User's Manual

EnergyPro Version 9

EnergySoft, LLC
December, 2022

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What's New in EnergyPro Version 9?

Significant Changes to the 2022 Standards and EnergyPro version 9

The text below describes some of the most significant changes in
the 2022 Standards, effective January 1, 2023, reflected in the new EnergyPro version 9 interface. It is NOT a comprehensive list of changes. Refer to the [CEC web page for the 2022 Standards](#) for comprehensive documentation regarding all of the requirements and to the specific Building Tree or Library topic for more information about a specific input or measure.

Three Compliance Metrics

Starting with the 2022 code cycle, compliance will be based on three metrics: hourly source energy (HSE) and a two-part Time Dependent Valuation (TDV) metric. For a proposed building to comply, each component of its TDV energy and the HSE energy use must be less than or equal to the standard design energy budgets.

- Hourly Source Energy: HSE is an energy metric for electricity, natural gas, and propane. Put simply, HSE represents the amount of long-term depletable energy resources used to meet the energy demand of the building in each hour. HSE values are very similar to the long-term hourly utility greenhouse gas (GHG) emissions and a strong metric for encouraging building decarbonization.

- Time Dependent Valuation (TDV): The TDV metric values energy differently depending on the day of the year and hour of the day that a specific type of energy is used. This means that electricity saved during peak periods will be worth more in the compliance process than the same amount of electricity saved during off peak times when grid demand for energy is lower. The value assigned to energy savings through TDV more closely reflects the long-term costs for electricity, natural gas, and propane and provides compliance credit for measures that results in load shifting from peak periods to off-peak periods.

  TDV is composed of two components: Efficiency TDV (TDVeff) and Total TDV (TDVtotal). The TDVeff is based on the energy efficiency features of the building. TDVtotal includes the effects of the PV system, battery storage system, precooling, and other demand-responsive measuresin addition to the efficiency measures.

- Compliance results for single family residential projects are based on TDV and HSE, but are converted to unitless Energy Design Rating (EDR1 and EDR2) metrics. EDR1 represents the HSE and EDR2 represents the TDV metrics. The two components of EDR2 are the efficiency EDR2, which does not include solar electric generation but can include a self-utilization credit for batteries, and

total EDR2 which includes the effects of solar generation and the battery storage beyond the self-utilization credit. EDR only applies to new single family residential projects.

Additional information regarding EDR

Multifamily Occupancies

The 2022 Energy Code groups all multifamily building requirements together, regardless of number of stories, and relocated all relevant multifamily code to Standards Sections 160.0 through 180.2. Requirements for multifamily occupancies are mostly consolidated in Chapter 11 of the Nonresidential and Multifamily Manual, however, some content remains within the associated nonresidential chapters. Refer to the "Overview" tables in Chapter 11 that document the location of multifamily mandatory, prescriptive and performance requirements for each component in the Standards, as well as related content in the Compliance Manual.

Heat Pump Baselines

California's buildings produce a quarter of the state's greenhouse gas (GHG) emissions. Reducing these emissions, also referred to as building decarbonization, is a key part of California's climate strategy. The 2022 Standards for newly constructed buildings, and additions and alterations to existing buildings seeks to accelerate the decarbonization of the building sector. The Stnadards encourage heat pumps, establish electric-ready requirements for newly constructed homes, and strengthen ventilation standards. In addition, for the first time in the nation, the Standards require solar photovoltaic systems plus battery systems for select nonresidential building types.

- **Single Family Heat Pump Baselines**

  The prescriptive compliance approach requires a heat pump for either water heating or space heating, depending on the climate zone.

  In Climate Zones 3, 4, 13, and 14, the space heating system is required to be a heat pump under the prescriptive compliance approach. In other climate zones, it can be either a heat pump or a gas heating system (§150.1[c]6).

  Water heating equipment is required to be a heat pump water heater or a solar water heating system with electric backup and minimum 70 percent solar fraction. In Climate Zones 3, 4, 13, and 14 a gas instantaneous water heater is allowed (§150.1[c]8).

