OREGON HOUSING & COMMUNITY SERVICES

MULTIFAMILY Energy Program

Energy Modeling Guidelines

April 2, 2025
Version 2025.1

These ***Energy Modeling Guidelines*** describe the modeling requirements for projects pursuing the *Whole Building Path* for both Existing Building and New Construction projects and serve as supplement to OHCS Multifamily Energy Program Manual.

Applicable for:

- **All Existing Building Projects**
- **New Construction Projects following the 2025 Oregon Zero Energy Ready Commercial Code**

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1 Summary Of Changes Since v2023.1

Modeling Requirement Update

- Dishwasher baseline updated to reference federal minimum efficiency requirements rather than ENERGY STAR Simulation Guidelines

Code Update

- 2025 Oregon Energy Efficiency Special Code (OEESC) (Effective July 1, 2025) guidelines included in the main guidelines
- 2021 Oregon Energy Efficiency Special Code (OEESC) guidelines were moved to the appendix
- 2019 Oregon Zero Energy Ready Commercial code guidelines were removed

Program Updates

- Whole building path projects must have at least one measure from each of the following measure types:
    - Efficient heating system (such as DHP, PTHP)
    - Heat Pump Water Heater
    - Envelope measure
- Following measures are no longer eligible for incentives
    - Smart or programmable thermostat
    - Low flow fixtures

2 Introduction

Oregon Housing & Community Services' (OHCS) Multifamily Energy Program (OR-MEP) promotes and facilitates energy-efficient design in affordable multifamily housing through design assistance, cash incentives, coordination with other regional programs, and education opportunities. Projects may apply for OR-MEP funding to upgrade Existing Building or New Construction projects. The purpose of the OR-MEP funding is to reduce energy use and heating costs for low-income Oregonians through energy efficiency improvements.

These ***Energy Modeling Guidelines*** describe the modeling requirements for projects pursuing the *Whole Building Path* for both Existing Building and New Construction projects. The *Whole Building Path*, which is targeted for projects interested in comprehensive energy upgrades, awards incentives based on energy savings calculations completed by an independent third-party Energy Consultant through an approved energy modeling software. (Refer to 1.4.1 Approved Modeling Software)

The Energy Modeling Guidelines serve as supplement to OHCS Multifamily Energy Program Manual.

Project pursuing the Menu or Bundled Path should follow guidelines included in the OHCS Multifamily Energy Program Manual.

The ***Energy Modeling Guidelines*** are based on best practices and where applicable aligning regional and national industry accepted practices including with:

- ENERGY STAR Multifamily New Construction Simulation Guidelines V 1, Revision 4

2.1 Roles & Responsibilities

The following are key OR-MEP program participants and their roles and responsibilities:

- ***Participant***: The entity applying to OR-MEP for their multifamily project and the recipient of program incentives.

- ***OR-MEP Energy Advisor***: The OR-MEP program staff assigned to each project who is the main point of contact for the Participant and any members of the project team throughout a project's participation in OR-MEP from enrollment to completion.

- ***Energy Consultant***: Participants must work with an independent third party known in the OR-MEP as the Energy Consultant, hired at the discretion of the Participant, to complete energy savings calculations through an approved energy modeling software.

  An Energy Consultant may be a licensed architect (RA), engineer (PE), or energy professional (ex: OHCS Approved Utility Allowance contractor, BPI-MFBA, CEM) who can provide technical assistance, verification and/or energy modeling services for the Participant.

2.1.1 Energy Consultant – Required Skills & Training

An Energy Consultant should be well versed in completing an energy assessment, energy savings calculation, and energy modeling using one of the Program's approved energy modeling software.

- **For Energy Consultants supporting Existing Building projects**, the Energy Consultant must do an onsite assessment according to industry standards, such as Building Performance Institute's (BPI) Multifamily Standards and in accordance with OR-MEP's Program Manual and these Modeling Guidelines. The Energy Consultant must document existing conditions and capture these conditions in an energy model to establish a proper baseline to calculate energy savings.

- **For Energy Consultants supporting New Construction projects**, the Energy Consultant should be well versed in the Oregon's energy code requirements.

- OR-MEP Energy Advisors will work with the Participant's Energy Consultant to complete the Technical Review. If a submittal requires revisions, the OR-MEP Energy Advisor will provide comments in a review document identifying the issues of each submittal revision. The Energy Consultant should review all comments and find and correct the errors causing each identified issue or explain why an identified issue is justified. OR-MEP Energy Advisors are available to provide one-on-one technical support with the Energy Consultant to discuss and resolve any issues identified in the Technical Review.

  It is the Energy Consultant's responsibility to identify any modeling issues causing the identified issues and to resolve them. OR-MEP staff are available to provide any needed technical assistance if the Energy Consultant is having difficulties.

  All Energy Consultants and project teams are expected to review their work and to submit a high-quality model along with fully completed tools and documents. If at any time during the Technical Review process the OR-MEP Energy Advisor deems the submittal as incomplete or missing information, the submittal will be rejected and sent back to resubmit.

2.2 Existing Building Requirements – Building Assessment

OR-MEP requires an independent third-party energy consultant (Energy Consultant) to conduct a comprehensive onsite assessment of existing building units and common areas in order to participate in the whole building path. The assessment will identify and quantify opportunities to reduce the reduction in property energy usage. After the onsite assessment is complete, the Energy Consultant will create a building model using approved building simulation software, as detailed in 1.4.1 Approved Modeling Software.

2.2.1 Site Visit Preparation

It is recommended that the Energy Consultant request 12 months of prior utility bills from the Owner to conduct bill analysis including identifying annual utility cost by fuel type and seasonal variations. The Energy Consultant could then conduct an interview with property manager and/or maintenance to better understand any utility costs anomalies and how the property operates.

The Energy Consultant shall schedule the site visit with the owner's representative that will cause minimal disruption to the project's residents. Owner applicant shall notify all residents in advance of the site visit, regardless of whether the unit is part of the sampling plan. This will allow for increased sampling if the rater finds inconsistencies and needs to inspect more units.

2.2.2 Sampling Protocols

OR-MEP requires the following sampling protocol for existing conditions assessment in Existing Building projects and verification for both Existing Building and New Construction projects. These protocols have been adapted from the RESNET Guidelines for Multifamily Energy Ratings *(Refer to Sampling section, p.52).*

Unit Sampling

The Energy Consultant shall inspect seven (7) apartment units, and then conduct assessment at a minimum ratio of one (1) out of seven (7) apartment units in the project. Sampled units shall be representative of the variety of apartment types in the project including: end/corner and interior units; top-floor, middle-floor, bottom-floor units; and at least one unit of each type (i.e.: studios, 1-bed, 2-bed, etc.). For projects less than 7 units, all units must be verified.

The Energy Consultant shall increase the sampling set if inconclusive and/or inconsistent findings occur. *(Refer to RESNET Guidelines for more details)*

For projects with multiple buildings, at least one unit in each unique building type shall be verified.

Common Area Sampling

The Energy Consultant shall meet the following requirements for sampling of common area spaces:

- **Unique Area Sample Size**: The rater shall inspect 100 percent of unique common area spaces such as basements, lobbies, etc.

- **Repetitive Area Sample Size**: The rater shall inspect a representative 20 percent sample (with a minimum of five areas) of similar or repetitive areas such as stairwells and stairwell landings, corridors, trash chute rooms, etc.

2.2.3 Visual Inspection

The site visit shall involve visual inspections and data collection of the building envelope (including roof, floor, overhangs, walls, and windows), mechanical systems (heating, cooling, domestic hot water), fixture flow rates, lighting, and appliances. The Energy Consultant shall identify and record all building assembly and equipment specifications (nameplate data) necessary for creating building energy simulation. Raters may use data collection sheets of their own design to collect information on-site. OR-MEP will review and may request more information or clarification around data collection.

2.2.4 Testing Documentation

During the building assessment, OR-MEP does not require testing, such as blower door testing, duct leakage testing, or ventilation balancing testing. However, testing may be necessary to demonstrate baseline performance for measures, such as air sealing or duct sealing, that are contributing to significant savings. Energy Consultants should contact OR-MEP staff in such circumstances to discuss how proposed performance will be demonstrated both for baseline modeling and at the verification stage when measures are installed.

If testing is required, testing results must be provided showing conditions meet measure requirements per 1.2.2 Sampling Protocols.

2.2.5 Assessment Report

For each project, the Energy Consultant must submit an assessment report that addresses the scope of the assessment. The assessment report shall include all the data collected, the evaluation of the building and the Energy Efficiency Plan. OR-MEP recommends that the assessment report include the following sections and content.

Executive Summary

- Number of units, building construction type, number of stories, year built, total building area identified by use (residential, community/common, commercial), history of previous retrofits or rehabs, and other significant building features
- Date of site visit

Narrative

Include a written narrative that describes existing property conditions in the following categories:

- Site description including property location, orientation, and important site details.
- Building envelope including roof and windows, air flow, insulation, and ducts
- Building mechanical and electrical systems including (when applicable) heating, ventilation, cooling and electrical systems, and elevators
- Mechanical room, including (when applicable) boilers, domestic hot water, and plumbing systems
- Common areas including community rooms, kitchens, lobbies, corridors, and commercial spaces
- Dwelling units, as relates to health and safety, and energy efficiency conservation

If leveraging a report that someone else created like a Capital Needs Assessment, include information from the site visit to verify existing conditions were captured accurately or update as needed. Include information on equipment specifications. Also, include photo documentation of the property, specifically targeting the relevant physical conditions and potential energy efficiency

Energy Assessment

Summarize the modeling approach and external calculation methods used in the energy analysis. Include the name and version of the energy modeling software used and indicate if the project is using external calculations to estimate energy and energy cost savings outside of the parameters of the model. Provide a summary of the approach and detailed calculations used in any external calculations.

2.2.6 Fuel Switching

OR-MEP cannot incentivize measures converting or replacing from one fuel type to another (e.g. natural gas to electric). The program can only provide incentives for measures that result in electric savings from existing electrical equipment.

2.3 New Construction Requirements – Oregon Code Baseline

The baseline energy use modeled should follow the energy code requirements of the specific project as follows:

- Projects should model the baseline using the code version accepted at time of permit approval.

- **Project permitted on or after July 1, 2025** shall follow the 2025 Oregon Energy Efficiency Specialty Code (OEESC)[1]
  1. Chapter 1 of the Oregon Structural Specialty Code (OSSC)[2], including specific modifications in 2025 OEESC.
  2. ANSI/ASHRAE/IES Standard 90.1 – 2022[3], including specific modifications in 2025 OEESC.

- **Project permitted before July 1, 2025** shall follow the 2021 Oregon Energy Efficiency Specialty Code (OEESC)[4].
  ASHRAE 90.1 - 2019[5]: This applies to buildings constructed under the OSSC including low-rise multifamily. Excluding detached single family, duplex, and townhouses[6] with three or fewer stories.

COM*check*

To establish baseline requirements, OR-MEP encourages projects to use COM*check* as a tool to establish baseline requirements per code to support energy modeling development and ensure alignment of permitted design and energy model. COM*check* reports submitted for code compliance can be helpful in energy model development.

[1] 2025 Oregon Energy Efficiency Specialty Code (OEESC): https://www.oregon.gov/bcd/codes-stand/Documents/25oeesc.pdf
[2] Oregon Structural Specialty Code (OSSC): https://codes.iccsafe.org/content/ORSSC2022P2
[3] ASHRAE 90.1-2022: https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards
[4] Oregon Building Code Division: https://www.oregon.gov/bcd/codes-stand/Pages/energy-efficiency.aspx
[5] ASHRAE 90.1-2019: https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2019

2.3.1 Oregon Code Baseline Requirements for Projects Permitted under 2025 Oregon Energy Efficiency Special Code (OEESC)

See appendix A for projects permitted prior to July 1, 2025.

