Custom - New Construction
Program Guide

December 2020

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List of Acronyms

DHW	Domestic Hot Water
DOAS	Dedicated Outdoor Air System
ENS	Efficiency Nova Scotia
HP	Heat Pump
HRV	Heat Recovery Ventilator
MURB	Multi-Unit Residential Buildings
NECB	National Energy Code for Buildings
NC	New Construction
PDA	Project Development Agreement
SPVAC	Single-Package Vertical Air Conditioner
SPVHP	Single-Package Vertical Heat Pump
SRE	Sensible Recovery Efficiency
VRF	Variable Refrigerant Flow

1.0　Introduction

The Efficiency Nova Scotia (ENS) Custom program offers a New Construction (NC) service that aims to assist in the design of energy efficient commercial, industrial, institutional, and multi-unit residential buildings. The objective of this service is to encourage property developers to evaluate potential energy efficiency measures for their entire building through energy modeling and implement measures most suitable to their project. The NC program provides financial assistance for energy modeling fees and helps to offset the capital cost of efficient technologies through implementation incentives, which are proportional to the electrical energy saved in the project.

2.0　Program Process

2.1.　Step One – Project Notification and Kick-Off Meeting

Interested parties must notify ENS of their intent to participate in the NC Program during the project's design phase. Following confirmation of project eligibility, ENS will host a kick-off meeting with the developer and engineer or energy modeler to review the NC process and discuss project details. If a modeler has not yet been selected, ENS can recommend a qualified consultant.

2.2.　Step Two – Energy Modeling Incentive Application

Prior to commencing the energy model, and before construction begins, the modeler and developer must submit an Energy Modeling Incentive Application outlining the project details including proposed design and energy efficiency measures. If the application meets eligibility criteria, ENS will issue an approval and modeling work can proceed.

2.3.　Step Three – Initial Energy Model Submission

The initial energy model and supporting documentation must be submitted to ENS when the project's design phase is complete but before major construction is underway. ENS will review the model to ensure that the baseline complies with NECB requirements and that the proposed accurately represents the building's design. Following review and approval, ENS provides an implementation incentive estimate and issues payment for the energy modeling incentive.

2.4.　Step Four – As-Built Energy Model Update & Site Visit

The developer must notify ENS when construction is complete and the building is occupied. The energy modeler must submit an as-built energy model reflecting any design changes since the original model approval. ENS will review the as-built submission and conduct a site visit to verify installation of modeled energy efficiency measures. When the site visit is complete and model approved, ENS issues payment of the implementation incentive.

3.0   Eligibility

3.1. Project Eligibility

A project must meet the following eligibility criteria to participate in the ENS NC service:
- Project must be in design phase (pre-construction)
- Total conditioned area must be at least 15,000 Ft²;
- Project must be located in Nova Scotia and save electrical energy;
- Project must be defined as one of the following:
    o   A new structure;
    o   An addition to an existing structure;
    o   A major renovation of a building 15,000 Ft² (1,394 m^2) or greater;
- Project must implement at least two energy efficient measures
- Project must achieve a reduction in total building energy consumption of at least 15% or 100,000 kWh, whichever is higher

ENS may deem projects ineligible for the NC service based on inadequate electrical energy savings potential.

3.2. Eligible Software

Energy models must be prepared using one of the following:
- CAN-QUEST/eQuest;
- IES;
- HAP; or
- EnergyPlus.

3.3. Eligible Energy Modelers

Energy models must be submitted by a consultant who:
- Is on the list of Approved Energy Modelers; or
- Has been approved by ENS for a one-time submission (must be approved prior to submitting an energy model)

Consultants who wish to be added to the Approved Modelers list or obtain single-project approval must submit an Experienced Energy Modeler Application and be approved by ENS NC personnel. Please email cicustom@efficiencyns.ca for more information.

3.4. New Industrial Facilities: Process Load Savings

Industrial new construction projects are eligible for additional incentives based on reduced energy consumption of process equipment. Projects must meet the following criteria:
- Facility meets general NC eligibility criteria outlined in section 3.1
- Industrial process loads account for at least 40% of the proposed building's total energy consumption
- Proposed building process loads must have at least 10% electrical energy savings compared to baseline process loads

Facilities with process load savings must also provide documentation to ENS demonstrating the additional costs of energy efficient process equipment compared to baseline equipment. Modeling requirements for industrial facilities are outlined in section 5.5.

4.1. Energy Modeling Incentive

ENS offers an Energy Modeling Incentive that covers 50% of eligible modeling fees, up to $10,000. To qualify, the proposed project must meet the eligibility criteria outlined in section 3.1 above.

An Energy Modeling Incentive Application must be submitted and approved by ENS in advance of the energy model submission to qualify for this incentive. The energy modeling incentive will be paid to the developer after the energy model is submitted and approved by ENS, and a Project Development Agreement (PDA) is signed between the developer and ENS.

If a project's total electrical energy savings are between 100,000 and 250,000 kWh, the energy modeling incentive amount will be deducted from the final implementation incentive amount. If a project's total electrical energy savings are over 250,000 kWh, both incentives will be paid at their full value.

4.2. Implementation Incentive

The NC service provides an Implementation Incentive to help offset the capital costs of efficient technologies. The Implementation Incentive is calculated based on the modeled energy savings between the Baseline case and the Proposed case. The Baseline case is the NECB reference building as defined in NECB Part 8 and the guidelines in section 5.0 of this document. The Proposed case is the project's final design, which includes the measures that will be installed with support from ENS.

