total annual GHG emissions cap (tonnes CO₂/year) referenced in the Code.

Additional mandatory requirements and modelling requirements for these buildings are outlined in the *City of Vancouver Modelling Guidelines for Large Homes*³. This document and its associated *GHG Calculator* include procedures for accounting for GHG emissions from non-typical loads that are not covered by ERS. This includes pools, secondary cooking areas, outdoor natural gas heaters/fireplaces, ice melt systems and other systems.

3. Performance Targets

For projects following the performance path, the TEDI, MEUI and GHGI must be calculated. For the majority of buildings using ERS, the performance targets can be obtained from HOT2000 as follows:

Metric	Modelling Procedure
Conditioned Floor Area (CFA)	For determining the floor area to be used to calculate all other metrics, follow <i>ERS Technical Procedures</i> 3.5.1.6 Heated floor area (above grade and below grade)

³ <https://vancouver.ca/files/cov/building-by-law-update-guide.pdf>
HYPER

Thermal Energy Demand Intensity (TEDI)	Hot2000 ERS Mode: <ALT + c> or Reports/Calculate; see Code Compliance Tab. (Note: adjusted TEDI is not applicable in the City of Vancouver)
Mechanical Energy Use Intensity (MEUI)	Hot2000 ERS Mode: <ALT + c> or Reports/Calculate; see Code Compliance Tab
Greenhouse Gas Intensity (GHGI)	Hot2000 ERS Mode: <ALT + c> or Reports/Calculate; Get GROSS electricity and NG GJ consumption and put into COV checklist to be calculated
Total Greenhouse Gas (GHG) Emissions (Large Homes only)	Model and determine total building energy use by fuel source and non-typical loads separately, as per <i>CoV Modelling Guidelines for Large Homes</i> . Input into the <i>GHG calculator</i> in the <i>CoV New Homes Checklist</i> .

For additional background information on calculating these metrics manually, please see the instruction manual for Energy Advisors from the BC Energy Step Code Part 9 Tools website⁴.

Note, the emissions factors used to calculate GHGI and GHG emissions may differ between VBBL, the BC Energy Step Code and HOT2000. For calculating GHG/GHGI for VBBL projects, the emission factors from the Vancouver Energy Modelling Guidelines and the Checklists must be used.

3.1. Mechanical Energy Use Intensity (MEUI)

Mechanical Energy Use Intensity (MEUI) is a measure of the annual energy consumption, for the building’s mechanical systems only, including space heating and cooling, fans, pumps, other ventilation equipment, domestic hot water and other auxiliary HVAC equipment, divided by the Modelled Heated Floor Area. This does not include any electrical energy use from plug loads, lighting, or other equipment, including any onsite renewable electrical generation.

$$MEUI \left[\frac{kWh}{m^2 a} \right] = \frac{\sum \text{Mechanical Energy Use} - \text{Baseloads} \left[\frac{kWh}{a} \right]}{\text{Modelled Heated Floor Area} [m^2]}$$

MEUI shall be reported in kWh/m²a, where a represents a year

3.2. Modelling Approach for Typical Building Types

The performance targets in Article 10.2.2.5 are based on the BC Energy Step Code (BCESC) targets in Climate Zone 4. As the BCESC targets are based on whole building modelling, some building typologies will need to use BCESC checklists to aggregate modelling results and obtain a whole building rating.

Building Type	Modelling Procedure
1&2 Family Homes (with or without suites)	Model each primary dwelling unit with its corresponding secondary or lock-off suite, per <i>ERS Technical Procedures</i> . The TEDI and MEUI values are inputted directly, and the energy consumption results are inputted to obtain the GHGI.

⁴ <https://energystepcode.ca/compliance-tools-part9/>

Townhomes and Rowhomes (Non-stacked)	Model all connected townhouse units separately in Hot2000 in ERS Mode and combine results using the “Attached non-MURB Calculator” tab in the <i>BC Energy Step Code Compliance Report Calculator</i> to record the whole-building TEDI and MEUI values. GHGI targets would need to be calculated separately using the aggregated energy consumption results using the CoV Energy Checklists (that uses emission factors from the CoV Modelling Guidelines)
MURBs and Stacked Townhomes	Model as a whole building to compare to TEDI, MEUI and GHGI targets and not per individual unit, as these metrics were developed and tailored toward whole building targets. See <i>ERS Technical Procedures Version 15.10 - 3.5.1.10 Multi-unit residential building types</i>
> 600 m ² building area	Comply with Table 10.2.2.5.A1 Group C occupancies in buildings up to 6 Storeys, except Hotel and Motel
Sloped building sites	Follow EnerGuide assessment of number of storeys: see <i>ERS Technical Procedures Version 15.10 - 1.2 Eligible housing types</i> ; as for average height above/below grade see EnerGuide Rating System Technical Procedures Version 15.10 - 3.5.9.1 Foundation walls – Geometry data collection requirements
Buildings partially over parkades	Buildings located above a heated or unheated parking garage, model the garage’s ceiling as an exposed floor as per <i>ERS Technical Procedures Version 15.10 - 3.5.8 Foundations</i>

4. Standard Assumptions for Building Components

4.1. Air Tightness Input values

Air tightness is a critical value to determine for energy performance. For initial modelling, the applicable value in VBBL Table 10.2.2.21. must be assumed as this is the maximum allowable by the Code. If the project is pursuing Net Zero, or other higher standards, the required target of that Standard must be assumed.