- **Nonresidential Heat Pump Baselines**

  The 2022 Standards adopt new prescriptive requirements for heat pump single zone space conditioning systems for certain nonresidential space categories, including retail, grocery, schools, offices, financial institutions, and libraries. In addition, the prescriptive baseline assumes heat pump water heating systems for small schools in climate zones 2 through 15.

Photovoltaic and Battery Storage Systems

The 2022 prescriptive requirements and Standard Design for many new nonresidential and multifamily projects with four or more habitable stories requires a PV and battery storage system. The minimum system size is based upon the occupancy type. The following occupancies are included: Grocery, High-rise Multifamily, Office, Financial Institution, Unleased Tenant Space, Retail, School, Warehouse, Auditorium, Convention Center, Hotel/Motel, Library, Medical Office Building/Clinic, Restaurat, and Theater.

There are several exceptions to the requirements, often related to limited solar access, that reduce the minimum system size required. If an exception applies, you may select it from the list and EnergyPro will automatically calculate the adjusted Standard System size.

Additional information regarding PV and Battery Storage Systems

- Single Family
- [Multifamily](#)
- [Nonresidential](#)

2022 Weather Files

The CEC adopted new hourly weather files for the 2022 Standards. The new files are more recent than previous versions, based on the 20-year period from 1998-2017. The 2022 weather files result in higher cooling loads and lower heating loads with the transitional climate zones, such as Climate Zone 8, experiencing the greatest change.

Previous Versions of EnergyPro

You may install multiple EnergyPro versions on your computer simultaneously without conflict. In addition, you may use EnergyPro version 7 and version 8 files in EnergyPro version 9 (but not vice versa). Carefully review your data inputs, add new and/or revise any data required by the 2022 Standards. Once you have opened the file in EnergyPro v9, save it as a v9 file. Should you need a file from version 6 or earlier, open and save the file in version 7 or 8, then you may open it in the current version.

Introduction

EnergyPro is a comprehensive energy analysis program that may be used to document compliance with California's 2022 Residential and Nonresidential Building Energy Efficiency Standards (Title 24, Part 6), ASHRAE 90.1 Standards, as well as residential and nonresidential Green Building rating systems, such as GreenPoint Rated and LEED. The official CEC notice of approval allowing the use of EnergyPro for compliance is included in Appendix 1 of this manual. EnergyPro is composed of an interface which includes a Building Tree and Libraries as well as several different residential and nonresidential calculation modules. The program performs several different types of calculations.

The Main Menu is the software's home base. The Main Menu is located across the top of the window that appears on your screen after you start the program. The Main Menu is the starting point and central core for managing files, moving into the Building Tree, running calculations, preparing reports, and accessing on-line Help.

This introduction provides an overview of the various program components as listed below. You may find additional details about each subject within the other chapters in the Help system. If you are not familiar with the software or the energy standards, or you do not have much experience with building energy analysis, read the rest of the Introduction and Building Tree Overview carefully.

What's New in EnergyPro 9?

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Overview

California Energy Commission Approval

EnergyPro version 9, developed by EnergySoft, LLC, is a software program which may be used for demonstrating compliance with the 2022 Title 24, Part 6 Building Energy Efficiency Standards, effective January 1, 2023.

Single Family Compliance: EnergyPro version 9 was approved by the CEC on December 14, 2022. The single family residential standards apply to single family dwellings (R-3 occupancy group). Multifamily buildings and hotels/motel projects document compliance using the nonresidential/multifamily modules.

EnergyPro version 9 includes the latest CBECC-Res (version 2022.2.0) compliance manager, approved by the Commission on October 12, 2022.

Nonresidential and Multifamily Compliance: EnergyPro version 9 was approved by the CEC on December 14, 2022. The NR/MF Title 24 Performance module uses the CEC's CBECC (version 2022.2.0) compliance manager approved by the CEC on October 12, 2022.