Figure 1: Oregon Code Baseline Requirements per 2025 Oregon Energy Efficiency Special Code (OEESC)

Building Component	Modeling Requirements	
Appliances[7]	Energy Consumption	Sensible/Latent Load Fraction
Refrigerators	Baseline (conventional unit): 529 kWh/yr Proposed (ENERGY STAR unit): as specified, or 423 kWh/yr	1.00/0.0
Dishwashers[8]	Baseline (conventional unit): 307 kWh/yr Proposed (ENERGY STAR unit): as specified, or 204 kWh/yr	0.60/0.15
Clothes Washers – In-Unit	**In-unit Clothes Washers:** Baseline (conventional unit): 81 kWh/yr Proposed (ENERGY STAR unit): as specified, or 57 kWh/yr **Commercial Clothes Washers:** Baseline (conventional unit): 196 kWh/yr Proposed (ENERGY STAR unit): as specified, or 138 kWh/yr	0.80/0.0
Cooking (electric stove/range)	604 kWh/year	0.40/0.30
Cooking (gas stove/range)	45 Therms/year	0.30/0.20
Clothes Dryer	Electric Dryer: Baseline: kWh/yr = [418 + (139*Nbr)]*F Proposed (ENERGY STAR unit): as specified, or [331 + (110*Nbr)]*F Gas Dryer: Electricity: kWh/yr = [38 + (12.7*Nbr)]*F Gas: Therms/yr = [26.5 + (8.8*Nbr)]*F Nbr = Average number of Bedrooms in dwelling units. F = scale factor to account for increased number of cycles of common space clothes dryers. F=1 for in-unit clothes dryers. F = 2.423 for common space clothes dryers.	Electric Dryer: 0.15/0.05 Gas Dryer: Electricity – 1.0/0.0 Gas – 0.10/0.05
Misc. Dwelling Unit Plug Loads	0.5 W/ft2 or 1.05 kWh/FFA FFA = Finished Floor Area of living space in square feet	0.90/0.1

[7] Per ENERGY STAR Multifamily New Construction Simulation Guidelines: https://www.energystar.gov/sites/default/files/asset/document/ENERGY_STAR_MFNC_Simulation_Guidelines_Version_1_Rev04.pdf

[8] Federal dishwasher minimum efficiency requirement: https://www.energy.gov/eere/buildings/articles/dishwasher-final-rule-2020-10-19

Building Component	Modeling Requirements	
Misc. **Non-Dwelling Unit Plug Loads**	Corridors, restrooms, stairs, and support areas: 0.2 W/ft2 design; 0.7 kWh/ft2 annual usage. Offices: 1.5 W/ft2 design; 4.9 kWh/ft2 annual usage Other Multifamily Public & Common Areas: 0.5 W/ft2 design; 1.6 kWh/ft2 annual usage	1.0/0.0
Domestic Hot Water		
Water Heater, Electric Resistance[9]	≤12kW, Resistance, ≥ 20 gallons and ≤ 55 gallons: Very Small EF = 0.8808 – (0.0008 x V_r) Low EF = 0.9254 – (0.0003 x V_r) Medium EF = 0.9307 – (0.0002 x V_r) High EF = 0.9349 – (0.0001 x V_r) ≤12kW, Resistance, > 55 gallons and ≤ 120 gallons: Very Small EF = 1.9236 – (0.0011 x V_r) Low EF = 2.0440 – (0.0011 x V_r) Medium EF = 2.1171 – (0.0011 x V_r) High EF = 2.2418 – (0.0011 x V_r) >12kW, Resistance, <4,000 (Btuh)/gal: SL ≤ 0.3 + 27/V_m %/h	
Low Flow Shower Heads	Not eligible for savings. Model baseline and proposed as the same GPM.	
Low Flow Aerators	Not eligible for savings. Model baseline and proposed as the same GPM.	
Envelope[10]		
Above Grade Walls		
Mass	**Climate Zone 4** Insulation Min: R-11.4ci Assembly Max: U-0.090 **Climate Zone 5** Insulation Min: R-13.3ci Assembly Max: U-0.080	
Metal Building	**Climate Zones 4 + 5** Insulation Min R-0 + R-19ci Assembly Max: U-0.050	
Steel-Framed	**Climate Zone 4** Insulation Min: R-13 + R-7.5ci Assembly Max: U-0.064 **Climate Zone 5** Insulation Min: R-13 + R-10ci Assembly Max: U-0.055	
Wood Framed and Other	**Climate Zone 4** Insulation Min: R-13 + R-3.8ci or R-20	

[9] Per ASHRAE 90.1-20122, Table 7.4-1 referencing Appendix F, Section F2; EF = Energy Factor, V_r = rated storage volume (in gallons), SL = Standby loss, V = rated volume in gallons, V_m= measure volume in gallons

[10] Commercial Energy Provisions: Per Table 5.5-4 (Climate Zone 4), Table 5.5-5 (Climate Zone 5), Residential; Multifamily Energy Provisions: Per Table C402.1.3

Building Component	Modeling Requirements
	Assembly Max: U-0.064 **Climate Zone 5** Insulation Min: R-13 + R-7.5ci or R-19 + R-5ci Assembly Max: U-0.051
Below Grade Walls	
Below Grade Walls	**Climate Zones 4 + 5** Insulation Min: R-10ci Assembly Max: C-0.092
Floors	
Mass	**Climate Zones 4 + 5** Insulation Min: R-16.7ci Assembly Max: U-0.051
Steel Joist	**Climate Zones 4 + 5** Insulation Min: R-30 Assembly Max: U-0.038
Wood-framed and Other	**Climate Zones 4 + 5** Insulation Min: R-30 Assembly Max: U-0.033
Slab-on Grade Floors	
Unheated	**Climate Zone 4** Insulation Min: R-15 for 24 in. below Assembly Max: F-0.520 **Climate Zone 5** Insulation Min: R-20 for 24 in. below Assembly Max: F-0.510
Heated	**Climate Zones 4 + 5** Insulation Min: R-20 for 48 in. below Assembly Max: F-0.688
Roofs	
Insulation entirely above deck	**Climate Zones 4 + 5** Insulation Min: R-30ci Assembly Max: U-0.032
Metal building	**Climate Zones 4 + 5** Insulation Min: R-19 + R-11 Ls or R-25 + R-8 Ls Assembly Max: U-0.037
Attic and other	**Climate Zones 4 + 5** Insulation Min: R-49 Assembly Max: U-0.021
Vertical Fenestration 0% to 40% of Wall	
Fixed	**Climate Zone 4 + 5** Assembly Min VT/SHGC: 1.10 **Climate Zone 4** Assembly Max: U-0.36/SHGC-0.36

Building Component	Modeling Requirements
	Climate Zone 5 Assembly Max: U-0.36/SHGC-0.38
Operable	**Climate Zone 4 + 5** Assembly Max: U-0.45/SHGC-0.33 Assembly Min VT/SHGC: 1.10
Entrance Door	**Climate Zone 4 + 5** Assembly Max: U-0.63/SHGC-0.33 Assembly Min VT/SHGC: 1.10
Skylight, 0% to 3% of Roof	
All Types	**Climate Zone 4 + 5** Assembly Max: U-0.50 Assembly Max: SHGC-0.40
Opaque Doors	
Swinging	**Climate Zone 4 + 5** Assembly Max: U-0.370
Nonswinging	**Climate Zone 4 + 5** Assembly Max: U-0.310
Air Leakage	
Air Leakage	0.4 CFM/sf at 75 Pa Refer to ASHRAE 90.1-2022 Section 5.4.3 Note: 1. Per Section 5.4.3.1, the entire building envelope shall be designed and constructed with a continuous air barrier. Per Section 5.4.3.1.1, the building shall comply with whole-building pressurization testing in accordance with ASTM E779 or ASTM E1827 by an independent third party [11] and with the continuous air barrier requirements in Section 5.4.3.1.2
Heating & Cooling	
Electric Heating System	Electric Resistance Heater[12]
Electric Cooling System	If cooling is proposed, refer to ASHRAE 90.1-2022 Tables 6.8 1-1 through 6.8.1-20, for minimum equipment efficiencies.
HVAC Fan Systems	Fan Power[13]: Refer to ASHRAE 90.1-2022, Section 6.5.3.
Lighting	
Apartment Lighting	Per 2025 Oregon Energy Efficiency Specialty Code modification of ASHRAE 90.1-2022 Section 9.4.3 Dwelling Units:

[11] "Whole-building pressurization testing shall be conducted in accordance with ASTM E779, ASTM E1827, or ASTM E3158 by an independent third party. The measured air leakage rate of the building envelope shall not exceed 0.35 cfm/ft2 under a pressure differential of 75Pa (0.3 in. of water), with this air leakage rate normalized by the sum of the above and below-grade building envelope areas of the conditioned and semi-heated space." Refer to ASHRAE 90.1-2022 for exceptions to 5.4.3.1.1.

[12] Per ASHRAE 90.1-2022, Section 6.3.2(e), an electric resistances heater is the least efficient electric heating system allowed. However, proposed equipment shall meet minimum equipment efficiencies as detailed in code: (1) ASHRAE 90.1-2022: refer to Tables 6.8 1-1 through 6.8.1-2 for minimum equipment efficiencies; (2) 2018 IECC: refer to Tables C403.3.2(1) through C403.3.2(9) for minimum equipment efficiencies.

[13] Per ASHRAE 90.1-2022 and IECC 2018, applicable to total fan system motor nameplate horsepower exceeding 5 hp.

Building Component	Modeling Requirements
	Not less than 100% of the permanently installed lighting fixtures shall use lamps with an efficacy of at least 75 lm/W or have a total luminaire efficacy of at least 50 lm/W.
Common Area Lighting	Building Area Method Per ASHRAE 90.1-2022 Tables 9.5.1, Multifamily = 0.46 W/sf
Lighting Controls	Building Area Method or Space by Space Method Refer to ASHRAE 90.1-2022
Exterior Lighting	Refer to ASHRAE 90.1-2022 Table 9.4.2-2: Individual Lighting Power Allowances for Building Exteriors For applicable lighting zone, refer to ASHRAE 90.1-2022 Table 9.4.2-1 Exterior Lighting Zones
Ventilation	
Apartment Ventilation	Minimum Ventilation Rates per 2022 Oregon Mechanical Specialty Code, Chapter 4 ASHRAE 90.1-2022 6.5.6: Enthalpy recovery of 50% for heating for all nontransient dwelling units greater than 500sf
Local Exhaust - Kitchen[14]	50 CFM, continuous 150 CFM, intermittent
Local Exhaust – Bathrooms[15]	20 CFM, continuous 80 CFM, intermittent
Outdoor Air for Dwelling Units	CFM = 0.01 x area (sf) + 7.5 x (1 + # of bedrooms)[16]
Outdoor Air for Other Spaces[17]	No less than 0.06 CFM/ft^2

2.3.2 Baseline Modeling Adjustments

While Figure 1: Oregon Code Baseline Requirements per OEESC outlines the baseline requirement per code, there may be some instances where the baseline assumptions are not appropriate or applicable based on the specific conditions of a building. The Energy Consultant is encouraged to contact OR-MEP program staff to discuss any deviations from these baseline requirements and propose alternative baseline values and reasoning.

When there is no defined code requirement for a specific modeling parameter, the Energy Consultant should reflect industry accepted practices and document these assumptions in the Energy Efficiency Plan.

[14] Per 2022 Oregon Mechanical Specialty Code, Table 403.3.1
[15] Per 2022 Oregon Mechanical Specialty Code, Table 403.3.1
[16] Per 2022 Oregon Mechanical Specialty Code, Section 403.3.2.1.
[17] Per 2022 Oregon Mechanical Specialty Code, Section 403.3.2.2.

2.4 General Modeling Requirements

2.4.1 Approved Modeling Software

The Energy Consultant must submit the modeling files used to calculate savings summarized in the Energy Efficiency Plan. Any OHCS approved energy analysis tool is acceptable for calculating savings. OHCS has reviewed and approved the following tools for multifamily use: EnergyPro (mid-rises only), TREAT, DOE-2, TRACE, HAP, REM/Rate (≤ 3 stories), REM/Design (≤ 3 stories), eQuest, and IES-VE.

2.4.2 Establishing the Baseline and Proposed Design Model

Projects shall be simulated as described in this document.

The Baseline design model and Proposed design model shall be based on the final design of the project. Baseline and Proposed design models shall include all the energy uses within and associated with the building.

Baseline Design Model Components

For Existing Building projects, components of the Baseline design model shall reflect the existing building conditions.

For New Construction projects, components of the Baseline design model shall comply with the applicable Oregon energy code the project is permitted under.

End uses that do not exist in the Proposed design model cannot be included in the Baseline design model.

Example: Parking Lot Lighting

If the parking lot in the Proposed design is not lit, then parking lot lighting power allowance cannot be added to the Baseline design model’s energy consumption.

Proposed Model Components

Components in the Proposed design model must reflect the actual building components, except where otherwise specified in this document. Components in the Proposed design must comply with applicable state and local codes. If components are not installed during construction, (for example appliances or room air conditioners), then such components may not be modeled in the Proposed design model as contributing to energy savings.

Example: Space Cooling

In New Construction projects, if heat pumps with cooling are in the Proposed design they should be included in the Proposed design model as specified. The Baseline design model should include cooling with an equivalent cooling system with a code level efficiency. If there is no cooling in the Proposed design, cooling should be excluded from the Baseline design model.