4.2. Multiple Heating Systems with Combustion (e.g. ‘dual-fuel’ or ‘hybrid’)

Due to several considerations, including the variability of thermostat use, heating system control strategies and limitations with HOT2000, energy advisors must model the highest-emitting (typically gas) system without a back-up heating system. This includes projects that propose a heat pump with gas backup system. In this case, only the gas-based system must be modelled; do not include the heat pump. This deviates from ERS and therefore two Hot2000 files need to be generated, one for compliance with the Code and one for compliance with ERS.

5. Additional Modelling Considerations

Programs such as ERS and energy simulation software like HOT2000 are primarily intended to be used as analysis tools for energy compliance. The following items highlight considerations of using these programs in additional analyses that are not required for energy compliance in the Code.

5.1. Mechanical Sizing

HOT2000 outputs can provide estimates based on CSA F280 standard for mechanical equipment sizing based on the peak design heating and cooling loads from the modelling. However, as stated in the *ERS Technical Procedures*, it will still be the responsibility of the equipment installer to ensure the proper sizing calculations are performed as per industry standards and Code requirements.

5.2. Cooling and Overheating

Section 4 of the *CoV Energy Modelling Guidelines* sets out the requirements for assessing overheating in Part 3 buildings that do not have mechanical cooling. This method requires determining hourly indoor air temperatures to calculate the number of overheated hours based on the ASHRAE 55 80% acceptability limits for naturally conditioned spaces.

For Residential Part 9 buildings, there are limitations as to the degree of analysis from typical programs used for modelling, such as HOT2000 and PHPP. These programs use monthly averages for energy calculations and are not based on hourly simulations. Similarly, they assume a whole building average for interior conditions and cannot provide a direct zonal analysis within the building (other than peak loads in a by room-by-room analysis). As a result, these programs cannot provide a thorough assessment of overheating risks as per Section 4 of the *CoV Energy Modelling Guidelines*.

Section 4 of the *CoV Energy Modelling Guidelines* is not intended to apply to Residential Part 9 projects, and it is currently understood that most of these projects do not have the capability to conduct hourly modelling. If a building will be known to house vulnerable occupants (such as seniors, supportive housing etc), it is strongly recommended to provide a mechanical cooling system. If not, then a more thorough overheating analysis via hourly modelling should be conducted.

Note: PHPP does provide an estimate of the number of overheated hours, and version 10 of the software has an integrated “summer stress test”. However, this is still an estimate based on average monthly temperatures and should not be relied upon solely to determine if cooling is or is not necessary.

6. Limitations and Assumptions

Other than building types, HOT2000 can also be limited for modelling specific types of building components or combined systems. NRCan has created an *ERS Workaround and Conversion Guide*, which address some of these limitations, however this is primarily dealing with HOT2000 error messages and there are system designs where there are no official procedures adopted by NRCan for the ERS program for their characterization within HOT2000. Within HOT2000 there are numerous assumptions, performance curves and system usages that are integrated within the program that cannot be adjusted. These assumptions may not always align with the intent of the Code.

7. Reference Information

A number of documents are referenced throughout this guideline. These documents are subject to updates with their associated certification programs. While this document references specific versions, for ERS or Passive House, ensure the most up to date versions are used unless explicitly stated otherwise.

Reference Document	Link	Notes
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CoV Building By-law Update Guide	https://vancouver.ca/files/cov/building-by-law-update-guide.pdf	Background information on Residential Part 9 energy compliance pathways for VBBL
CoV Guidelines and Resources for Homes	https://vancouver.ca/home-property-development/energy-efficiency-requirements-and-resources-for-homes.aspx	Contains additional information and checklists for modelling for Residential Part 9 buildings
ERS Standard v15.10	OEE Housing Program Members Only Resource Centre	Access requires an Energy Advisor account and login; however, materials can be requested directly from NRCan: nrcan.homes-maisons.rncan@canada.ca
ERS Administrative Procedures v15.10		
ERS Technical Procedures v15.10		
ERS Hot2000 User Guide v15.10		
ERS Workaround and Conversion Guide v15.10		
ERS Quality Assurance Procedure v15.10		
ERS Rule Sets Reference Document v15.10		
Hot2000 Online Climate Maps		
Passive House PHPP Manual v.10		
Passive House Design and Supplemental Tools	https://passipedia.org/planning/tools	
Passive House Portal	https://database.passivehouse.com/en/accounts/login/	
National Energy Code for Buildings (NECB) 2020	https://nrc.canada.ca/en/certifications-evaluations-standards/Codes-canada/Codes-canada-publications/national-energy-Code-canada-buildings-2020	Primary resource for Part 3 hourly modelling
CoV Energy Modelling Guidelines V.2	https://vancouver.ca/files/cov/guidelines-energy-modelling.pdf	Additional requirements for hourly modelling for VBBL and the BC Energy Step Code
CoV Modelling Guidelines for Large Homes V.2	https://vancouver.ca/files/cov/modelling-guidelines-large-homes.pdf	For modelling of homes greater than 325m ²
CoV New Homes Checklist	https://vancouver.ca/files/cov/new-homes-energy-checklist-2022.XLSM	Mandatory information for modelling
Energy Step Code Instruction Manual: BC Energy Compliance Reports for Part 9 Residential Buildings	https://energystepCode.ca/app/uploads/sites/257/2020/05/BC-SC-Manual-Rev-4.6.7.pdf	Documentation and workaround information for Step Code compliance