This manual provides a description of software inputs and a guide to using the software. Knowledge of the Standards is a pre-requisite. As the documentation author, you are responsible for the content of the compliance documents and all other documentation produced by EnergyPro, for any purpose including submittal to the enforcement agency as proof of compliance with the Standards. It's highly

recommended that you obtain and become familiar with all 2022 Standards Publications prior to performing compliance calculations.

General Program Procedure

For many residential and some nonresidential buildings, you may use one of the Building Wizards to create a new file. Each Building Wizard automatically leads you through the steps to define the building features and applicable calculations.

1. **Open and Save:** Open a new file and give it a project name. Immediately choose **File/Save As…** and name the file with the project name.

2. **Customize Libraries if Necessary:** You may use the existing entries in the libraries if applicable, modify them, or create new items in each library. Each building description file has its own unique set of libraries which are saved, along with the overall input, to the active job file. A second set of libraries, the Default Libraries, is accessible from every job file. The Default libraries can include assemblies, glazing, equipment or other entries which you want to have available for many different projects. If you modify the libraries before constructing the Building Tree, the features you need will be readily available. You may also create a set of default entries for the envelope construction components that will be specific to this project. If you prefer to customize the libraries as you go, you may access each library from within the various Building Tree elements. (See Libraries for more complete instructions for editing libraries.)

3. **Construct the Building Tree:** Each element in the Building Tree is preceded by an icon to provide a visual cue to assist you in making entries. You will include the project title and location, and other general identifying information such as your name, as you begin at the top of the tree. Once you complete the general project information, add new elements to the Building Tree to describe each component of the building, including the Plant, Systems, Zones, Rooms, Lighting, and Envelope features. Detailed descriptions of each element in the Building Tree are provided in the Building Tree Information topic and in Building Tree Overview.

4. **Run Calculations:** After you completely describe your building in the Building Tree, select the type of calculations you wish to run. Running Calculations lists step-by-step procedures.

5. **Print Reports:** The program allows you to print reports and full-page graphic forms which are reproductions of those used by state and other standards agencies. The **Report Wizard** makes it easy to prepare a report for printing. Details for preparing a printed report are provided in Printing Reports**.**

EnergyPro Installation

The EnergyPro Version 9 installation wizard will walk you through the program installation process.

Program Files: EnergyPro version 9 program files are automatically installed on the local drive in the Program Files folder, in the EnergyPro 9 subfolder.

Project Files: EnergyPro version 9 creates a subfolder in My Documents, also entitled EnergyPro 9. This sub-folder contains all the working files, including project files, default libraries and detailed simulation results.

Contact Database: EnergyPro v9 uses a database to store all contact information. This allows the user to simply select designers/clients from the contacts database rather than having to repeat the entries for each new project. The default location for the database is on the local drive, in the EnergyPro 9 subfolder of My Documents. The filename is EnergyProContacts.mdb. You may place the contacts database on a network installation also.

Libraries, Projects, and Results: You may modify the location of the Libraries, Projects, Results, and Contacts by selecting Options from the Tools Menu. You must re-start the software for any changes in File Locations to take effect.

System Requirements:
- 64-bit, Windows Operating System (Windows 10 or 11)
- Hard Disk: 1 GB of free space
- RAM: 4 GB
- High speed Internet connection (cable or dsl) for downloading updates and issuing certificates of compliance

Moving EnergyPro to a Different Computer: When moving to a new computer, you must first uninstall the EnergyPro license on your existing computer. Select Software Activation from the Help Menu, and EnergyPro will open the "Install EnergyPro License" dialog box. Click the Uninstall License button at the bottom of the dialog box. You may now install the software on a different computer.

What types of buildings may you analyze with EnergyPro?