2.4.3 Project Boundary & Non-Residential Spaces

The models shall include all dwelling units and common spaces in the building. Other nonresidential areas such as retail stores or offices open to the general public and unrelated to the building's residential function may be included or excluded from the simulations at the discretion of the energy modeler. If included, they must be modeled energy neutral and energy savings cannot be claimed for nonresidential areas.

2.4.4 Projects with Multiple Buildings

Separate Baseline design models and Proposed design models shall be created for each unique, non-identical building in the project.

Savings and incentives shall be calculated at a project level aggregating Baseline and Proposed design results across all buildings individually for each such building.

2.4.5 Schedules

The models must include the schedules described in this document, or approved equivalent. All schedules that differ from the ones specified here shall be documented and submitted to OR-MEP staff for approval.

The same schedules must be used in both the Baseline Building Design and Proposed Design unless explicitly allowed this document. Any difference in the schedules must be documented.

2.4.6 Modeling Interactive Effects

All measures that can be modeled in an approved modeling software shall be modeled in the software. Additionally, all energy efficiency measures shall be modeled to capture the interactive effects between measures. This results in the most accurate method for calculating the OR-MEP's Whole Building Path energy savings. The best method for modeling interactive effect varies across software tools. For example, in eQUEST measures can be modeled interactively using Parametric Runs. The Energy Consultant shall determine the best method for modeling measures interactively based on the modeling software and measures proposed. All interactive modeled savings shall be inputted into the Energy Efficiency Plan workbook accordingly at the measure level.

To align with regional guidance, OR-MEP recommends following these three approaches as accepted and outlined in Energy Trust of Oregon's New Buildings Program Technical Guidelines

1. **Subtractive baseline**: The as-designed building is run with all measures included. One measure is removed and the model is rerun. That measure is put back into the model and another is removed and the model is run again. This is done until all measures have been evaluated. The difference between the total interactive run values and the values determined when the measure is removed is considered the individual measure's contribution. A code baseline model is also required to determine the final interactive energy savings.

   This is viewed as the most conservative approach for ascertaining the savings associated with individual measures.

2. **Incremental or rolling baseline**: The measures to be included in the design are consecutively added to the baseline model with a run made for each measure to estimate the effect of that measure. It is possible that the sum of the individual savings will not equal the total for the interactive model. Care should be taken in the ordering of measures; those that are most likely to be implemented and most likely to be cost effective should be added first.

   This is a more expensive approach. If a measure is removed or modified the model will have to be rebuilt from the point where that element was changed in the model. It is less conservative than the subtractive approach in measuring the effect of individual measures due to the fact that they are not tested against the background of the rest of the measures.

3. **Individual approach**: The measures are tested one at a time in isolation against the baseline. Selected measures are included in a final, interactive model. This is considered the least conservative approach to estimating the effect of individual measures in the final building design.

2.4.7 External Calculations – Special Measures

For measures that cannot be modeled in the approved energy modeling software, external engineering calculations may be submitted instead, typically as spreadsheets or industry specific tools. Applicants should consult with OR-MEP staff prior to using any external calculation methods for pre-approval of the general method and for technical assistance with alternate modeling options.

All external calculations shall be documented as follows:

- A list of all assumptions, constants, and equations used in the calculations must be clearly identified.
- Interactions between measures should be accounted for in the calculations.
- All external calculations calculated in a spreadsheet tool, shall be submitted as an Excel file that is unlocked and can be followed by OR-MEP staff during technical review.

2.4.8 Gut-Rehab, Substantial Renovation, and Addition Projects

OR-MEP serves projects that are gut-rehab, substantial renovation, and addition projects. Generally, determine the baseline requirements of the components and whether they shall follow existing conditions or code requirements is determined by what code requires. As each project is unique, OR-

MEP approaches these projects on a case-by-case basis. Please contact OR-MEP staff to discuss in more detail to maximize energy savings opportunities while still aligning with code requirements.

2.4.9 Renewables

Energy savings associated with on-site power generation, including cogeneration with the associated waste heat recovery, photovoltaics, or wind turbines, may not contribute to savings or be used to meet OR-MEP's Whole Building Path savings thresholds (e.g. ≥ 20%, ≥ 25%, ≥30%, kWh savings).

2.5 Submittal Documentation

The Energy Consultant must submit the following documents for OR-MEP's Whole Building Path during the Technical Review Stage. The OR-MEP Energy Advisor will review proposed work scope and confirm all measures selected meet program requirements.

- **Energy Efficiency Plan (EEP) Worksheet**: The EEP is a program developed Excel spreadsheet that summarizes measures, savings, and eligible incentives for projects. Projects pursuing the Whole Building Path, should complete the Whole Building Path sections of the workbook.

- **Energy Model:** The Participant must submit the modeling files used to calculate savings summarized in the Energy Efficiency Plan. Any OHCS approved energy analysis tool is acceptable for calculating savings. OHCS has reviewed and approved the following tools for multifamily use: EnergyPro (mid-rises only), TREAT, DOE-2, TRACE, HAP, REM/Rate, REM/Design, and eQuest.

- **External Calculations (if applicable)**: For measures that cannot be modeled in the approved energy modeling software, external engineering calculations may be submitted instead, typically as spreadsheets or industry specific tools. Applicants should consult with OR-MEP staff prior to using any external calculation methods for pre-approval of the general method and for technical assistance with alternate modeling options.

- **Specification Sheets**: The project must submit specification sheets for any energy saving equipment included in the work scope. Examples include domestic hot water equipment, heating and cooling equipment, windows, and ventilation equipment. Specification sheets must document make, model, and efficiency specifications.

- **Construction Drawings / Work Scope Specifications:** The project's construction plans must include at minimum the building floor plan, elevations, and mechanical plan. Additional plan sheets will be required when applicable to the project scope, such as roofing/attic plans, duct design, or electrical plans.

- **Photos (EXISTING BUILDING ONLY)**: Photos of all existing conditions must be submitted prior to installation of any new measure.

3 DOE Software Engine

3.1 General Approach

The guidelines noted in this section are based on best practices and where applicable aligning with:

- Energy Trust of Oregon's New Buildings Program Technical Guidelines
- ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2023
- ASHRAE 90.1-2022 Appendix G

3.1.1 Applicable Energy Simulation Software

The guidance in this section is applicable to energy simulation using a DOE software engine. Examples of such tools include eQUEST, DOE2.1, Energy Plus, Open Studio, and Trane Trace 700. These software tools are generally used for more "commercial" building modeling typically including multifamily properties that are greater than three (3) stories but can be used to model any multifamily property.

3.2 Building Component Modeling Requirements

The following guidance provides modeling requirements by building component level for both the baseline model and the proposed model. Where applicable, the guidance distinguishes modeling requirements distinctions for Existing Building and New Constructions projects.

3.2.1 Building Envelope

Baseline Design

- **Existing Building**
  Opaque envelope assemblies and fenestration for Existing Building projects shall be modeled based on the existing conditions identified during the onsite visit as described in 1.2 Existing Building Requirements – Building Assessment.

- **New Construction**
  Opaque envelope assemblies and fenestration for New Construction projects shall be modeled following the applicable Oregon energy code requirements, as described in Figure 1: Oregon Code Baseline Requirements per Oregon Zero Energy Ready Commercial Code

Proposed Design

For both Existing Building and New Construction project opaque envelope assemblies and fenestration shall be modeled to reflect the proposed design as described in construction documents and specifications.

Existing Building: Building Components Unchanged

For Existing Buildings, any components not changing shall be modeled the same in both the Baseline design and Proposed design.

- **Thermal Bridging**
  - **Framing Members:** Thermal properties of framing, including but not limited to steel-framed assemblies to capture thermal bridging following industry best practices such as ASHRAE 90.1-2016 Appendix A.

Example: Cavity Insulation and Steel Framed Walls

Q. A project has 16" on center steel framed walls with R-13 cavity insulation and R-10 continuous insulation. How should this assembly be modeled?

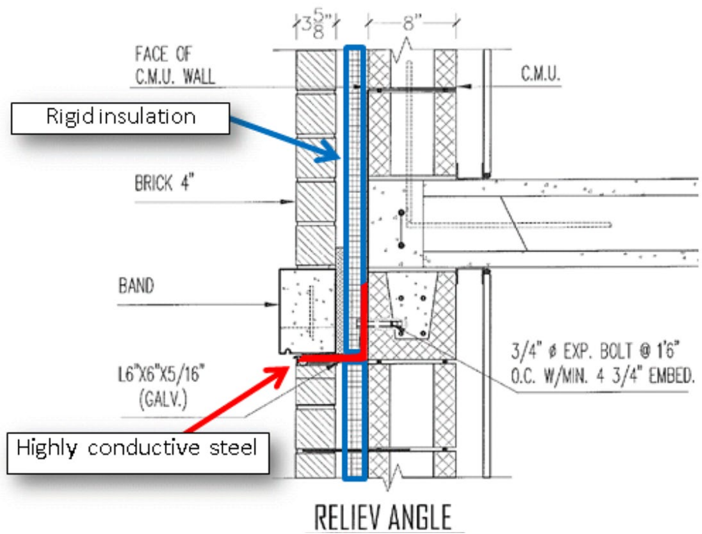
A. Based on ASHRAE 90.1-2019 Table A3.3.3.1, the effective thermal resistance of the R-13 cavity insulation is R-6, thus the overall R-value of the cavity and continuous insulation is 6 + 10 = 16

  - **Shelf Angles**: The Proposed Design model must account for thermal bridging through portions of the wall assembly where shelf angles or other continuous metal fastened to the wall are used. Where those conditions exist, the insulation cannot contribute to the assembly U-factor for those areas. An overall U-factor shall be calculated based on an area weighted average of the thermal properties.

Example: Shelf Angles

Q. The wall assembly has rigid insulation and cavity insulation for the overall U-0.064. The vertical component of the shelf angle shown on the figure below comprises 5% of the vertical wall area. The U-factor of the areas thermally bypassed by the shelf angle is U-0.097, based on the cavity insulation only, excluding the rigid insulation. What overall U-factor of the wall assembly should be modeled in the proposed design?

A. Based on ASHRAE 90.1-2016 Table A3.3.3.1, the effective thermal resistance of the R-13 cavity insulation is R-6, thus the overall R-value of the cavity and continuous insulation is 6 + 10 = 16



- **Fenestration**

  Fenestration must be modeled as specified, to reflect whole window assembly SHGC and U-factors including frame (not the center-of-glass U-factor). Acceptable sources include:
  - NFRC rating from the window manufacturer for the entire fenestration unit. (This is usually available only for standard window sizes.)
  - LBNL WINDOW software
  - NFRC's CMAST software
  - ASHRAE 2009 Fundamentals [9], Chapter 15 Table 4 and 10.
  - Certification provided by the installer or supplier listing the assembly U-factor and SHGC can be used in lieu of NFRC labels, provided that they comply with the fenestration rating requirements in Section 5.8.2 of the reference version of 90.1.

- **HVAC Penetrations**
  - **Unique envelope assemblies**: Unique envelope assemblies such as projecting balconies, perimeter edges of intermediate floor slabs, concrete floor beams over parking garages, and roof parapets, shall be separately modeled in the Proposed Design, per ASHRAE

90.1-2016 Appendix G Table G3.1, No. 5 (a). A weighted average of the U-factors of these assemblies is acceptable in the simulation. Projected balconies and perimeter edges of intermediate floor slabs are considered to be a wall, per wall definition in Section 3 of 90.1, and shall be modeled in the Baseline Building Design with the same U-factor and construction as exterior walls.

- **Partially Glazed Doors**
  In the proposed design, the door U-factor and SHGC shall be modeled as per the NFRC label for the door specified in the final design.

- **Shading**
  New Construction
  - Automatically-controlled fenestration shades or blinds and permanent shading devices that are part of the building, including but not limited to side fins, overhangs, and balconies, must be modeled in the proposed design, and not modeled in the baseline.
  - Manual shading such as blinds or shades must not be modeled in either the baseline or proposed design.

- **Slab-on Grade Floor Construction: F-factor**
  If the energy modeling software tool does not allow input of the perimeter heat loss factor (F-factor), then the slab-on-grade construction that corresponds to the F-factor shall be modeled as is appropriate for the software tool being used.

3.2.2 Infiltration

Baseline Design

- **Existing Building**
  Infiltration for Existing Building projects shall be modeled based on the existing conditions identified during the onsite visit as described in 1.2 Existing Building Requirements – Building Assessment.
  While OR-MEP does not require blower door testing, blower door testing may be necessary for scopes of work with high infiltration reductions (e.g., greater than 10% infiltration reduction from baseline), where air sealing is contributing to significant savings (e.g., greater than 20% of total savings).

  Blower door testing is encouraged and recommend maximizing air sealing related savings.