The Implementation Incentive is calculated based on the following criteria (for all buildings and system types excluding Hybrid Hydronic heat pumps; incentive information for Hybrid Hydronic Heat Pumps is provided in section 4.3):
- If the Proposed achieves less than 40% *total energy savings* from the Baseline, the Implementation Incentive is $0.10 per kWh of *electrical energy savings* (not including lighting); and
- If the Proposed achieves 40% or more *total energy savings* from the Baseline, the Implementation Incentive is $0.12 per kWh of *electrical energy savings* (not including lighting).

Total energy savings refers to all energy sources and uses (including non-electric energy and lighting). The Implementation Incentive rate applies to *electrical energy savings* only (not inclusive of lighting savings, see section 6.8 for more information) up to a maximum Implementation Incentive of $500,000. Energy production from a solar PV system will be added to the electrical energy savings; see section 6.9 for details.

The Initial Energy Model must be submitted and approved by ENS before energy efficiency measures are installed or the project will not be eligible for the Implementation Incentive. The Implementation Incentive will be paid to the developer when the project is constructed and occupied, and when the As-Built Energy Model has been submitted and approved by ENS. If as-built savings are less than 85% of approved original savings, the implementation incentive amount will be adjusted.

4.3. Incentive Structure for Hybrid Hydronic Heat Pumps

Projects with hybrid hydronic heat pumps in the proposed HVAC system will be incentivized as follows:
1. Projects may apply for the energy modeling incentive and receive the funds as outlined in section 4.1, but the modeling incentive amount will be deducted from the implementation incentive
2. The implementation incentive rate will be $0.10 per kWh of electrical energy saved, regardless of total building energy savings.

5.0   Baseline Requirements

5.1. NC Project Baselines

The baseline building must adhere to the requirements of NECB Part 8 and/or the guidelines in this document. Exceptions to NECB and the NC guidelines will be considered on a case-by-case basis and must be approved prior to an energy model incentive approval.

The NC program baseline requirements are subject to revision based on changes to building codes and market conditions. Project-specific baselines must be confirmed with ENS prior to commencing the energy model.

Guidelines for the selection of baseline HVAC systems in Multi-Unit Residential Buildings (MURBs) are provided in section 5.2 below. Section 5.4 provides a detailed description of the NECB baseline systems (systems 1 to 6 in NECB Table 8.4.4.7-B). If any components of the proposed HVAC system are not covered in this document, the energy modeler should request clarification from ENS about the baseline system before any energy modeling work begins.

5.1.1.   NC Program NECB Exceptions

Projects participating in the NC Program must comply with NECB Part 8, except for the following:
1. All project baseline systems 1-7 shall be modeled with supply fan power in accordance with NECB 2017 8.4.4.18(3) or (4) as applicable, regardless of total proposed building fan power
2. All H/ERVs in MURBs (both single-zone and central systems) shall be modeled with baseline fan power identical to proposed (see section 5.3.1)
3. Water loop heat pump applications in MURBs shall be modeled with unitary air conditioners in the baseline, with auxiliary baseboard heat to match proposed heating energy source
4. Heat pump water heaters (for service water applications) shall be modeled with an electric boiler baseline.
5. Where a proposed MURB design includes VRF, and the MURB is located in an area where natural gas is available, the baseline shall be modified as per section 5.2.7. Otherwise, the baseline shall follow applicable NECB requirements.
6. The baseline requirements for eligible major renovation projects will be assessed on a case-by-case basis

5.2. Baseline HVAC System selection for Multi-Unit Residential Buildings

The following sections outline the baseline HVAC systems for various types of proposed systems:
- Mini-Split Heat Pump
- Central Air to Water Heat Pump with back-up boilers
- Distributed Water to Air Heat Pumps with boiler/cooling tower
- Distributed Water to Air Heat Pumps connected to ground loop/backup boiler
- Hybrid Hydronic Heat Pumps
- Air Cooled Variable Refrigerant Flow Systems

Ventilation system details are provided in section 5.3, for Single-zone HRVs and Central Ventilation Systems.

5.2.1. Mini-Split Heat Pump

System Description	Proposed System Details	Baseline System Details
System Type	Mini-Split Heat Pump	Table 8.4.4.13-Packaged unitary rooftop heat pump (based on 8.4.4.7-(4))
Central Plant	Not Applicable	Not Applicable
Fan Control	Constant-Volume	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Air cooled direct expansion	Air cooled direct expansion
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode
Heating Type	Air source heat pump	Heat pump
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode
Auxiliary Heating Type	Electric resistance furnace	Electric Resistance
Heat Rejection	Not Applicable	Not Applicable
Heat Rejection Efficiency	Not Applicable	Not Applicable
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

5.2.2. Central Air to Water Heat Pump with back-up boilers

The baseline for buildings with a central air to water heat pump will be single-zone packaged unitary rooftop heat pumps (air source). If the proposed building includes fuel-fired heating in the water loop, the baseline will include fuel-fired hydronic heating with identical setpoints and operating schedule as proposed.