- Single Family Residential buildings (use Single Family Performance (Title 24 and non-Title 24), Residential Loads, and GreenPoint Rated)
- Multifamily Low- and High-rise Residential buildings (use NR T24 Mandatory, NR/MF T24 Performance, Nonresidential Loads, NR Performance (non-T24), and ASHRAE 90.1 Performance)
- Hotels/Motels (use NR T24 Mandatory, NR T24 Prescriptive, NR/MF T24 Performance, NR T24 Process, Nonresidential Loads, NR Performance (non-T24), and ASHRAE 90.1 Performance)
- Nonresidential buildings (use NR T24 Mandatory, NR T24 Prescriptive, NR/MF T24 Performance, NR T24 Process, NR Performance (non-T24), Nonresidential Loads, and ASHRAE 90.1 Performance)
- Outdoor Lighting (Use NR Prescriptive Outdoor Lighting and ASHRAE 90.1 Performance)

What building information do you need for EnergyPro?

Before you try to perform any Title 24 compliance analysis, it is essential that you have the most recent editions of certain manuals from the California Energy Commission. Refer to 2022 Standards Publications *for a list of essential CEC publications in the Introduction. These publications contain key explanations of the Standards and include information you need to run EnergyPro.*

Once you are familiar with these state manuals you can start analyzing buildings for compliance with Title 24, Part 6. To do an analysis you need various types of project information. Obtain the information from the building plans or by discussing the project with the designer and other consultants. In some cases, you must make preliminary assumptions. It's a good idea to study the building plans and specifications carefully before sitting down in front of the computer.

For a new project you typically need to input:
- Basic title block information (i.e., Project Title, Designer, etc.)
- Location and climate zone
- Floor, wall, roof and glazing areas and orientations
- Construction assemblies and glazing types
- Characteristics of the project's HVAC, Lighting and DHW systems

- Features of covered process loads.

If the project has common assemblies, glazing types and the HVAC and DHW systems, you may often use the pre-defined entries in the libraries. Other inputs, such as domestic hot water for residential buildings, are required for some projects but not for others. This is covered in the detailed explanations in Libraries and Building Tree**.**

Tutorials and Sample Files

EnergyPro includes tutorial files for typical residential and nonresidential projects and installs several sample files which you can use to see how a particular system or permit situation is modeled. The files are automatically installed in the Projects subfolder.

The tutorial files, (Single Family Sample.bld, Multifamily Sample, and NonRes Sample.bld), illustrate how to enter data and run compliance calculations for a sample single family, multifamily, and nonresidential building using EnergyPro. In addition, there is a practice tutorial for each Library that you may access from each Library topic screen.

Additional sample files include: Multifamily Electric, Multifamily WSHP, NR Built-UP VAV systems, VRF and Mini-Split Systems, Existing + Addition + Alteration, Outdoor Lighting, Single Family Attached ADU, Single Family Hydronic Systems, Tailored Lighting, NR Envelope and Mechanical Only, as well as several files that highlight specific HVAC equipment.

2022 Standards Publications

Before you try to perform any Title 24 compliance analysis, it is essential that you acquire and become familiar with the following CEC publications:

- *2022 Building Energy Efficiency Standards* (CEC-400-2022-010-CMF, August 2021) contains the official standards adopted by the Energy Commission.
- *2022 Reference Appendices for the 2022 Building Energy Efficiency Standards* (CEC-400-2022-010-AP, August 2022) is the source document for climate zones, envelope assembly assumptions, HERS protocols for measures requiring verification by a HERS rater, requirements for photovoltaic and battery storage systems, as well as eligibility and installation criteria for energy efficiency and electrification measures.
- *2022 Single Family Residential Compliance Manual* (CEC-400-2022-006-CMF, May 2022) is the interpretive manual for complying with the single family standards (also contains sample compliance forms).
- *2022 Single Family Residential Alternative Calculation Method (ACM) Reference Manual* (CEC-400-2022-008-CMF-REV, October 2022) contains the rules that the software follows to establish the standard and proposed designs for a proposed single family building.
- *2022 Nonresidential and Multifamily Compliance Manual* (CEC-400-2022-007-CMF, May 2022) is the interpretive manual for complying with the nonresidential standards (also contains sample compliance forms).
- *2022 Nonresidential and Multifamily Alternative Calculation Method (ACM) Reference Manual* (CEC-400-2022-009-CMF-REV, October 2022) contains the rules that the software follows to establish the standard and proposed designs for a proposed building.