  For projects where blower door testing is not completed, the Energy Consultant shall use a baseline infiltration value based observed visual conditions. (Refer to ASHRAE Handbook – Fundamentals for guidance)

- **New Construction**
  Infiltration for New Construction projects shall be modeled following the applicable Oregon energy code requirements, as described in Figure 1: Oregon Code Baseline Requirements per 2025 Oregon Energy Efficiency Special Code.

Example: New Construction Baseline Modeling

Q. The project involves a 5-story multifamily building with slab-on-grade foundation following the ASHRAE 90.1-2019. Each floor is 8,000 ft^2. The total gross floor area is 40,000. The total gross wall area is 17,117 ft^2. The total conditioned building volume is 360,068 ft^3. The project is modeled in eQUEST. How should be baseline infiltration rate be entered?

A. As noted in Figure 1: Oregon Code Baseline Requirements per 2021 Oregon Energy Efficiency Special Code, the ASHRAE 90.1-2019 requires building envelope air leakage not to exceed 0.4 CFM/sf at 75 Pa. This shall include the total area of the envelope air pressure boundary, including the lowest floor, any below- or above-grade walls, and roof (or ceiling) including windows and skylights, separating the interior conditioned space from the unconditioned environment.

The total envelope air pressure boundary for the project is:

S=8,000 x 2 + 17,117=33,117 ft^2

The air leakage at 75 Pa must be converted to leakage at the wind pressure. This can be calculated using equations in ASHRAE 90.1-2019 Section G3.1.1.4 as follows:

I=33,117*0.4*0.112=1,484 CFM

ASHRAE 90.1-2019 Table G3.1 No.5 (b) notes that simulation accounts for the factors such as weather conditions. "Air Change" method is the best fit for it in eQUEST. The calculated flow rate is converted to the air-change rate for input into eQUEST as follows:

1,484 [CFM] * 60 [min/hr] / 360,068 [ft3] = 0.25 [ACH]

The modeled infiltration schedule "ASH Inf Sch" has hourly fraction of 1 for all hours.

2-D Geometry | 3-D Geometry | Spreadsheet | Summary

Display Mode: Infiltration

	Space Name	Parent Floor	Activity Desc.	Infiltration Method	Infiltration Schedule	A-C Air Changes/hr	A-C Infiltration Flow (cfm/ft2)
1	EL1 South Perim Spc (G.S	EL1 Ground Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
2	EL1 East Perim Spc (G.E2	EL1 Ground Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
3	EL1 North Perim Spc (G.N	EL1 Ground Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
4	EL1 West Perim Spc (G.W	EL1 Ground Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
5	EL1 Core Spc (G.C5)	EL1 Ground Flr	Corridor	Air Change	ASH Inf Sch	0.25	0.0000
6	EL1 South Perim Spc (M.S	EL1 Mid Flrs	Resident	Air Change	ASH Inf Sch	0.25	0.0000
7	EL1 East Perim Spc (M.E7	EL1 Mid Flrs	Resident	Air Change	ASH Inf Sch	0.25	0.0000
8	EL1 North Perim Spc (M.N	EL1 Mid Flrs	Resident	Air Change	ASH Inf Sch	0.25	0.0000
9	EL1 West Perim Spc (M.W	EL1 Mid Flrs	Resident	Air Change	ASH Inf Sch	0.25	0.0000
10	EL1 Core Spc (M.C10)	EL1 Mid Flrs	Corridor	Air Change	ASH Inf Sch	0.25	0.0000
11	EL1 South Perim Spc (T.S	EL1 Top Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
12	EL1 East Perim Spc (T.E1	EL1 Top Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000
13	EL1 North Perim Spc (T.N	EL1 Top Flr	Resident	Air Change	ASH Inf Sch	0.25	0.0000

Proposed Design

For both Existing Building and New Construction projects, infiltration shall be modeled to reflect the proposed design as described in construction documents and specifications.

While OR-MEP does not require blower door testing, blower door testing may be necessary for scopes of work with high infiltration reductions (e.g. greater than 10% infiltration reduction from baseline), where air sealing is contributing to significant savings (e.g. greater than 20% of total savings).

Blower door testing is encouraged and recommend to maximize air sealing related savings.

3.2.3 Interior Lighting

Lighting Schedule

- Baseline and Proposed Design lighting inside dwelling units shall be modeled as lit for 2.34 hours per day[18]. No schedule-based performance credits may be claimed for lighting inside dwelling units.

Exception: In-Unit Lighting Schedule

The 2.34 hours per day assumption for in-unit lighting noted above is a default multifamily assumption referenced based on ENERGY STAR Multifamily High Rise Program Simulation Guidelines. However, it may not be appropriate depending on the population type of the property. For example, a senior or family population may occupy an apartment for longer periods.

As noted in Section 1.3.2 Baseline Modeling Adjustments, the Energy Consultant is encouraged to contact OR-MEP program staff to discuss any deviations from these baseline requirements, proposed alternative baseline values, and reasoning.

- Balcony lighting shall use the same schedule as the dwelling units.
- Baseline lighting in corridors, stairwells and lobbies shall be modeled as lit for 24 hours per day.
- Hours of operation of Baseline lighting fixtures in areas not identified above may be estimated by the Energy Consultant based on the occupancy type of each space.

Baseline Lighting

- **In-Unit Lighting:**

  Existing Building

  - In-unit lighting LPD (W/sf) shall be calculated by the Energy Consultant based on an assessment of existing light fixtures.

  New Construction

  - In-unit lighting shall be modeled as required by code.

- **Common Area Lighting:**

[18] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2019

Existing Building

- Common area lighting LPD (W/sf) shall be calculated by the Energy Consultant based on an assessment of existing light fixtures.

New Construction

- Lighting power in common area spaces must be established using either the Building Area Method or Space-by-Space Method, as described in code. For types of spaces not listed in code, a reasonable equivalent space type must be used.
- Figure 2 lists the ASHRAE 90.1-2022 LPD Allowances for common multifamily space types.

Figure 2: ASHRAE 90.1-2022 Allowances Using Space-by-Space Method and Minimum Control Requirements for Common Multifamily Space Types

	ASHRAE 90.1-2022		
Space Type	LPD (W/ft^2)	Lighting Controls Required	If Lighting Controls not Required, Recommended Reduction for Savings Credit
Conference / Meeting / Multipurpose Room	0.88	YES	-
Corridor	0.44	YES	-
Corridor, Facility for the Visually Impaired	0.71	YES	-
Electrical/Mechanical	0.71	-	10%
Exercise Area	0.82	YES	-
Laundry/Washing Area	0.51	YES	-
Lobby	0.80	YES	-
Lobby, Facility for the Visually Impaired	1.44	YES	
Lounge/Recreation	0.55	YES	-
Office, ≤ 150 ft^2	0.73	YES	-
Office, > 150 ft^2 and ≤ 300 sf	0.66	YES	-
Office, >300	0.56	YES	-
Restroom	0.74	YES	-
Stairwell	0.47	YES	-
Storage, ≤50 ft2	0.49	YES	-
Storage, all other	0.35	YES	-

- For rooms that include more than one space type, such as a large basement space with part of the area housing electrical/mechanical equipment, and the rest used for storage, apply the lighting power density to the appropriate square footage, and model the area-weighted lighting power density in the baseline.

- Senior housing projects can use allowances for facilities for the visually impaired defined in code for spaces used primarily by building residents. For example, 0.92 W/SF lighting power allowance may be used for the corridors in the baseline. To qualify for the increased allowance, the project must provide housing for seniors and/or people with special visual needs.

- **Lighting Controls:**
  Existing Building
  - Any existing lighting controls in the property shall be factored in the lighting schedule for the Baseline model.

  New Construction
  - For spaces where code requires lighting controls, the controls shall be reflected in the Baseline building design lighting schedules and modeled the same in the baseline and proposed design.

Proposed Lighting

- **In Unit Lighting:** For both Existing Building and New Construction projects, in-unit lighting shall be modeled based on calculated lighting power density (W/sf) using proposed lighting schedule that reflects proposed fixture quantity, wattage, and space area.
  - In-Unit lighting power density shall be averaged for all unit types or calculated or modeled based for each typical unit type (e.g. studio, 1 bedroom, 2 bedroom, etc.)

- **Common Area Lighting:** For both Existing Building and New Construction projects, common area shall be modeled based on calculated lighting power density (W/sf) using proposed lighting schedule that reflects proposed fixture quantity, wattage, and space area.

- **Lighting Controls:** For both Existing Building and New Construction projects, lighting controls shall be modeled with reduced lighting power density (W/sf) using in spaces where lighting controls are proposed and not required by code.
  - Refer to Figure 2 for ASHRAE 90.1-2022 code requirements for common multifamily spaces.

3.2.4 Exterior Lighting

General

Exterior lighting that is connected to the site utility meters, including but not limited to pole fixtures for walkways and parking, and exterior lighting attached to the building, shall be included in the Baseline design and Proposed design.

Schedule

Exterior lighting shall be modeled as lit for no more than 12 hours per day. The same schedules must be modeled in the baseline and proposed design and is assumed to include the specified lighting controls.

Baseline Exterior Lighting Power

Existing Building:

- Exterior lighting shall be calculated by the Energy Consultant based on an assessment of existing exterior light fixtures.

New Construction:

- ASHRAE 90.1-2022: Exterior lighting in areas identified as "Tradable Surfaces" in Table 9.4.2-2 shall be modeled with the baseline lighting power shown in Table 9.4.2-2. Tradable exterior lighting applications include uncovered parking areas, building grounds, building entrances, exits and loading docks, canopies and overhangs, and outdoor sales areas may be traded. The baseline exterior lighting is the product of the lighting allowance from Table 9.4.2-2 and the associated area or length for which illumination is provided in the proposed design.
- Other exterior lighting, including unregulated and non-tradable applications, shall be modeled the same in the baseline building design as in the proposed design.

Proposed Lighting Power

- For both Existing Building, the lighting power in the Proposed Design must be modeled include all power used by the luminaire, including lamps, ballasts/drivers, transformers, and control devices
- For New Construction projects, the lighting power in the Proposed Design must be modeled include all power used by the luminaire, including lamps, ballasts/drivers, transformers, and control devices as described in ASHRAE 90.1-2022 Section 9.4.2, and based on the actual installed lamp.

3.2.5 Heating, Ventilation, and Air Conditioning

Thermostat Setpoints

Setpoint temperature of 72°F and setback temperature of 70°F shall be used for heating. Setpoint temperature of 78°F and setback temperature of 80°F shall be used for cooling. The simulated hourly schedules shall be as described in Figure 3: Thermostat Setpoints[19]

Figure 3: Thermostat Setpoints

Hour of Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Heating Setpoint °F	70	70	70	70	70	70	70	72	72	72	72	72	72	72	72	72	72	72	72	72	72	70	72	70
Cooling Setpoint °F	78	78	78	78	78	78	78	78	78	80	80	80	80	80	80	78	78	78	78	78	78	78	78	78

Baseline HVAC System

- **System Type & Efficiency**:

  Existing Building

  - Model HVAC system type based on existing conditions observed during site assessment.

[19] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2019

New Construction

- **Heating**: When the proposed HVAC system is electric, model baseline as an electric resistance heater as required by code[20] as detailed in Figure 1: Oregon Code Baseline Requirements per Oregon Energy Efficiency Special Code.
- **Cooling**: If heat pumps with cooling are in the Proposed design they should be included in the Proposed design model as specified. The Baseline design model should include cooling with an equivalent cooling system with a code level efficiency as detailed in Figure 1: Oregon Code Baseline Requirements per Oregon Energy Efficiency Special Code. If there is no cooling in the Proposed design, cooling should be excluded from the Baseline design model.

- **System Capacity**:

  Existing Building

  - Model HVAC system capacity based on existing conditions observed during site assessment.

  New Construction[21]

  - Baseline HVAC system coil capacities shall be oversized by 15% for cooling and 25% for heating.
    - E.g. the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs shall be 1.15 for cooling and 1.25 for heating. Only the coil capacities, and not the fan flow rates, shall be over-sized.
  - Weather conditions used in sizing runs to determine baseline equipment capacities shall be based either on hourly historical weather files containing typical peak conditions or on design days developed using 99.6% heating design temperatures and 1% dry-bulb and 1% wet-bulb cooling design temperatures per Appendix G Section G3.1.2.2.1. The typical hourly schedules for lighting, equipment, occupancy, and infiltration must be used in the sizing runs for Systems 1 and 2, and not the peak loads.
  - Where multiple HVAC zones or residential spaces are combined into a single thermal block, the efficiencies for baseline HVAC Systems shall be based on the equipment capacity of the thermal block divided by the number of HVAC zones or residential spaces.

Proposed HVAC System

Existing Building

- Model HVAC system including type, capacity, and efficiency to match proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

[20] Per ASHRAE 90.1-2019, Section 6.3.2(c).