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	4-pipe Fan coil for heating and cooling or 2-pipe Fan Coil for cooling and hot water baseboards for heating	Table 8.4.4.13-Packaged unitary rooftop heat pump with electric baseboards (based on 8.4.4.7-(4))	Table 8.4.4.13-Packaged unitary rooftop heat pump with hydronic baseboards (based on 8.4.4.7-(4))
Central Plant	Central air to water heat pump with back-up boilers	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Central air to water heat pump	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Central air to water heat pump	Heat pump and electric resistance	Heat pump and fuel-fired hydronic
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode	
Auxiliary Heating Type	As per design	Electric resistance	The proposed building's ratio of fuel heating energy to electric heating energy shall be applied to the baseline heating energy, to determine the baseline heating electricity use
Heat Rejection	Not Applicable	Not applicable	
Heat Rejection Efficiency	Not Applicable	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

5.2.3. Distributed Water to Air Heat Pumps with boiler/cooling tower

The baseline for buildings with water loop heat pumps (water to air or water to water heat pumps) will be unitary air conditioners. If the proposed building includes fuel-fired heating in the water loop, the baseline will include fuel-fired hydronic heating with identical setpoints and operating schedule as proposed.

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	Distributed Water to Air Heat Pumps	Unitary air conditioner with electric baseboards	Unitary air conditioner with hydronic baseboards
Central Plant	Boilers Cooling Tower	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Distributed Water to Air Heat Pumps	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Distributed Water to Air Heat Pumps	Electric resistance	Fuel-fired hydronic
Heating Efficiency	Cutsheet	Not applicable	Gas-fired boilers
Auxiliary Heating Type	Not Applicable	Electric resistance	The proposed building's ratio of fuel heating energy to electric heating energy shall be applied to the baseline heating energy, to determine the baseline heating electricity use
Heat Rejection	Cooling Towers	Not applicable	
Heat Rejection Efficiency	Cutsheet	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

5.2.4. Central Ground Source Heat Pump with back-up boilers

The baseline for buildings with a ground source heat pump will be single-zone packaged unitary rooftop heat pumps (air source). If the proposed building includes fuel-fired heating in the water loop, the baseline will include fuel-fired hydronic heating (zone baseboards) with identical setpoints and operating schedule.

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	4-pipe Fan coil units for heating and cooling or 2-pipe Fan Coil Units for cooling and baseboards for heating	Table 8.4.4.13- Packaged unitary rooftop heat pump with electric baseboards (based on 8.4.4.7-(4))	Table 8.4.4.13- Packaged unitary rooftop heat pump with hydronic baseboards (based on 8.4.4.7-(4))
Central Plant	Central Ground Source Heat Pump with back up boilers	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Central water to water heat pump	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Central water to water heat pump with backup boiler	Heat pump and electric resistance	Heat pump and fuel-fired hydronic
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode	
Auxiliary Heating Type	Not Applicable	Electric resistance	The proposed building's ratio of fuel heating energy to electric heating energy shall be applied to the baseline heating energy, to determine the baseline heating electricity use
Heat Rejection	Not Applicable	Not applicable	
Heat Rejection Efficiency	Not Applicable	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

5.2.5. Distributed Water to Air Heat Pumps connected to ground loop/backup boiler

The baseline for buildings with a ground water loop will be single-zone packaged unitary rooftop heat pumps (air source). If the proposed building includes fuel-fired heating in the water loop, the baseline will include fuel-fired hydronic heating with identical setpoints and operating schedule as proposed.

System Description	Proposed System Details	Baseline System Type	
		Electric boiler in proposed	Fuel-fired boiler in proposed
System Type	Water to air distributed heat pumps	Table 8.4.4.13-Packaged unitary rooftop heat pump with electric baseboards	Table 8.4.4.13-Packaged unitary rooftop heat pump with hydronic baseboards
Central Plant	Ground source loop with back-up boiler	Not Applicable	Fuel-fired boiler
Fan Control	As per design	Constant-Volume	
Fan Operation	As per design (intermittent or continuous)	Identical to proposed	
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Water cooled Direct Expansion	Air cooled direct expansion	
Cooling Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Heat pump	Heat pump and electric resistance	Heat pump and fuel-fired hydronic
Heating Efficiency	Cutsheet	Table 5.2.12-SPVAC & SPVHP in Heating mode	
Auxiliary Heating Type	Not Applicable	Electric resistance	The proposed building's ratio of fuel heating energy to electric heating energy shall be applied to the baseline heating energy, to determine the baseline heating electricity use
Heat Rejection	Ground source loop	Not applicable	
Heat Rejection Efficiency	Not Applicable	Not applicable	
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.	

5.2.6. Hybrid Hydronic Heat Pumps

A hybrid hydronic heat pump is a system of distributed fan coil units with DX cooling and gas-fired hydronic heating, where the DX cooling rejects heat into the hydronic loop. The baseline for hybrid hydronic heat pumps will be an identical system with efficiencies as outlined below.

