Energy Modelling Requirements for New Construction and Major Renovation in Health-care

The energy modelling requirements for health-care new construction includes:

- Energy Model Report Requirements
- Simulation Engine Requirements
- Inputs and Assumptions

Energy Model Report Requirements

Energy model reports must include:

1. Executive summary
2. Project description
    a. Description of modeled building systems
    b. Description of modeling methodologies, any workarounds or post-processing of results made outside of software
3. Detailed summary of all energy model inputs and assumptions including:
    a. Project address and location
    b. Weather file
    c. Relevant climate zone (ASHRAE or NECB)
    d. Total unmet heating hours
    e. Total unmet cooling hours
    f. Simulation software and version
    g. Total MFA (m^2)
        - Conditioned area
        - Unconditioned area
        - Parking area
    h. Schedules
    i. Envelope performance (effective)
        - Roof
        - Wall
        - Slab on grade
        - WWR glazing (%)
        - Vertical envelope area to floor area ratio (VFAR)
        - Glazing U-value and SHGC
        - Shading Devices
        - Infiltration rate
    j. Internal load
        - General plug load and schedule
        - Elevator load and schedule
        - Process load and schedule
        - Number of occupants
        - Number of beds
        - Interior lighting power density
        - Interior lighting control

- Exterior lighting
- Ventilation Rate
- Domestic hot water load

k. Mechanical systems
   - Temperature and humidity set-points
   - Mechanical system description (central- and zone-level)
     - Fan power and control
   - Heat recovery ventilators
     - Sensible (or apparent sensible) and latent efficiency

l. Central plant
   - Heating, cooling, and heat rejection equipment
   - Loop supply and return temperatures
   - Loop resets and controls description
   - Domestic hot water equipment
   - Pumps
     - Controls, power, and flow

m. Utility rates
n. Carbon emission factors
o. Renewable energy
p. Any other assumptions and inputs

4. Include assumptions and parameters not described, or that deviate from those described herein with a rationale and solution used for any deviation

5. Provide thermal bridging calculations.

   a. For thermal bridges to be included and excluded, follow methodology outlined in City of Vancouver Energy Modeling Guideline v.2.0, Section 3. Overall, opaque assembly U-values must be determined using the Enhanced Thermal Performance Spreadsheet[1], performance data for clear fields and interface details from the Building Envelope Thermal Bridging Guide (BETBG), and the calculation methodology as outlined in the BETBG.

6. Provide output summary reports from the energy simulation software.

7. Provide energy consumption end-use breakdown including: Interior Lighting, Exterior Lighting, Fans, Pumps, Space Cooling, Heat Rejection, Space Heating, Humidification, Service Water Heating, Receptacle Loads, Elevators and Escalators, and Total

8. Identify energy consumption fuel-type for each end-use (i.e. electricity, natural gas, or any other source of energy that may be available).

9. Provide calculations and results for:
   a. Total indicative building annual energy consumption as both MWh and energy-use intensity (kWh/m^2/year) per end-use, and by sourced energy-type.
   b. Total thermal energy demand intensity (kWh/m^2/year)
   c. Total greenhouse gas emissions, both as tCO_{2e}/year and carbon intensity ($kgCO_{2e}/m^2$/year), and by sourced energy type.

[1] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/betbg-enhanced-spreadsheet.xlsm

d. Total building energy cost, as $/year and monthly, and by sourced energy type.
e. Peak annual electricity demand and average monthly peak demand
f. Reference the sample formats (Table 1, 2, 3) for submission of Energy Target Results

10. Climate resilience simulation
    a. Simulate models using CWEC 2030, 2050, and 2080 and report unmet heating and cooling hours.
    b. Project should have zero unmet hours when using CWEC 2030 and 2050. For CWEC 2080 scenario, briefly explain how the current design has planned for the future increase in cooling capacity.

Simulation Engines Requirements

1. For determining the energy target, simulation engines will at a minimum have the following abilities:
    - Explicitly model 8760 hours per year,
    - Hourly variations in occupancy, lighting power, miscellaneous equipment,
    - HVAC system operation variations in set-points and schedules,
    - Part-load performance curves for systems & equipment,
    - Output time-series variables in the following electronic file format:
        - Tab- or comma-separated value
        - Spreadsheet files
    - Acceptable software for whole building analysis includes:
        - DOE 2.1e
        - EE4 version 1.7
        - EnergyPro, VisualDOE
        - DOE2.2 and derivations (eQuest PowerDOE)
        - EnergyPlus and derivations (Design Builder, Open Studio, Simergy, Trane TRACE 3D Plus, Bentley Hevacomp and Bentley AECOsim Energy Simulator V8i)
        - IES Virtual Environment
        - ESP-r
        - TRNSYS
        - Trane Trace 600 (Version 6.1 and higher)
        - Carrier E20-II HAP
2. Other supporting calculations tools are at the discretion of the project team
3. Use operating schedules (Table 4) with the assumption that no adjacent buildings will provide a shading effect to the facility.
4. It is expected that the project team will perform spreadsheet calculations outside of the simulation engine by utilizing time-series output data from the simulation to perform calculations that the simulation engine cannot.

Inputs and Assumptions

1. Weather file
    a. Use CWEC 2020 weather file at project location in alignment with *Climate Resilience Guidelines for B.C. Health Facility Planning & Design* v1.1 [2] section 3.3.