[21] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2019

New Construction[22]

- The Proposed Design equipment shall be modeled using the specified system type, capacity, and supply airflow. Auto-sizing cannot be used.

- Where efficiency ratings include supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy from the efficiency rating in the baseline building design using manufacturers' data at the AHRI rated conditions, and equations below.
  - Exception: If the supply fan in the proposed design cycles with load and fan energy is included in the energy-efficiency rating of the equipment, fan energy shall not be modeled explicitly.

- Where efficiency rating of the specified DX cooling and heating systems includes supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy as follows:
  - **Cooling:**
    EER=Net Cooling [Btu/h] / Total Input Power [W]
    Indoor Fan Power [W]= (Gross Cooling [Btu/h]-Net Cooling [Btu/h])/3.412[Btu/h x W]

    COPnfcooling =Gross Cooling [Btu/h]/((Total Input Power [W]–Indoor Fan Power[W])x3.412[Btu/h x W])

  - **Heating:**
    COPheating=Net Heating [Btu/h]/ (Total Input Power [W] x 3.412 [Btu/h x W]

    Indoor Fan Power [W]= (Net Heating [Btu/h]-Gross Heating [Btu/h])/3.412[Btu/h x W]

    COPnfheating =Gross Heating [Btu/h]/((Total Input Power [W] – Indoor Fan Power [W])x3.412[Btu/h x W])

HVAC Fan System Energy

- **Baseline System Power & Efficiency**
  Existing Building:
  - Model HVAC fans system energy based on existing conditions observed during site assessment.

  New Construction:
  - For HVAC systems with fans, model baseline fan system power and efficiency as required by code23 as detailed in Figure 4: Oregon Code Baseline Requirements per 2025 Oregon Energy Efficiency Special Code (OEESC)

[22] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2019
[23] For ASHRAE 90.1-2022 applicable projects, refer to section 6.5.3.

Figure 5: Fan Power Limitations[24]

	Limit	Constant Volume	Variable Volume
Option 1: Fan *system* motor nameplate hp	Allowable *motor nameplate hp*	hp ≤ $cfm_S \times 0.0011$	hp ≤ $cfm_S \times 0.0015$
Option 2: Fan *system* bhp	Allowable fan *system* bhp	bhp ≤ $cfm_S \times 0.00094 + A$	bhp ≤ $cfm_S \times 0.0013 + A$

a. where
cfm_S = maximum design supply airflow rate to *conditioned spaces* served by the *system* in cubic feet per minute
hp = maximum combined motor *nameplate horsepower*
bhp = maximum combined fan-brake horsepower
A = sum of (PD × cfm_D/4131)
where
PD = each applicable pressure drop adjustment from Table 6.5.3.1-2 in in. of water
cfm_D = the design airflow through each applicable device from Table 6.5.3.1-2 in cubic feet per minute

- **Proposed System Power & Efficiency**
  <u>Existing Building:</u>
  - Model HVAC fans power to match proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

  <u>New Construction:</u>
  - HVAC fan power and flow for exhaust, supply, and return fans must be modeled explicitly, as specified.
    - <u>Exception</u>: fan energy of ductless packaged systems that cycle with load, such as PTHP, PTAC, room air-conditioners, and variable refrigerant flow heat pumps shall not be modeled explicitly if the fan power is included in the equipment efficiency rating.

- **HVAC Fan System Schedule**
  Baseline Model:
  - **<u>Existing Building</u>**: Model HVAC fans system schedule based on existing conditions observed during site assessment.
  - **<u>New Construction</u>**: Supply and return fans shall operate continuously whenever spaces are occupied and shall be cycled to meet heating and cooling loads during unoccupied hours (*Appendix G* Section G3.1.2.4). Following this rule, the baseline HVAC systems in apartments and corridors must be modeled as running continuously. Unoccupied periods may exist in supporting spaces such as rental office, mechanical rooms, etc.

  Proposed Model
  - **<u>Existing Building</u>**: Model HVAC fans system schedule to match baseline, unless fan operation schedule is planned to change in proposed design.

[24] Per ASHRAE 90.1-2016 and IECC 2018, applicable to total fan system motor nameplate horsepower exceeding 5 hp.

- **New Construction:** HVAC fans that provide outdoor air for ventilation shall run continuously whenever spaces are occupied, and shall be cycled to meet heating and cooling loads during unoccupied hours. (*Appendix G* Table G3.1 No. 4).

HVAC Distribution System - Ducts

Baseline Model:

- **Existing Building**: Model ducted distribution systems based on existing conditions observed during site assessment.
- **New Construction**: If ducts are present in proposed design, model ducted distribution system as required by code. If not present, leave blank

Proposed Model:

- **Existing Building & New Construction**: If ducts are present, model ducted distribution system Enter duct system properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

- If duct sealing is proposed and the project would like to pursue credit for related duct sealing energy savings, please contact program staff to discuss how duct sealing will be achieved and verified in proposed design.

Mechanical Ventilation

- **Baseline Building Design**

  Existing Building

  Baseline mechanical equipment type and efficiency shall be modeled in the based on existing conditions as observed during the site assessment.

  New Construction

  Baseline mechanical equipment type and efficiency shall be modeled as required by code based on the proposed equipment.

  - In Unit Ventilation[25]:
    - Minimum ventilation outdoor air intake flow shall be the same as in the proposed design (Appendix G, Section G3.1.2.5), except where indicated otherwise in the following provisions.
    - The baseline ventilation method (mechanical versus natural) and controls (continuous versus intermittent) must be modeled as specified for each application.
    - The baseline local mechanical exhaust from bathrooms and kitchens, and the baseline dwelling-unit ventilation rate shall be modeled using the same rates as in the Proposed Design, without exceeding the minimum required by code as detailed in Figure 1: Oregon Code Baseline Requirements per 2019 Oregon Zero Energy Ready Commercial Code.

[25] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016

        - If the same mechanical ventilation system is used to provide both local mechanical exhaust and whole-unit ventilation, the baseline ventilation rate must be based on the greater of the two rates.
    - Common Area Ventilation[26]: The baseline ventilation rate in common spaces shall be modeled using the same rates as in the Proposed Design, without exceeding the minimum required code as as detailed in Figure 1: Oregon Code Baseline Requirements per 2019 Oregon Zero Energy Ready Commercial Code.

- **Proposed Design**
    - Exhaust and supply ventilation rates and controls must be modeled as specified.

- **Mechanical Ventilation Schedule[27]:**
    - The mechanical ventilation schedule may differ between Baseline Building Design and Proposed Design when necessary to model nonstandard efficiency measures, provided that the revised schedules are approved by program staff. Measures that may warrant use of different schedules include Demand Control Ventilation (DCV), as described in Appendix G, Table G3.1 No. 4 Exception 2.
    - If not specified, intermittent local mechanical exhaust, such as intermittently running range hoods or bathroom exhaust fans, shall be modeled with a 2 hr/day runtime, or converted to an equivalent 24 hr/day runtime if combined with dwelling unit mechanical ventilation. The same modeling method and schedule must be used in the baseline and proposed design.

3.2.6 Domestic Hot Water Heating

Equipment Type & Efficiency

- **Baseline Building Design:**

  Existing Building

  Baseline equipment type and efficiency shall be modeled in the based on existing conditions as observed during the site assessment.

  New Construction

  When the proposed domestic hot water system is electric, model baseline as electric resistance water heater with efficiency as required by code as detailed in Figure 6: Oregon Code Baseline Requirements per 2025 Oregon Energy Efficiency Special Code (OEESC)

- **Proposed Building Design**

  Existing Building and New Construction

  The domestic hot water system type, heating source, capacity, and efficiency shall be modeled as specified in design documents.

[26] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016
[27] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016

Hot Water Demand[28]

- **Baseline Hot Water Demand**

  Existing Building

  Baseline hot water demand shall be modeled in the based on existing conditions as observed during the site assessment.

  New Construction

  Hot water demand in the Baseline Building Design shall be determined based on the number of occupants in the building when fully occupied assuming one person per bedroom.

  - Per-person consumption of 12/25/44 gal/day shall be used based on low/medium/high usage determined based on appropriate occupancy demographics.
    - Low per-person values are associated with buildings having such occupant demographics as all occupants working, seniors, and middle income.
    - High usage is associated with high percentages of children, low income, public assistance, or no occupants working, and can only be used if the building qualifies as affordable housing. Hot water consumption of clothes washers and dishwashers is not included in the per-person usages above, and shall be added according to the calculations described below.

- **Proposed Hot Water Demand**

  Low Flow Fixtures

  - Baseline and proposed models should match and be modeled as a proposed specification.

  ENERGY STAR Dishwashers

  Water savings from ENERGY STAR dishwashers may be calculated as follows:

  - Assume proposed water consumption of 860 gal/year per ENERGY STAR dishwasher [this default is used by EPA for ENERGY STAR dishwasher].
  - Calculate annual per-unit hot water demand reduction by subtracting annual hot water usage of the Proposed dishwasher from 1290 gal/year for standard dishwasher [this default is used by EPA for conventional dishwashers].
  - Divide annual per unit savings calculated in the previous step by 365 and multiply by the number of dishwashers in the building to obtain total daily savings for the building.
  - Subtract total daily savings from ProposedHWDemand to obtain adjusted daily demand of the Proposed Design.

[28] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016

Clothes Washer Hot Water Usage

- Determine hot water usage by each residential clothes washer in Baseline and Proposed Design as follows:

	Baseline Design Hot Water Gal/yr	Proposed Design Hot Water Gal/yr
In-Unit Clothes Washer	0.2 x 12,179	0.2 x 5,637
Common Space Clothes Washer	0.2 x 29,515	0.2 x 13,661

0.2 = estimated ratio of hot water to total water consumed per year.

- Values based on annual water consumption of conventional and ENERGY STAR clothes washers, from EPA Savings Calculator for Clothes Washers.
- Usage assumptions used by EPA for commercial clothes washers are based on 950 loads/year.
- Convert annual hot water consumption calculated above to hourly values using appropriate hourly load profile as recommended by the energy modeling software tool.

Domestic Hot Water Distribution System

- Distribution losses shall not be modeled in either baseline or proposed design.
- The same hot water setpoint capable of delivering a temperature of 120°F at the point of use shall be used in both Baseline Building Design and Proposed Design.
- If hot water recirculation system is present in the Proposed Design, it shall be included in both Baseline and Proposed Designs.

3.2.7 Appliances and Plug Loads

Existing Building

- Baseline appliance and plugs loads shall be modeled based on existing conditions as observed during site assessment.
- Proposed savings may only be claimed for electric energy savings measures. All other loads shall be modeled the same in the Baseline Design and Proposed Design.

New Construction

- Non-lighting receptacle loads shall be included in the simulation as specified in Figure 1. All such loads, including the fraction of loads contributing to internal heat gain, shall be identical in the Baseline Building Design and Proposed Design, unless the particular load source is impacted by a specific Energy Reduction Measure.
  - **Exception**: Dishwashers, clothes washers, and clothes dryers shall not be included in either Baseline Building Design or Proposed Design if they are not specified for the project. If laundry hook-ups or a laundry room are present, the laundry equipment shall be modeled as energy neutral, with the values given in the table below.

- Where annual or daily consumption is provided in the table below, it must be converted into the equivalent design load (Watt or Watt/ft2) and hourly schedule as appropriate for the energy modeling software being used.

3.2.8 Elevator Loads[29]

In order to take credit for energy savings associated with improvements to the elevator system, baseline and Proposed Design energy estimates must be completed by a design engineer using a simulation based on first principles, traffic models, and engineering data from empirical studies. This energy model must include energy consumed when the elevator is idling and in stand-by as well as the energy consumed when actively transporting the cabs (loaded and unloaded) based on an appropriate traffic model for the building. Some elevator equipment manufacturers will provide these calculations upon request as part of their design assistance service.

When elevator energy usage is modeled using the approach described above, the baseline elevator design shall use the following assumptions:

- The baseline elevator technology shall be based on number of stories serviced by the elevator as shown in the following table:

Elevator Service Height	Baseline Technology
4 to 6 stories	Hydraulic
7 to 20 stories	Geared traction
21+ stories	Gearless traction

- Standard efficiency DC motors
- Variable Voltage Variable Frequency Drive
- No regeneration of braking power losses
- Controls based on simple elevator algorithm
    - Continue traveling in same direction if there are remaining calls for service in that direction
    - If no more calls for service in direction being traveled, stop and remain idle, or change
    - direction if there are calls for service in that direction
- Traction elevators are equipped with counterweights sized at 50% of full load capacity.
- Hydraulic elevators have no counterweight or hydraulic accumulators.
- Worm gears for geared traction elevators
- 2:1 roping scheme

If the elevator system is not modeled using the approach described above, use the default table below to determine the total energy consumption associated with all elevators in the building for both the Baseline Building Design and the Proposed Design. If "NA", model as energy neutral, using no less than 2.0 MWh per year.