System Description	Proposed System Details	Baseline System Type
System Type	Hybrid hydronic heat pumps	As per Table 8.4.4.7-A, the baseline system shall be identical to that of the proposed building
Central Plant Type	Condensing boilers Cooling Towers	Identical to proposed
Fan Control	As per design	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Water cooled Direct Expansion	Identical to that of the proposed building
Cooling Efficiency	Cutsheet	Table 5.2.12-Internal Water-loop heat pumps
Heating Type	Condensing fuel fired Boilers	Identical to that of the proposed building
Heating Efficiency	Cutsheet	Gas fired boilers
Auxiliary Heating Type	Not Applicable	Not Applicable
Heat Rejection	Cooling Towers	Cooling Towers
Heat Rejection Efficiency	Cutsheet	Table 5.2.12-Cooling towers- propeller or axial fan, direct
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

5.2.7. Air Cooled Variable Refrigerant Flow Systems

The Baseline for a proposed Air Cooled Variable Refrigerant Flow (VRF) system, in electrically-heated buildings located in an area where natural gas is available (as confirmed by ENS), shall be modeled with minimum efficiencies following ASHRAE 90.1 2013 Table 6.8.1-9 as summarized below. The Size Category applies to the Baseline system, not the Proposed VRF. The part-load operation will follow the performance curves from NECB 2017 Table 8.4.4.21-E (Electric Air-Source Heat Pump Equipment Part-Load Performance). The Baseline heat pump operation must extend beyond the NECB baseline heat pump with a minimum operating temperature of -18°C instead of -10°C. All other components must comply with the NECB or the guidelines in this document.

System Description	Proposed System Details	Baseline System Type
System Type	Air-cooled VRF	Table 8.4.4.13-Packaged unitary rooftop heat pump
Central Plant	Air-cooled condensing units	Not Applicable
Fan Control	Multi-Speed	Constant-Volume
Fan Operation	As per design (intermittent or continuous)	Identical to proposed
Fan Power	Cutsheet	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Air cooled direct expansion	Air cooled direct expansion
Cooling Efficiency	Cutsheet	As per ASHRAE 90.1-2013-Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements (see Table 1)
Heating Type	Air source heat pump	Heat pump
Heating Efficiency	Cutsheet	As per ASHRAE 90.1-2013-Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow Air Conditioners—Minimum Efficiency Requirements (see Table 1)
Auxiliary Heating Type	As per design	Electric Resistance with heat pumps operating under part load from -10°C to -18°C
Heat Rejection	Not Applicable	Not Applicable
Heat Rejection Efficiency	Not Applicable	Not Applicable
Cooling w/Outside Air	Not Applicable	Not applicable as per 8.4.4.12. & 5.2.2.7.

Table 1:Minimum Baseline VRF Heating and Cooling Efficiencies (as per ASHRAE 90.1 2013 Table 6.8.1-10)

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency
VRF Cooling Mode	<65,000 Btu/h	VRF multisplit system	13.0 SEER
	>=65,000 Btu/h and <135,000 Btu/h	VRF multisplit system	11 EER
	>=65,000 Btu/h and <135,000 Btu/h	VRF multisplit system with heat recovery	10.8 EER
	>=135,000 Btu/h and <240,000 Btu/h	VRF multisplit system	10.6 EER
	>=135,000 Btu/h and <240,000 Btu/h	VRF multisplit system with heat recovery	10.4 EER
	>=240,000 Btu/h	VRF multisplit system	9.5 EER
	>=240,000 Btu/h	VRF multisplit system with heat recovery	9.3 EER
VRF Heating Mode	<65,000 Btu/h (cooling capacity)	VRF multisplit system	7.7 HSPF
	>=65,000 Btu/h and <135,000 Btu/h (cooling capacity)	VRF multisplit system 47F db/43F wb outdoor air	3.3 COP
	>=65,000 Btu/h and <135,000 Btu/h (cooling capacity)	VRF multisplit system 17F db/15F wb outdoor air	2.25 COP
	>=135,000 Btu/h (cooling capacity)	VRF multisplit system 47F db/43F wb outdoor air	3.2 COP
	>=135,000 Btu/h (cooling capacity)	VRF multisplit system 17F db/15F wb outdoor air	2.05 COP

5.3. Ventilation Baseline for MURBs/hotels

Ventilation in MURBs or hotels is typically provided by either a central fresh air system or suite-level HRVs. NECB requires the baseline ventilation system configuration for MURBs to be identical to proposed. Baseline system details for each of these system types are outlined below.

5.3.1. Single-zone HRVs

System Description	Proposed System Details	Baseline System Details
Ventilation System Type	Single-zone (suite) HRVs Direct to zone or supplying fresh air to zone terminal systems	Zone supply fan and exhaust fan Configuration identical to proposed[1]
Heat Recovery	As per design	Not required
Fan Power	As per design (supply fan cutsheet, exhaust fan cutsheet)	Supply Fan: Identical to Proposed Exhaust Fan: Identical to Proposed
Fan Operation	Continuous	Continuous

Notes:
1. Configuration identical: if the proposed building uses suite HRVs that deliver fresh air directly to the zone through dedicated ductwork, the baseline building's ventilation system configuration will be identical. If the proposed building uses suite HRVs that are ducted to the zone terminal heating and cooling equipment, the baseline building's supply fan will be configured to serve the baseline heating and cooling equipment.