[2] https://bcgreencare.ca/wp-content/uploads/2021/09/ClimateResilienceGuidelinesForBCHealthFacilityPlanningAnd-Design_v1-1.pdf

2. Plug and Process Load
    a. Refer to NERL U.S. Department of Energy Commercial Reference Building Models of the National Building Stock[3]
3. Elevator load: Follow CleanBC Commercial New Construction Program Energy Modelling Guidelines[4]
4. Schedules and Hours of Operation: Reference NECB 2017 schedules (Table 1)
    a. All non clinical areas: Follow NECB 2017 setback schedules/set-points for each of the following eight parameters:
        i. Space Lighting,
        ii. Receptacles/Plug loads
        iii. Occupants
        iv. Fans
        v. Room Supply Airflow rates
        vi. Heating temperature set points
        vii. Cooling temperature set points
        viii. Humidity
    b. All clinical area: Follow NECB 2017 setback schedules/set-points for lighting, receptacle/plug load and occupancy. During setback operation, airflow can be reduced to 1/3 of the occupied air change rate defined in CSA Z317-15, while humidity, cooling and heating set points will remain within the CSA Z317-15 defined ranges.
5. Occupancy density and peak receptacle load: Reference NECB
6. Ventilation rates
    a. Apply CSA Z317.2-15 minimum air change rates
    b. Ventilation setback is permitted where identified in CSA Z317.2.
7. Parking garage: Assume 6 hours daily exhaust fan operation controlled by vehicle emission sensors
8. Infiltration rates: use 0.2 L/s/m^2, improved infiltration rate may be used if project team can prove this infiltration rate can be achieved e.g. through blower door tests; reference PNNL Report 18898 "Infiltration Modelling Guidelines for Commercial Building Energy Analysis", publicly available at: efiling.energy.ca.gov/GetDocument.aspx?tn=65229
9. Energy recovery ventilators: follow City of Vancouver Energy Modeling Guidelines v 2.0[5] section 2.6.1
10. Energy Emission Factor (current) – per latest version of BC Best Practices Methodology for Quantifying GHG Emissions
11. Use local utility provider energy rates

[3] https://www.nrel.gov/docs/fy11osti/46861.pdf
[4] https://betterbuildingsbc.ca/wp-content/uploads/2020/04/April-2020_BCH20-299-CleanBC-CNC-Energy-Modeling-Guidelines.pdf
[5] https://vancouver.ca/files/cov/guidelines-energy-modelling.pdf

Table 1 Sample format for summary of energy, cost, and emissions

Energy, Cost and Emissions Summary		Total	Electricity		Natural Gas		Greenhouse Gas	
		Cost	Cost	Demand	Cost	Demand	Cost	CO_2e
			Cost	Energy		Energy		
January	kW	$	$	kW	$	kW	$	tonne
	MWh		$	MWh		MWh		
February	kW							
	MWh							
March	kW							
	MWh							
April	kW							
	MWh							
May	kW							
	MWh							
June	kW							
	MWh							
July	kW							
	MWh							
August	kW							
	MWh							
September	kW							
	MWh							
October	kW							
	MWh							
November	kW							
	MWh							
December	kW							
	MWh							

Table 2 Sample format for summary of energy consumption by end-use (MWh/year)

Energy Consumption by End-Use (MWh/year)		
End Use	**Electricity**	**Natural Gas**
Interior Lights		
Exterior Lights		
Fans		
Pumps		
Cooling and Heat Rejection Cooling Tower		
Cooling Heat Recovery		
Heating		
Humidification		
Service Water Heating		
Receptacles		
Electrical Losses		
Elevators and Escalators		
Assumed non-targeted Energy Consumption		
Total		

Table 3 Sample format for summary of energy consumption by end-use (kWh/m2/year)

Energy Consumption by End-Use (kWh/m^2/year)		
End Use	**Electricity**	**Natural Gas**
Interior Lights		
Exterior Lights		
Fans		
Pumps		
Cooling and Heat Rejection Cooling Tower		
Cooling Heat Recovery		
Heating		
Humidification		
Service Water Heating		
Receptacles		
Electrical Losses		
Elevators and Escalators		
Assumed non-targeted Energy Consumption		
Total		

Table 4 Example of an Operating Schedule, National Energy Code of Canada for Building 2017

Department		NECB 2017 Schedule
A	Emergency Services	H
B	Critical care	H
C	Inpatient care	J
D	Renal Outpatient	H
E	Maternity Centre	H
F	Urban Health and Integrated Mental Health and Substance Use	
	F1 Stabilization Unit	H
	F2 Outpatient Services	B
	F3 Mental Health Inpatients	J
	F4 Transitional care Centre	J
G	Surgical and Interventional Services	H
H	Outpatient care Centre	A
I	Medical Imaging	H
J	Clinical Support Services	H
K	Centre for Healthy Aging	C
L	Rehabilitation Centre	C
M	Main Entrance and Public Services	
	Ml Main Entrance	H
	M2 Public Services	H
	M3 Volunteer Services	B
	M4 Clinical Operations Centre	B
	M5 Roman catholic Chapel M6	H
	M6 All Nations Sacred Space	H
	M7 Meditation Space	H
N	Education and learning	
	N1 Learning Commons	C
	N2 Conference Centre	C
	N3 Clinical Skills	C
	N4 Media Services	C
	N5 On-call Support	G
O	Operational Support	
	O1 Biomedical Engineering	A
	O2 MDRD	C
	O3 Central Food Production	B
	O4FMO	B
	O5 Logistics Centre	H
	O6 Integrated Protection Services	H
	O7 Equipment Depot	H
	O8 Environmental Services	H
	O9 Cycling Centre	H
	O10 Waste Management	H
	O11 Laundry and Linen Services	H
	O12 Central Mail Services	H
	O13 Support Services Administration	A
P	Management and Administration	A