[29] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines

Figure 7: Default Elevator Energy Usage Table

Class	Annual Energy Consumption (MWh)		
	Hydraulic (1-6 stories)	Geared Traction (7-20 stories)	Gearless Traction (21+ stories)
1. Up to 6 dwelling units	1.91	NA	NA
2. 7 to 20 dwelling units	2.15	NA	NA
3. 21 to 50 dwelling units	2.94	3.15	NA
4. More than 50 dwelling units	4.12	4.55	7.57

10% of elevator energy usage shall be added to space heat gains.

Savings related to lighting in the cabin may be claimed as a separate performance credit if not included in an elevator system simulation. Cab lighting in the baseline model shall be equal to 1.3 W/ft2 operated 24/7.

Ventilation system improvements may also claim savings based on high efficiency fans and/or modified control systems. Elevator cab ventilation in the baseline model shall be modeled using standard efficiency fans operating 24/7.

3.2.9 Other Loads - Non-HVAC Motors 1 HP or Larger [30]

Energy use of motors other than in systems that provide heating, ventilation, and air-conditioning, including, but not limited, to water booster pumps and hot water recirculation pumps, shall be modeled, and calculated as follows:

$P_{fan,base}$ = bhp x 746 / Fan Motor $Efficiency_{base}$
$P_{fan,prop}$ = bhp x 746 / Fan Motor $Efficiency_{prop}$

$P_{fan,base}$ = electric power of the baseline motor [Watt]
$P_{fan,prop}$ = electric power of the proposed motor [Watt]
bhp = break horse power of the motor specified in the proposed design
Fan Motor $Efficiency_{base}$ = baseline motor efficiency from Appendix G Table G3.9.1, based on the next motor size greater than bhp
Fan Motor $Efficiency_{prop}$ = proposed motor efficiency, as specified

Savings may be claimed for improved motor efficiency or improved equipment controls, such as installing Variable Speed Drive on booster pumps. Constant flow capacity control may be assumed in the Baseline Building Design. Actual capacity control may be modeled in the Proposed Design.

When modeling non-HVAC motors, the baseline and proposed runtime hours used in the model must be documented and submitted with the model.

[30] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016

4 REM/Rate

4.1 General Approach

This section provides technical guidance on modeling buildings using REM/Rate to generate energy savings estimates. These modeling guidelines were created based on ANSI/RESNET/ICC standards and REM/Rate™ version 16.3.3, and where applicable aligning with the Northwest Modeling Requirements. If using a newer version of REM/Rate, please contact program staff for guidance on content not covered in the REM/Rate™ help files.

For any input not specifically covered in this guide, refer to REM/Rate™'s internal help file.

There are limitations to modeling multi-family buildings using REM/Rate™ that should be considered when deciding which software is best for the project. The following is a list of some of the known limitations:

- REM/Rate™ is limited to modeling buildings that are no more than 3 stories above grade. Projects that are more than 3 stories should model in an alternative software, such as a DOE Software Engine described in Section **2 DOE Software Engine**
- REM/Rate™ is limited to modeling buildings that have a conditioned floor area of no more than 99,999 square feet.
- REM/Rate™ does not have an option for modeling common areas only the apartment units, so common area savings would need to be externally calculated.
- Most inputs are based on values for the entire buildings and not per unit.
- There are many assumptions being made about the building by REM/Rate™, here are some examples:
    - Bedrooms: makes assumptions of the number of bedrooms per unit based on the number of bedrooms and number of units entered
    - Footprint: makes assumptions based on square footage and number of floors entered
    - Appliances: assumes each apartment unit has one of each appliance. If the project is claiming savings for common area appliances such as clothes washers and dryers, these would need to be externally calculated.
    - Lighting: makes assumptions on the number of lighting fixtures and there are only two efficiency tiers available; Tier I is CFL + Fluorescent and Tier II is LED
    - DHW Efficiencies:
        - Only option for faucet or shower fixture flowrate is </= 2gpm
        - Only option for DHW pipe insulation is >/=R-3
        - Water heater energy usage is calculated per building, not per unit

4.2 Detailed Inputs

The following guidance provides modeling requirements by building component level for both the baseline model and the proposed model. Where applicable, the guidance distinguishes modeling requirements distinctions for Existing Building and New Constructions projects.

4.2.1 Building Name and Property/Builder Information

This section lets you provide general information about the property and builder. The information provided here does not affect the results of energy calculations, but does help identify the individual REM projects.

4.2.2 Organization Information

Please enter the project's organization information.

4.2.3 Energy Rating Information

This screen is not required for OR-MEP.

4.2.4 Site Information

Climate Location

The building shall be modeled in the geographically closest Oregon climate location that is in the same IECC climate zone.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

4.2.5 General Building Information

Conditioned Floor Area

The floor area of the spaces within the thermal envelope of the building, not including the floor area of attics, crawlspaces, and basements below air sealed and insulated floors. For the clearest guidance on what should be included or excluded, refer to the definition in ANSI/RESNET/ICC Standard 380-2016.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Infiltration Volume

The sum of the Conditioned Space Volume and additional adjacent volumes in the dwelling unit that meet the following criteria:

- Crawlspaces, when the access doors or hatches between the crawlspace and Conditioned Space Volume are open during the enclosure airtightness test
- Attics, when the access doors or access hatches between the attic and Conditioned Space Volume are open during the enclosure airtightness test
- Basements, where the doors between the basement and Conditioned Space Volume are open during the enclosure airtightness test

Conditioned Space Volume is the volume within a building serviced by a space heating or cooling system designed to maintain space conditions at 78°F (26°C) for cooling and 72°F (20°C) for heating.

For additional guidance refer to the definitions in ANSI/RESNET/ICC Standard 380-2016, and important corrections & refinements in Standard 380 Addendum A.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Housing Type
Select 'Multi-family, whole building' as the housing type.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Number of Units
Enter the total number of apartment units per building.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Number of Floors Above Grade
Enter the number of floors above grade for the entire building.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Projects > 3 Floors Above Grade.
REM/Rate™ is limited to modeling buildings that are no more than 3 stories above grade. Projects that are more than 3 stories should model in an alternative software, such as a DOE Software Engine described in Section 2 DOE Software Engine

Number of Bedrooms
Enter the total number of bedrooms for the entire multi-family building.
Per ANSI/RESNET/ICC Standard 301-2014 a bedroom is defined as: A room or space 70 square feet or greater, with egress window and closet, used or intended to be used for sleeping. A "den", "library", "home office" with a closet, egress window, and 70 square feet or greater or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

Foundation Type
Refer to the guidance provided in REM/Rate™'s internal help file.

- **Model inputs on this screen should be identical in Baseline model and Proposed model.**

4.2.6 Foundation Walls
Refer to the guidance provided in REM/Rate™'s internal help file.
Baseline Model:

- **Existing Building**: Enter foundation wall properties based on existing conditions observed during site assessment.

- **New Construction**: Enter foundation wall properties as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter foundation wall properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Location and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.7 Slab Floors

lab insulation characteristics shall be entered accurate for the building. “Total Exposed Perimeter” value shall include all slab perimeter that does not abut conditioned space or a separate, below grade buffer space. Enter all slab characteristics according to the guidance provided in REM/Rate™’s help file.

Baseline Model:

- **Existing Building**: Enter slab floor properties based on existing conditions observed during site assessment.

- **New Construction**: Enter slab floor properties as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter slab floor properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.8 Floors

Refer to the guidance provided in REM/Rate™’s internal help file.

Baseline Model:

- **Existing Building**: Enter floor properties based on existing conditions observed during site assessment.

- **New Construction**: Enter floor properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter floor properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Location and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.9 Rim/Band Joists

Refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **<u>Existing Building</u>**: Enter rim and band joist properties based on existing conditions observed during site assessment.

- **<u>New Construction</u>**: Enter rim and band joist properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter rim and band joist properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Location and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.10 Above-Grade Walls

Refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **<u>Existing Building</u>**: Enter above grade wall properties based on existing conditions observed during site assessment.

- **<u>New Construction</u>**: Enter above grade wall properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter above grade wall properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Location and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.11 Windows and Glass Doors

Enter the window and glass door areas, orientations, and physical characteristics accurate to the building. Refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **<u>Existing Building</u>**: Enter window properties based on existing conditions observed during site assessment.

- **<u>New Construction</u>**: Enter window properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter window properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Location, wall assignments, and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

U-value and SHGC

May calculate as area-weighted averages. Fenestration with similar characteristics (orientation, overhangs, wall association, and thermal characteristics) may be combined to streamline data entry.

Shading Factors

Default interior shading values are 0.85 for Winter and 0.70 for Summer as specified in the RESNET Standards. If you have a typical building with no overhangs or significant obstructions, you should use None for the winter and summer Adjacent Shading factors.

4.2.12 Doors

Enter door areas, R-values, and other physical characteristics accurate to the building.

Baseline Model:

- **<u>Existing Building</u>**: Enter door properties based on existing conditions observed during site assessment.

- **<u>New Construction</u>**: Enter door properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter door properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Wall assignments and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.13 Ceilings

Model ceiling characteristics accurately for the building and follow the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **<u>Existing Building</u>**: Enter ceiling properties based on existing conditions observed during site assessment.

- **<u>New Construction</u>**: Enter ceiling properties as required by code.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter ceiling properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

4.2.14 Skylights

Refer to window modeling guidance and REM/Rate™'s internal help file.

Baseline Model:

- **<u>Existing Building</u>**: Enter skylight properties based on existing conditions observed during site assessment.
- **<u>New Construction</u>**: Enter skylight properties as required by code, if included in proposed design.

Proposed Model:

- **<u>Existing Building & New Construction</u>**: Enter ceiling properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Ceiling assignment and applicable measurements, such as length, height, area, depth, perimeter should remain identical in Proposed model as Baseline model.

Space Conditioning The Space Conditioning (aka Mechanical Equipment) input screen describes the characteristics of all heating and cooling equipment in the building The space conditioning properties for a building can be described by one or multiple pieces of equipment. Please be aware that in earlier versions of this REM/Rate, this screen will also include water heating equipment.

Baseline Model:

- **<u>Existing Building</u>**: Enter mechanical equipment properties based on existing conditions observed during site assessment.
- **<u>New Construction</u>**: Enter mechanical properties as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter mechanical properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

Library Type

Select the appropriate library type for the equipment being modeled. Some common examples are:

- Space Heating: gas furnace, baseboard, cadet
- Space Cooling: air conditioner
- Domestic Water Heating: water heater
- Air-Source Heat Pump: Traditional ducted air source heat pump (ASHP), mini-split ductless (DHP) and ducted heat pump

Equipment

Select the appropriate heating and cooling equipment. Select the "…" button to open the Heating Type library and confirm capacity, efficiency, etc. details.

Location

Select the appropriate location of the equipment in the building.

Setpoint Temperature

Enter heating and cooling setpoints, typical values are 72°F and 78°F.

- **Setpoint temperature should be identical in Baseline model and Proposed model.**

Programmable Thermostat

Programmable and smart thermostats are no longer eligible for incentives. Baseline and proposed models should match.

Baseline Model:

- **Existing Building & New Construction**: Thermostat must be modeled matching what is installed after construction.

Proposed Model:

- **Existing Building & New Construction**: Thermostat must be modeled matching what is present.

Capacity Weight % of Load Served

If multiple pieces of equipment are present for any load control, you must select how the load is served by each piece of equipment. If the Capacity Weight % of Load Served checkbox is checked, the Load Served (%) is automatically calculated for each piece of equipment based on a capacity weighted average.

Baseline Model:

- **Existing Building**: Enter % of Total Load Served based on existing conditions observed during site assessment.

New Construction: Enter % of Total Load Served to align with proposed design and equipment specified

Proposed Model:

- **Existing Building & New Construction**: Enter % of Total Load Served to align with proposed design and equipment specified.

4.2.15 Domestic Hot Water

The Domestic Hot water input screen describes the characteristics of all water heating equipment in the building The DHW properties for a building can be described by one or multiple pieces of equipment. Please be aware that in earlier versions of this REM/Rate, this information is included in the 'Mechanical Equipment' input screen.

Baseline Model:

- **Existing Building**: Enter water heater properties based on existing conditions observed during site assessment.
- **New Construction**: Enter water heater properties as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter mechanical properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

Equipment

Select the appropriate equipment type for the water heater being modeled. Select the "…" button to open the Water Heating Type library and confirm efficiency, sizing, etc. details.