5.3.2. Central Ventilation Systems

System Description	Proposed System Details	Baseline System Details
Ventilation System Type	Central DOAS Direct to zone or supplying fresh air to zone terminal systems	Central DOAS Configuration identical to proposed[1]
Heat Recovery	As per design	NECB 2017 5.2.10.1.(3): minimum 50% SRE[2]
Fan Power	As per design (supply fan cutsheet, exhaust fan cutsheet)	Supply Fan: Identical to Proposed Exhaust Fan: Identical to Proposed
Fan Operation	Continuous	Continuous

Notes:
1. Configuration identical: if the proposed building's DOAS delivers fresh air directly to the zone through dedicated ductwork, the baseline building's ventilation system configuration will be identical. If the proposed building's DOAS is ducted to the zone terminal heating and cooling equipment, the baseline building's ventilation system will be configured to serve the baseline heating and cooling equipment.
2. For NECB 2015 projects, baseline heat recovery shall be modeled as per requirements outlined in NECB 5.2.10.

5.4. NECB Baseline HVAC system Descriptions

For building other than MURBs, the baseline HVAC system selection follows NECB Part 8 Table 8.4.4.7-A and Table 8.4.4.7-B. Descriptions for Systems 1 to 7 are provided below for clarity. In case of discrepancy with NECB, the energy modeler should follow the requirements in NECB Part 8.

System Description	Baseline System Type 1	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-1-Unitary air-conditioner with hot water baseboard heating	System-1-Unitary air-conditioner with electric resistance baseboard heating
Central Plant	Fuel Fired Water Boiler	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-SPVAC & SPVHP in Cooling mode	
Heating Type	Fuel fired water boiler	Electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 2,7	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-2-Four-pipe fan-coil	System-2-Four-pipe fan-coil
Central Plant	Fuel Fired Boiler	Electric Resistance Water Boiler
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Water cooling water chiller	
Cooling Efficiency	SPVAC & SPVHP in Cooling mode	
Heating Type	Fuel Fired Boiler	Electric resistance water boiler
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Cooling Towers	
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 3	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-3-Single-zone packaged rooftop unit with baseboard heating	System-3-Single-zone packaged rooftop unit with baseboard heating
Central Plant	Fuel Fired Furnace	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-Packaged water chillers see Table 9 to 15 in standard	
Heating Type	Fuel Fired Furnace	Electric resistance furnace for rooftop, electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas-fired warm air furnaces	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 4	
	Fuel-fired Heating in Proposed	**Electric Heating in Proposed**
System Type	System-4-Single-zone make-up air unit with baseboard heating	System-4-Single-zone make-up air unit with baseboard heating
Central Plant	Fuel Fired Furnace	Not Applicable
Fan Control	Constant-Volume	
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%	
Cooling Type	Air cooled direct expansion	
Cooling Efficiency	Table 5.2.12-Air conditioner, all electric phases, Split and single-package	
Heating Type	Fuel Fired Furnace	Electric furnace with electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas-fired warm air furnaces Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Not Applicable	
Heat Rejection Efficiency	Not Applicable	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

System Description	Baseline System Type 5
System Type	System-5-Two-pipe fan-coil
Central Plant	Water cooling water chiller
Fan Control	Constant-Volume
Fan Power	8.4.4.18. 640 Pa; Combined fan and motor efficiency 40%
Cooling Type	Water cooling water chiller
Cooling Efficiency	Table 5.2.12-Packaged water chillers see Table 9 to 15 in standard
Heating Type	Not Applicable
Heating Efficiency	Not Applicable
Auxiliary Heating Type	Not Applicable
Heat Rejection	Cooling Towers
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20

System Description	Baseline System Type 6	
	Fuel-fired Heating in Proposed	Electric Heating in Proposed
System Type	System-6-Multi-zone built-up system with baseboard heating	System-6-Multi-zone built-up system with baseboard heating
Central Plant	Fuel fired boiler Water cooling water chiller	Not Applicable
Fan Control	Variable-volume	
Fan Power	8.4.4.18.(4)(b) Supply fan with 1000 Pa; Combined fan and motor efficiency 55% & Return fan with 250 Pa; Combined fan and motor efficiency 30%	
Cooling Type	Water cooling water chiller	
Cooling Efficiency	Table 5.2.12-Packaged water chillers see Table 9 to 15 in standard	
Heating Type	Fuel Fired Boiler	Electric resistance baseboards
Heating Efficiency	Table 5.2.12-Gas fired boilers	-
Auxiliary Heating Type	Not Applicable	
Heat Rejection	Cooling Towers	
Heat Rejection Efficiency	Table 5.2.12-Cooling towers- propeller or axial fan, direct	
Cooling with Outside Air	HVAC Systems-1,3,4 and 6, except for HVAC systems serving only dwelling units, hotel/motels if 5.2.2.7 conditions apply economizer applies as per 5.2.2.8	
DHW system	Same energy source as proposed, as per NECB 2017 8.4.4.20	

5.5. Baseline Requirements for Industrial Process Loads

The baseline requirements for new industrial buildings that meet the eligibility criteria in section 3.4 are as follows:

- Systems regulated by the NECB shall be modeled according to NECB Part 8, with the following exception:
    - o Where facility processes require space temperature setpoints that differ from NECB-prescribed setpoints, both the baseline and proposed buildings shall be modeled with alternative setpoints as appropriate to the facility
- Unregulated process loads shall be modeled as follows:
    - o Baseline equipment specifications and operating cycle times: Baseline process equipment specifications must be based on existing equipment/systems that are representative of industry-standard practices, as demonstrated by either
        - ▪ Equipment used in a similar facility/process, with the same owner as the proposed facility, where the equipment is less than 10 years old
        - ▪ Equipment used in three similar facilities/processes located in Canada or the United States
    - o Proposed equipment specifications and operating cycle times shall be modeled based on a real system with available performance data
    - o For all unregulated equipment, in both baseline and proposed buildings, specifications must be taken from data published by equipment manufacturers
    - o The baseline and proposed models must include heating and cooling load effects of the equipment and operating cycles

6.0   Additional Energy Modeling Requirements

6.1. Effective Thermal Resistance

When calculating the thermal properties of building assemblies, the energy modeler must account for the reduction in thermal resistance from steel, wood, or masonry assemblies. Effective thermal resistance calculations must be submitted along with the Energy Modeling Submission Package for verification, using the ENS Envelope Calculations Template or similar.