Location

Select the appropriate location of the equipment in the building.

Capacity Weight % of Load Served

If multiple pieces of equipment are present for any load control, you must select how the load is served by each piece of equipment. If the Capacity Weight % of Load Served checkbox is checked, the Load Served (%) is automatically calculated for each piece of equipment based on a capacity weighted average.

Baseline Model:

- **Existing Building**: Enter % of Total Load Served based on existing conditions observed during site assessment.

New Construction: Enter % of Total Load Served to align with proposed design and equipment specified

Proposed Model:

- **Existing Building & New Construction**: Enter % of Total Load Served to align with proposed design and equipment specified.

4.2.16 DHW Efficiencies

Checkboxes

Select for low-flow fixtures and insulated hot water pipes. Low flow fixtures are no longer eligible for incentives. Baseline and proposed models should match.

Baseline Model:

- **Existing Building and New Construction:** Select for low-flow fixtures (≤ 2 gpm) and insulated hot water pipes (≥ R-3) based on proposed design.

Proposed Model:

- **Existing Building and New Construction:** Select for low flow fixtures (≤ 2 gpm) and insulated hot water pipes (≥ R-3) based on proposed design.

Farthest Fixture to DHW Heater

Enter the plan-view (i.e. horizontal) length of the hot water pipe running from the DHW heater to the most distant fixture. REM automatically calculates the vertical portions. If there are multiple hot water plumbing systems, enter the longest pipe length found in any of the systems. For example, if system #3 has the longest run from its water heater to its farthest fixture, use that to represent all the systems.

- **Farthest fixture to DHW heater inputs should be identical in Baseline model and Proposed model.**

4.2.17 Duct Systems

Refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **Existing Building**: Enter duct system properties based on existing conditions observed during site assessment.
- **New Construction**: If ducts are present in proposed design, enter duct system properties as required by code. If not present, leave blank

Proposed Model:

- **Existing Building & New Construction**: Enter duct system properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

4.2.18 HVAC CX

DO NOT USE

4.2.19 Infiltration/Ventilation

Whole Dwelling Infiltration

Refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **Existing Building**: Enter baseline annual infiltration value (ACH @ 50 Pasacals) based on existing conditions observed during site assessment.

- **New Construction**: Enter baseline annual infiltration value (ACH @ 50 Pasacals) with code equivalent value of 4.0 ACH50

Proposed Model:

- **Existing Building & New Construction**: Enter proposed annual infiltration value (ACH @ 50 Pasacals) based on proposed design. If no air sealing credit is claimed, model proposed same as baseline.
    - NOTE ON BLOWER DOOR TESTING: While OR-MEP does not require blower door testing, blower door testing may be necessary for scopes of work with high infiltration reductions, where air sealing is contributing to significant savings. Blower door testing is encouraged and recommend to maximize air sealing related savings.

4.2.20 Mechanical Ventilation

Mechanical ventilation refers to a ventilation system designed to continually bring outdoor air into the house to maintain indoor air quality. Enter the efficiency, capacity, runtime, and fan wattage value accurate for the system in the baseline and proposed building.

Baseline Model:

- **Existing Building**: Enter mechanical ventilation properties based on existing conditions observed during site assessment.
- **New Construction**: Enter mechanical ventilation as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter mechanical ventilation based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

Type
Select the appropriate type for the building.

Recovery Efficiencies:
Enter the ASRE for balanced ventilation type, this value can be found on the HVI directory (https://www.hvi.org/hvi-certified-products-directory/)

Hours/Day
This is the number of hours per day the fresh air fan is operating. In the case of an Air Cycler system (which uses the air handler for its fan), indicate the total amount of time that fresh air ventilation is provided in the home.

Delivered CRM
Enter the air flow of the ventilation fan in cubic feet per minute (CFM). If it is an Air Cycler system, the air flow for this entry is the amount of outdoor air in cfm that is coming into the air-cycler system. This is not the total fan flow for the air-handler.

Fan Watts
The fan power (wattage) of the fresh air fan. In the case of an Air Cycler system, this is the fan power of the air handler.

4.2.21 Lights and Appliances

Lights and Appliances
Go through menu of Lights and Appliances and input appropriate location and efficiency information. Select the accurate fuel type for the range/oven and clothes dryer. Enter the average appliance consumption per unit because the consumption data is multiplied by the number of units.

Baseline Model:

- **Existing Building**: Enter appliance properties based on existing conditions observed during site assessment.
- **New Construction**: Enter baseline appliance properties such as annual consumption (kWh/yr) as described in Figure 1 for applicable appliances, since not defined by code.

Proposed Model:

- **Existing Building & New Construction**: Enter appliance properties based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.
- Any appliances not included in proposed design shall be omitted from both Proposed and Baseline model.

Common Area Laundry

For buildings with shared, common area clothes washers and/or dryers use the following default inputs for both the baseline and proposed model and calculate the savings externally:

Clothes Dryer

- Dyer Fuel: NC: As proposed; EB: existing conditions.
- Dryer CEF: 3.01
- Moisture Sensing toggled “on” (Checkmark in box)

Clothes Washer

- Washer Presets: “Med Efficiency”

Lighting Properties

Model the lighting accurate for the building, refer to the guidance provided in REM/Rate™'s internal help file.

Baseline Model:

- **Existing Building**: Enter lighting properties based on existing conditions observed during site assessment.
- **New Construction**: Enter lighting properties as required by code.

Proposed Model:

- **Existing Building & New Construction**: Enter lighting properites based on proposed design. If not included as an energy efficiency measure, model proposed same as baseline.

In-Unit and Common Area Lighting

REM/Rate provides simplified lighting savings calculation, simplified as % fluorescent, % CFL, and % LED fixtures for interior, exterior and garage spaces.

Given lack of granularity in modeling lighting, external calculations are allowed for lighting calculations for REM/Rate modeled projects. If pursuing external calculations, continue to model approximate Baseline and Proposed lighting as described above to capture interactive effects of lighting in model. However, replace lighting savings calculated from model with external calculations.

4.2.22 Interior Mass

DO NOT USE

4.2.23 Active Solar

DO NOT USE

4.2.24 Photovoltaics

DO NOT USE

4.2.25 Sunspace

DO NOT USE

Appendix

4.3 Appendix A – Baseline for Projects Permitted Prior to October 1, 2021

The baseline energy use modeled should follow the energy code requirements of the specific project as follows:

- Projects should model the baseline using the code version accepted at time of permit approval.

- **Project permitted on or after October 1, 2021** shall follow the 2021 Oregon Energy Energy Efficiency Specialty Code (OEESC)[31].
  ASHRAE 90.1 - 2019[32]: This applies to buildings constructed under the OSSC including low-rise multifamily. Excluding detached single family, duplex, and townhouses[33] with three or fewer stories.

- **Project permitted before October 1, 2021** shall follow the 2019 Oregon Zero Energy Ready Commercial Code[34].
  - Part 1 – Commercial Energy Provisions: Part I applies to buildings constructed under the OSSC that are not Group R-2, R-3, or R-4 buildings, three stories and fewer above the finished grade. The construction standards are based on ASHRAE Standard 90.1-2016[35].

  - Part II – Multi-family Energy Provisions: Part II applies to Group R-2, R-3, and R-4[2] buildings three stories and fewer above the finished grade designed and constructed under the OSSC. The construction standards are based on 2018 International Energy Conservation Code

[31] Oregon Building Code Division: https://www.oregon.gov/bcd/codes-stand/Pages/energy-efficiency.aspx
[32] ASHRAE 90.1-2019: https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2019
[33] Townhouses defined by ORSC 2021 as: A single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from foundation to roof and with a yard or public way on not less than two sides.
[34] Oregon Building Code Division Codebook History – 2019 Oregon Zero Energy Ready Commercial Code: https://www.oregon.gov/bcd/codes-stand/Documents/19ozercc.pdf
[35] ASHRAE 90.1-2016: https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2016_IP

COM*check*

To establish baseline requirements, OR-MEP encourages projects to use COM*check* as a tool to establish baseline requirements per code to support energy modeling development and ensure alignment of permitted design and energy model. COM*check* reports submitted for code compliance can be helpful in energy model development.

4.3.1 Oregon Code Baseline Requirements for Projects Permitted under 2021 Oregon Energy Efficiency Special Code (OEESC)

See appendix A for projects permitted prior to July 1, 2025.

Figure 8: Oregon Code Baseline Requirements per 2021 Oregon Energy Efficiency Special Code (OEESC)

Building Component	Modeling Requirements	
Appliances[36]	Energy Consumption	Sensible/Latent Load Fraction
Refrigerators	Baseline (conventional unit): 529 kWh/yr Proposed (ENERGY STAR unit): as specified, or 423 kWh/yr	1.00/0.0
Dishwashers	Baseline (conventional unit): 206 kWh/yr Proposed (ENERGY STAR unit): as specified, or 164 kWh/yr	0.60/0.15
Clothes Washers – In-Unit	**In-unit Clothes Washers:** Baseline (conventional unit): 81 kWh/yr Proposed (ENERGY STAR unit): as specified, or 57 kWh/yr **Commercial Clothes Washers:** Baseline (conventional unit): 196 kWh/yr Proposed (ENERGY STAR unit): as specified, or 138 kWh/yr	0.80/0.0
Cooking (electric stove/range)	604 kWh/year	0.40/0.30
Cooking (gas stove/range)	45 Therms/year	0.30/0.20
Clothes Dryer	Electric Dryer: kWh/yr = [418 + (139*Nbr)]*F Gas Dryer: Electricity: kWh/yr = [38 + (12.7*Nbr)]*F Gas: Therms/yr = [26.5 + (8.8*Nbr)]*F Nbr = Average number of Bedrooms in dwelling units. F = scale factor to account for increased number of cycles of common space clothes dryers. F=1 for in-unit clothes dryers. F = 2.423 for common space clothes dryers.	Electric Dryer: 0.15/0.05 Gas Dryer: Electricity – 1.0/0.0 Gas – 0.10/0.05
Misc. Dwelling Unit Plug Loads	0.5 W/ft2 or 1.05 kWh/FFA FFA = Finished Floor Area of living space in square feet	0.90/0.1
Misc. Non-Dwelling Unit Plug Loads	Corridors, restrooms, stairs, and support areas: 0.2 W/ft2 design; 0.7 kWh/ft2 annual usage. Offices: 1.5 W/ft2 design; 4.9 kWh/ft2 annual usage Other Multifamily Public & Common Areas: 0.5 W/ft2 design; 1.6 kWh/ft2 annual usage	1.0/0.0

[36] Per ENERGY STAR Multifamily New Construction Program Simulation Guidelines-Appendix G 90.1-2016

Building Component	Modeling Requirements
Domestic Hot Water	
Water Heater, Electric Resistance[37]	≤12kW, Resistance, ≥ 20 gallons and ≤ 55 gallons: Very Small EF = 0.8808 – (0.0008 x V_r) Low EF = 0.9254 – (0.0003 x V_r) Medium EF = 0.9307 – (0.0002 x V_r) High EF = 0.9349 – (0.0001 x V_r) ≤12kW, Resistance, > 55 gallons and ≤ 120 gallons: Very Small EF = 1.9236 – (0.0011 x V_r) Low EF = 2.0440 – (0.0011 x V_r) Medium EF = 2.1171 – (0.0011 x V_r) High EF = 2.2418 – (0.0011 x V_r) >12kW, Resistance, <4,000 (Btuh)/gal: SL ≤ 0.3 + 27/V_m %/h
Low Flow Shower Heads	Not eligible for savings. Model baseline and proposed as the same GPM.
Low Flow Aerators	Not eligible for savings. Model baseline and proposed as the same GPM.
Envelope[38]	
Above Grade Walls	Anna
Mass	**Climate Zone 4** Insulation Min: R-11.4ci Assembly Max: U-0.090 **Climate Zone 5** Insulation Min: R-13.3ci Assembly Max: U-0.080
Metal Building	**Climate Zones 4 + 5** Insulation Min R-0 + R-19ci Assembly Max: U-0.050
Steel-Framed	**Climate Zone 4** Insulation Min: R-13 + R-7.5ci Assembly Max: U-0.064 **Climate Zone 5** Insulation Min: R-13 + R-10ci Assembly Max: U-0.055
Wood Framed and Other	**Climate Zone 4** Insulation Min: R-13 + R-3.8ci or R-20 Assembly Max: U-0.064 **Climate Zone 5** Insulation Min: R-13 + R-7.5ci or R-19 + R-5ci Assembly Max: U-0.051

[37] Per ASHRAE 90.1-2019, Table 7.8 referencing Appendix F, Table F-2; EF = Energy Factor, V_r = rated storage volume (in gallons), SL = Standby loss, V = rated volume in gallons, V_m= measure volume in gallons

[38] Commercial Energy Provisions: Per Table 5.5-4 (Climate Zone 4), Table 5.5-5 (Climate Zone 5), Residential; Multifamily Energy Provisions: Per Table C402.1.3

Building Component	Modeling Requirements
Below Grade Walls	
Below Grade Walls	**Climate Zones 4 + 5** Insulation Min: R-10ci Assembly Max: C-0.092
Floors	
Mass	**Climate Zones 4 + 5** Insulation Min: R-16.7ci Assembly Max: U-0.051
Steel Joist	**Climate Zones 4 + 5** Insulation Min: R-30 Assembly Max: U-0.038
Wood-framed and Other	**Climate Zones 4 + 5** Insulation Min: R-30 Assembly Max: U-0.033
Slab-on Grade Floors	
Unheated	**Climate Zone 4** Insulation Min: R-15 for 24 in. below Assembly Max: F-0.520 **Climate Zone 5** Insulation Min: R-20 for 24 in. below Assembly Max: F-0.510
Heated	**Climate Zones 4 + 5** Insulation Min: R-20 for 48 in. below Assembly Max: F-0.688
Roofs	
Insulation entirely above deck	**Climate Zones 4 + 5** Insulation Min: R-30ci Assembly Max: U-0.032
Metal building	**Climate Zones 4 + 5** Insulation Min: R-19 + R-11 Ls or R-25 + R-8 Ls Assembly Max: U-0.037
Attic and other	**Climate Zones 4 + 5** Insulation Min: R-49 Assembly Max: U-0.021
Vertical Fenestration 0% to 40% of Wall	
Fixed	**Climate Zone 4 + 5** Assembly Min VT/SHGC: 1.10 **Climate Zone 4** Assembly Max: U-0.36/SHGC-0.36 **Climate Zone 5** Assembly Max: U-0.36/SHGC-0.38
Operable	**Climate Zone 4 + 5** Assembly Max: U-0.45/SHGC-0.33

Building Component	Modeling Requirements
	Assembly Min VT/SHGC: 1.10
Entrance Door	**Climate Zone 4 + 5** Assembly Max: U-0.63/SHGC-0.33 Assembly Min VT/SHGC: 1.10
Skylight, 0% to 3% of Roof	
All Types	**Climate Zone 4 + 5** Assembly Max: U-0.50 Assembly Max: SHGC-0.40
Opaque Doors	
Swinging	**Climate Zone 4 + 5** Assembly Max: U-0.370
Nonswinging	**Climate Zone 4 + 5** Assembly Max: U-0.310
Air Leakage	
Air Leakage	0.4 CFM/sf at 75 Pa Refer to ASHRAE 90.1-2019 Section 5.4.3 Note: 2. Per Section 5.4.3.1, the entire building envelope shall be designed and constructed with a continuous air barrier. Per Section 5.4.3.1.1, the building shall comply with whole-building pressurization testing in accordance with ASTM E779 or ASTM E1827 by an independent third party [39] and with the continuous air barrier requirements in Section 5.4.3.1.2
Heating & Cooling	
Electric Heating System	Electric Resistance Heater[40]
Electric Cooling System	If cooling is proposed, refer to ASHRAE 90.1-2019 Tables 6.8 1-1 through 6.8.1-20, for minimum equipment efficiencies.
HVAC Fan Systems	Fan Power[41]: Refer to ASHRAE 90.1-2019, Section 6.5.3.
Lighting	
Apartment Lighting	Per 2021 Oregon Energy Efficiency Specialty Code modification of ASHRAE 90.1-2019 Section 9.4.3 Dwelling Units: Not less than 100% of the permanently installed lighting fixtures shall use lamps with an efficacy of at least 55 lm/W or have a total luminaire efficacy of at least 45 lm/W.
Common Area Lighting	Building Area Method Per ASHRAE 90.1-2019 Tables 9.5.1, Multifamily = 0.45 W/sf

[39] "Whole-building pressurization testing shall be conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building envelope shall not exceed 0.40 cfm/ft2 under a pressure differential of 0.3 in. of water, with this air leakage rate normalized by the sum of the above and below-grade building envelope areas of the conditioned and semi-heated space." Refer to ASHRAE 90.1-2019 for exceptions to 5.4.3.1.1.

[40] Per ASHRAE 90.1-2019, Section 6.3.2(c), an electric resistances heater is the least efficient electric heating system allowed. However, proposed equipment shall meet minimum equipment efficiencies as detailed in code: (1) ASHRAE 90.1-2019: refer to Tables 6.8 1-1 through 6.8.1-20 for minimum equipment efficiencies; (2) 2018 IECC: refer to Tables C403.3.2(1) through C403.3.2(9)for minimum equipment efficiencies.

[41] Per ASHRAE 90.1-2019 and IECC 2018, applicable to total fan system motor nameplate horsepower exceeding 5 hp.

Building Component	Modeling Requirements
	Space-by-Space Method Refer to ASHRAE 90.1-2019 Section 9.6.1
Lighting Controls	Building Area Method or Space by Space Method Refer to ASHRAE 90.1-2019 Section 9.6.1
Exterior Lighting	Refer to ASHRAE 90.1-2019 Table 9.4.2-2: Individual Lighting Power Allowances for Building Exteriors For applicable lighting zone, refer to ASHRAE 90.1-2019 Table 9.4.2-1 Exterior Lighting Zones
Ventilation	
Apartment Ventilation	Minimum Ventilation Rates per 2019 Oregon Mechanical Specialty Code, Chapter 4 ASHRAE 90.1-2019 6.5.6: Enthalpy recovery of 60% for heating for all nontransient dwelling units greater than 500sf
Local Exhaust - Kitchen[42]	25 CFM, continuous 150 CFM, intermittent
Local Exhaust – Bathrooms[10]	20 CFM, continuous 80 CFM, intermittent
Outdoor Air for Dwelling Units	CFM = 0.01 x area (sf) + 7.5 x (1 + # of bedrooms)[43]
Outdoor Air for Other Spaces[44]	No less than 0.06 CFM/ft^2

4.3.2 Baseline Modeling Adjustments

While Figure 1: Oregon Code Baseline Requirements per 2021 OEESC outlines the baseline requirement per code, there may be some instances where the baseline assumptions are not appropriate or applicable based on the specific conditions of a building. The Energy Consultant is encouraged to contact OR-MEP program staff to discuss any deviations from these baseline requirements and propose alternative baseline values and reasoning.

When there is no defined code requirement for a specific modeling parameter, the Energy Consultant should reflect industry accepted practices and document these assumptions in the Energy Efficiency Plan.

4.4 General Modeling Requirements

[42] Per 2019 Oregon Mechanical Specialty Code, Table 403.3.2.3.
[43] Per 2019 Oregon Mechanical Specialty Code, Section 403.3.2.1.
[44] Per 2019 Oregon Mechanical Specialty Code, Section 403.3.2.2.

4.4.1 Approved Modeling Software

The Energy Consultant must submit the modeling files used to calculate savings summarized in the Energy Efficiency Plan. Any OHCS approved energy analysis tool is acceptable for calculating savings. OHCS has reviewed and approved the following tools for multifamily use: EnergyPro (mid-rises only), TREAT, DOE-2, TRACE, HAP, REM/Rate (≤ 3 stories), REM/Design (≤ 3 stories), eQuest, and IES-VE.

4.4.2 Establishing the Baseline and Proposed Design Model

Projects shall be simulated as described in this document.

The Baseline design model and Proposed design model shall be based on the final design of the project. Baseline and Proposed design models shall include all the energy uses within and associated with the building.

Baseline Design Model Components

For Existing Building projects, components of the Baseline design model shall reflect the existing building conditions.

For New Construction projects, components of the Baseline design model shall comply with the applicable Oregon energy code the project is permitted under.

End uses that do not exist in the Proposed design model cannot be included in the Baseline design model.

Example: Parking Lot Lighting

If the parking lot in the Proposed design is not lit, then parking lot lighting power allowance cannot be added to the Baseline design model's energy consumption.

Proposed Model Components

Components in the Proposed design model must reflect the actual building components, except where otherwise specified in this document. Components in the Proposed design must comply with applicable state and local codes. If components are not installed during construction, (for example appliances or room air conditioners), then such components may not be modeled in the Proposed design model as contributing to energy savings.

Example: Space Cooling

In New Construction projects, if heat pumps with cooling are in the Proposed design they should be included in the Proposed design model as specified. The Baseline design model should include cooling with an equivalent cooling system with a code level efficiency. If there is no cooling in the Proposed design, cooling should be excluded from the Baseline design model.

4.4.3 Project Boundary & Non-Residential Spaces

The models shall include all dwelling units and common spaces in the building. Other nonresidential areas such as retail stores or offices open to the general public and unrelated to the building's residential function may be included or excluded from the simulations at the discretion of the energy modeler. If included, they must be modeled energy neutral and energy savings cannot be claimed for nonresidential areas.

4.4.4 Projects with Multiple Buildings

Separate Baseline design models and Proposed design models shall be created for each unique, non-identical building in the project.

Savings and incentives shall be calculated at a project level aggregating Baseline and Proposed design results across all buildings individually for each such building.

4.4.5 Schedules

The models must include the schedules described in this document, or approved equivalent. All schedules that differ from the ones specified here shall be documented and submitted to OR-MEP staff for approval.

The same schedules must be used in both the Baseline Building Design and Proposed Design unless explicitly allowed this document. Any difference in the schedules must be documented.

4.4.6 Modeling Interactive Effects

All measures that can be modeled in an approved modeling software shall be modeled in the software. Additionally, all energy efficiency measures shall be modeled to capture the interactive effects between measures. This results in the most accurate method for calculating the OR-MEP's Whole Building Path energy savings. The best method for modeling interactive effect varies across software tools. For example, in eQUEST measures can be modeled interactively using Parametric Runs. The Energy Consultant shall determine the best method for modeling measures interactively based on the modeling software and measures proposed. All interactive modeled savings shall be inputted into the Energy Efficiency Plan workbook accordingly at the measure level.

To align with regional guidance, OR-MEP recommends following these three approaches as accepted and outlined in Energy Trust of Oregon's New Buildings Program Technical Guidelines

4. **Subtractive baseline**: The as-designed building is run with all measures included. One measure is removed and the model is rerun. That measure is put back into the model and another is removed and the model is run again. This is done until all measures have been evaluated. The difference between the total interactive run values and the values determined when the measure is removed is considered the individual measure's contribution. A code baseline model is also required to determine the final interactive energy savings.

This is viewed as the most conservative approach for ascertaining the savings associated with individual measures.

5. **Incremental or rolling baseline**: The measures to be included in the design are consecutively added to the baseline model with a run made for each measure to estimate the effect of that measure. It is possible that the sum of the individual savings will not equal the total for the interactive model. Care should be taken in the ordering of measures; those that are most likely to be implemented and most likely to be cost effective should be added first.

   This is a more expensive approach. If a measure is removed or modified the model will have to be rebuilt from the point where that element was changed in the model. It is less conservative than the subtractive approach in measuring the effect of individual measures due to the fact that they are not tested against the background of the rest of the measures.

6. **Individual approach**: The measures are tested one at a time in isolation against the baseline. Selected measures are included in a final, interactive model. This is considered the least conservative approach to estimating the effect of individual measures in the final building design.

4.4.7 External Calculations – Special Measures

For measures that cannot be modeled in the approved energy modeling software, external engineering calculations may be submitted instead, typically as spreadsheets or industry specific tools. Applicants should consult with OR-MEP staff prior to using any external calculation methods for pre-approval of the general method and for technical assistance with alternate modeling options.

All external calculations shall be documented as follows:

- A list of all assumptions, constants, and equations used in the calculations must be clearly identified.
- Interactions between measures should be accounted for in the calculations.
- All external calculations calculated in a spreadsheet tool, shall be submitted as an Excel file that is unlocked and can be followed by OR-MEP staff during technical review.

4.4.8 Gut-Rehab, Substantial Renovation, and Addition Projects

OR-MEP serves projects that are gut-rehab, substantial renovation, and addition projects. Generally, determine the baseline requirements of the components and whether they shall follow existing conditions or code requirements is determined by what code requires. As each project is unique, OR-MEP approaches these projects on a case-by-case basis. Please contact OR-MEP staff to discuss in more detail to maximize energy savings opportunities while still aligning with code requirements.

4.4.9 Renewables

Energy savings associated with on-site power generation, including cogeneration with the associated waste heat recovery, photovoltaics, or wind turbines, may not contribute to savings or be used to meet OR-MEP's Whole Building Path savings thresholds (e.g. ≥ 20%, ≥ 25%, ≥30%, kWh savings).