The standard calculation method follows ASHRAE Handbook - Fundamentals, and is outlined in NBC 2015 A-9.36.2.4.(1) for both wood-framed and steel-framed assemblies. Table A.9.36.2.4.(1)-D of the same reference provides thermal resistance values for common building materials.

Other calculation methods can be accepted; however, the energy modeler should request pre-approval of the methodology before submitting the energy modeling package.

Effective thermal transmittance calculations must account for envelope penetrations as listed in NECB 2017 3.1.1.7.

If the building is modeled in eQuest/CANQuest and has a heavyweight construction, the effective thermal resistance must be entered using the Layers method. The U Value keyword method is acceptable for assemblies that are considered lightweight construction (e.g. low heat capacity), though the layers method is recommended for improved accuracy.

6.2. Assemblies in contact with the ground in Can-Quest, eQuest

If a project is modeled in eQuest/CANQuest, a modified method must be used for assemblies in contact with the ground. Heat transfer occurs mainly through the exposed perimeter rather than uniformly over the whole area of the surface. If the raw U-value of the surface is used, then heat transfer will be overestimated.

A simplified approach that is acceptable for the program is the method developed by Fred Winkelmann, which is outlined in the DOE-2 Modeling Tips document, "Underground surfaces: How to get a better underground surface heat transfer calculation in DOE-2.1E". A copy of this document can be provided by ENS upon request. Alternatively, modelers may use the eQuest Wizard for assemblies in contact with the ground, which is based on the Winkelmann method.

In this method, the effective U value is modified based on the exposed perimeter, using a sizing factor. Underground assemblies with no exposed perimeter are modeled with no heat loss. This applies only to projects modeled in eQuest or CANQuest; other software systems may use different calculation methods.

6.3. Dedicated Outside Air Systems: Dummy Zones

Projects that are modeled using eQuest or CANQuest must use the dummy zone method for 100% fresh air ventilation systems, for both the baseline and proposed models. The configuration must be identical in the baseline, i.e., if the proposed building has a ventilation system that is coupled to the zone heating and cooling equipment, the baseline ventilation system must also be coupled.

A system that provides 100% fresh air to the space, either through dedicated ductwork or directly to the terminal HVAC equipment, is modeled using a DOAS system that serves a "dummy zone".

The basic instructions for creating and assigning dummy zone systems are outlined below:

1. Create a "dummy space" with area (square feet) equal to 1/3*supply flow rate (cfm), where supply flow rate is the total code-minimum outside air requirements for the spaces served.
   a. Code-minimum outside air should be determined outside of the model, and must be based on ASHRAE 62.
2. Create a new corresponding thermal zone called "dummy zone"
3. Set the heating and cooling schedules and temperature setpoints as follows:
   a. For decoupled ventilation systems, identical to zone schedules and setpoints.
   b. For coupled ventilation systems, use design setpoints and applicable NECB schedules
4. Create a new HVAC system (PSZ for constant volume systems, PVVT for variable volume).
5. Set the control zone to "dummy zone"
6. Set the heating and cooling equipment as per instructions in 6.3.1 and 6.3.2 below
7. Set the fan power "supply and return" equal to proposed system fan power
8. Set the minimum outside air ratio to 1.0 and fan mode to continuous
9. Set the supply flow rate equal to supply flow rate described above
10. Repeat steps above as needed, based on proposed ventilation system design
11. To avoid model errors, the dummy zone DOAS unit(s) must be moved to the top of the HVAC systems in the model's INP file.
    a. Save and close the eQuest file
    b. Open the .INP file
    c. Find the dummy zone DOAS unit(s) in the section "HVAC Systems/Zones
    d. Select the text corresponding to the DOAS unit(s) and associated zone(s). Start at the first line, e.g. "DZ DOAS" = SYSTEM, and end after SPACE = "dummy zone". Be sure to include the ". ." line.
    e. Cut this text selection, and paste at the top of the HVAC systems list.
    f. Save and close the .INP file.
    g. Reopen the eQuest file and ensure that the DOAS units are at the top of the air-side systems list
12. Set the zone outside air as follows:
    a. If the proposed building has a decoupled ventilation system, set the secondary system outside air ratio to 0 (zone fans intermittent)
    b. If the proposed building has a coupled ventilation system, set the secondary system "OA from system" to the applicable dummy zone DOAS (zone fans continuous)

Detailed instructions for modeling DOAS in MURBs are provided below. For all other building types, the model must be configured such that the outside air is conditioned as per design intent (for both temperature and humidity control). See section 6.4 for additional DOAS modeling requirements.

6.3.1. Central DOAS in Proposed Building (MURBs)

If the proposed building has one or more multi-zone fresh air systems, the modeled ventilation system must match its configuration; i.e. each separate system in the design must have a separate dummy zone and associated DOAS, where each is modeled with fan power and H/ERV efficiency modeled as per design specifications. The air flow assigned to each dummy zone system must match the sum of zone airflows for the spaces it serves.

If the proposed DOAS is decoupled from the zone equipment, and zone equipment runs intermittently, the DOAS supply temperature must be preconditioned to the zone supply temperature.

Two options exist for modeling a decoupled, central DOAS:

1. Fresh air conditioned by zone equipment (DOAS is a central H/ERV)

This option is most appropriate for proposed systems with minimal heating and cooling equipment, where the equipment operates only part of the year and the energy consumption of the heating and cooling equipment is minimal in comparison to the zone equipment energy consumption. For example: A central DOAS with heat wheel and electric coil, and minimum supply air setpoint of 18°C.

In this method, the DOAS is modeled the same as single-zone HRVs, i.e.:
1. Heating and cooling equipment type and efficiency is identical to the zone equipment, for both baseline and proposed building.
2. DOAS supply temperature setpoint is set to the zone temperature setpoint
3. Each secondary system must be modeled with "OA from system" set to "undefined", and secondary system minimum outside air ratio set to 0.

2. Fresh air conditioned by DOAS equipment

This option is most appropriate for proposed systems with heating and cooling equipment that meet a larger portion of the fresh air heating/cooling loads, where the equipment operates most of the year and the energy consumption of the heating and cooling equipment is more significant in comparison to the scenario outlined in option 1 above.

In this method, the DOAS is modeled as follows:
1. Heating and cooling equipment type and efficiency as per design specifications and associated baseline requirement
2. DOAS supply temperature setpoint is set to the zone temperature setpoint
3. Each secondary system must be modeled with "OA from system" set to "undefined", and secondary system minimum outside air ratio set to 0.
   If the DOAS supply temperature is less than the zone setpoint, and the DOAS includes a heat recovery device, an adjustment must be added to the exhaust air. See section 6.3.3.

6.3.2. Single-zone HRVs in Proposed Building (MURBs)

If the proposed building's fresh air system is comprised of suite-level HRVs, the modeled ventilation system can be a single dummy zone DOAS. The supply flow must still be the sum of all zone outdoor air flows. In this case, the DOAS is modeled with heating and cooling equipment identical to the zone heating and cooling equipment (for both baseline and proposed), and proposed heat recovery specifications identical to the suite HRVs; this ensures that air supplied by the DOAS is conditioned exactly as it would be if it entered the space via HRVs. Fan power must match the W/cfm of the proposed building's HRVs.

Each zone system must be modeled with "OA from system" set to "undefined", and zone OA set to 0. Zone system fan operation is set as per requirements in section 5.2 (identical to proposed).

6.3.3. DOAS Heat Recovery

Additional guidelines for DOAS equipped with heat recovery are outlined below.

1. **Fan Power in Heat Recovery Applications**

To accurately model heat recovery fan operation, the fans must be modeled as follows (for both baseline and proposed heat recovery applications):
   1. Set the main DOAS supply and exhaust fans to the NECB/ENS requirement (baseline model) and design fan power (proposed model)
   2. In the "outdoor air – heat recovery 2" tab, set ERV Fans to "HVAC Supply/Return"
   3. In the same tab, set "Delta P @ Dsgn Flow" as 0 for both Make-up and Exhaust
   4. In the "outdoor air – heat recovery 2" tab, set the ERV operation to "When Fans On", where the main DOAS fans have been set to run on the applicable fan schedule.

2. **Heat Recovery in Coupled Ventilation Systems**

In buildings where the DOAS supplies fresh air via terminal equipment, and is equipped with heat recovery on the exhaust stream, an adjustment must be implemented to ensure the exhaust air temperature is set to zone temperatures. By default, eQuest will model the exhaust air temperature as equal to the dummy zone temperature, which is set by the DOAS supply air setpoint (typically lower than zone temperature).

The adjustment is modeled as follows (for DOAS with no heating and cooling equipment):
   1. In the "Heat Recovery 2" tab, set Condensation/Frost Ctrl to "Preheat Exhaust"
   2. Set the Preheat Temp Ctrl to "Fixed Setpoint" and enter the zone temperature setpoint
   3. Set the Preheat Source to "Electric"
   4. In the "Meters" tab, set the system's "Space Heating" to a dummy meter

If the DOAS is equipped with heating (gas or electric), the exhaust preheat must be set to hot water, served by a dummy boiler (such that preheat energy is not added to the system's heating energy consumption). In this case, the adjustment must be modeled as follows:
   1. Create a dummy fuel-fired boiler and associated pump
   2. Set boiler and pump energy consumption to dummy meters (one fuel and one electric)
   3. In the DOAS "Heat Recovery 2" tab, set Condensation/Frost Ctrl to "Preheat Exhaust"
   4. Set the Preheat Temp Ctrl to "Fixed Setpoint" and enter the zone temperature setpoint
   5. Set the Preheat Source to "Hot Water" with the associated dummy boiler
   6. Keep the DOAS space heating on the main meter (electric or gas)

6.4. Additional Modeling Requirements for DOAS

Model parameters for DOAS units and associated dummy zones must be carefully selected to ensure the modeled system reflects design conditions. Models must consider the following:
- Humidity setpoints for zones and supply air
- Frost protection on heat wheels, when the exhaust preheat adjustment has been used
- Dummy zone schedule for variable flow DOAS

Because the inherent variability in HVAC system design across different building types, DOAS modeling requirements will be reviewed and assessed on a case by case basis.

6.5. Modeling of Water to Water and Air to Water Heat Pumps for Service Hot Water Applications

In eQuest/CANQuest models, soft service hot water equipment is limited to three types of water heaters:
1. Gas-fired water heater,
2. Electric resistance water heater,
3. Heat pump water heater with electric resistance backup.

The heat pump water heater module includes a set of 3 curves that provide the capacity and efficiency as a function of the environment temperature and part load ratio. It is imperative that the location of the heat pump is set correctly (indoor in a conditioned zone or outdoor) as the program will use the zone temperature when calculating the heat pump water heater performance.

The capacity and EIR (Energy Input Ratio) curves can be modified based on manufacturers engineering manuals. Default curves can be used when data is not available.

The systems also include a backup/supplemental immersion electric heater and requires the following inputs:
1. The capacity of the immersion heater. The default is the capacity of the heat pump.
2. Maximum heat pump supply temperature. This is the maximum water temperature that the heat pump can provide. Any additional boost to the supply temperature will be provided by the backup immersion heaters.

Proposed water-source heat pump water heaters must be modeled with the location set to an indoor heated zone and with the Capacity, EIR and PL-EIR set according to manufacturer's data. If the source is other than ground loop, the source energy consumption must be calculated outside of the model and added to the simulation output. Other methods may be used, but are subject to ENS approval.

6.6. Domestic Hot Water (DWH) Consumption and Load Reduction

DHW consumption in MURBs must be modeled per the Energy Star Multifamily High-Rise Program (MFHR) Simulation Guidelines (Version 1.0, Revision 03) Section 3.9.2. DHW Consumption in other buildings must be modeled per the ASHRAE Handbook – HVAC Applications, Chapter 51, Table 6. The "average daily" values must be used.

Energy savings can be claimed for hot water load reduction attributed to low flow shower and faucet fixtures, and Energy Star clothes washers and dishwashers. The Energy Star Multifamily High-Rise Program (MFHR) Simulation Guidelines (Version 1.0, Revision 03) Section 3.9.2 must be used. A copy of this document is available from ENS by request. The reduction in hot water load must be calculated and input in the energy model.

6.7. Receptacle load reduction using Energy Star Appliances

Energy savings for installing Energy Star appliances (refrigerators, dishwashers, clothes washers and dryers, and stoves) can be quantified using Section 3.10 of the Energy Star MFHR Simulation Guidelines. The reduction in equipment loads for the appliances must be input in the energy model to account for interactive effects.

6.8. Lighting Savings

Lighting savings will not be incentivized through the ENS NC program, because incentives are included in the sale price when purchased via provincial distributers through the ENS Business Energy Rebates (BER) Instant Rebates program. Exceptions are available for process lighting such as horticultural grow lights, which can be incentivized through NC and are not eligible for BER rebates. Lighting load reductions should be included in the energy model to account for interactive effects. If the developer has not received instant rebates through their distributor, lighting savings may be incentivized through NC provided adequate proof that an incentive has not already been received and energy savings can be verified.

6.9. Solar PV Model Requirements

Electrical energy savings achieved through a solar PV system will be added to a project's total electrical savings. Models of PV energy production must be submitted in one of the following:
1. PV Watts
2. RETScreen

The PV model must account for site-specific characteristics that affect solar potential (e.g. shading) and must include efficiencies associated with all components of the PV system as per design specifications.

7.0   Energy Modeling Submission Package(s)

7.1. Initial Energy Model Submission

For ENS to complete a thorough review of the submitted energy model and verify the energy savings, the following documents must be submitted in the Initial Energy Model Submission. Failure to provide required documents will result in rejection of energy model by ENS.

- Energy model simulation files for the Baseline case and Proposed case. Baseline case and Proposed case must be completed as separate models. Baseline models auto generated by software will not be accepted;
- Proposed building envelope calculations, completed in the ENS Envelope Calculations Template or similar;
- Architectural, mechanical, and electrical drawings for the building;
- Specification sheets for relevant equipment;
- Any additional calculations completed outside the energy model;
- Explanation of errors or warnings, and explanation of any workarounds used in the model;
- Additional supporting documentation as required (will be determined on a case-by-case basis).

7.2. As-Built Energy Model Update

If any design changes occurred during construction that may affect the building energy consumption, the energy modeler must complete an update to the energy model (As-Built Energy Model) to reflect the actual as-built design. The As-Built Energy Model submission must include the same documents as the Initial Energy Model listed in section 7.1 above that reflect the as-built design.

If the modeled energy savings calculated from the as-built design are less than 85% of the approved savings from the original model, the Implementation Incentive will be adjusted to the as-built energy model savings.

The Implementation Incentive will not be paid to the developer until the As-Built Energy Model is submitted by the energy modeler and approved by ENS.

If the design has not changed, the modeler must submit a statement from the developer confirming that the as-built condition is as per the IFC drawings.

8.0   Contact Information

For additional information regarding the Custom New Construction service or energy modeling requirements for this program, please contact:

cicustom@efficiencyns.ca