You may obtain the documents from the California Energy Commission website https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency

User Interface

EnergyPro's user interface provides an intuitive method of simulating both residential and nonresidential buildings for Title 24 compliance as well as many other purposes, including compliance with ASHRAE 90.1, and documenting green building ratings. The format is the product of development and refinement over several code cycles resulting in an efficient, easy-to-use, and flexible interface.

Multi-Pane Window

The multi-pane window format allows users to view the Building Tree, the detailed data for the component being edited, and the most recent calculation results simultaneously. This format makes editing files more convenient and also eliminates having to open and close a dialog box each time the user wishes to edit a project feature. It also allows the user to easily and visually track the exact location of the component being edited while it's being edited.

The user can customize the panes to fit the screen in a number of ways.

- The Upper Left Window Pane displays the major program components: the Building Tree, Libraries, Calculations, Reports, and Project Defaults. You may customize the display by dragging the dividing line between the upper and lower sections up or down.

- The Lower Left Window Pane displays choices that allow you to easily switch views in the Upper Left Pane from the Building Tree to Libraries, Calculation and Report Options, or the Project Default construction assemblies. You may customize the display to show all selections in a list, only some, with the remaining choices displayed as icons, or display only icons at the bottom of the screen.

- The Upper Right Window Pane displays the detailed information about the selected item in the Left Window Pane. For example, if one selects the Zone Element of the Building Tree, the detailed entries for that Element are displayed in the Upper Right Window.

- The Lower Right Window Pane displays the most recent calculation results as well as any errors or warnings. Each different calculation is displayed on its own tab.

User and Project Defaults

User Defaults: EnergyPro contains a set of default construction assemblies that are included in each new file. You may customize the Default Library settings selecting Default Libraries…and the specific library from the Tools Menu. Select assemblies you use most often to automatically populate specific Building Tree elements in each new project file. Changes to User Default Libraries will be applied in the next new project file. They will not change the data in an open project.

Project Defaults: EnergyPro also allows you to set Project Defaults, which only apply to the currently open project. Select the Defaults option in the left window pane. Specify assemblies you expect to use in your project. Each time you create a building tree element that uses one of the assemblies, EnergyPro will automatically populate the library field with the specified default assembly.

Metric System

EnergyPro can display entry fields and calculation results in either the US Customary or Metric (SI) number and measurement systems. To switch from one system to the other, you must first close EnergyPro.

Open the Control Panel:

In Windows 10, Select Language.

Select the option to Change Date, Time or Number Formats, then in the Region Dialog Box, select the Additional Settings… button. Select either Metric or U.S. from the Measurement System drop-down list. Close the dialog boxes, and re-start EnergyPro. All data entries and measurement units will be converted to the selected system.

Contacts Database

EnergyPro uses a database to store all contact information. This allows the user to simply select designers/clients from the contacts database rather than having to repeat the entries for each new project. The default location for the database is on the local drive, in the EnergyPro 9 subfolder of My Documents. The filename is EnergyProContacts.mdb. You may also place the Contacts Database on a network drive.

Modify the location of the Contacts Database by selecting Options from the Tools menu. You must re-start the software for any changes in File Locations to take effect.

Building Tree

Construct the Building Tree by entering the building description of an unlimited number of thermal Zones and HVAC Systems as explained in the Building Tree Overview and Building Tree, Information topics. The building description includes the specification of all envelope characteristics, installed lighting power and controls (applicable primarily to nonresidential buildings), domestic hot water and HVAC systems.

Hover over the Building, Plant, System or Zone Elements in the Building Tree to display the conditioned floor area for that element.

Undo (Element Delete Only)

If you accidentally delete an element from the Building Tree, EnergyPro allows you to retrieve it. EnergyPro will restore the element as well as all the sub-elements contained within it. However, if you delete a sub-element first, then delete the element at a higher level in the Tree, when you select Undo, the element will be restored, but you will have to restore the sub-element separately by selecting Undo again.

Use caution when using this feature, as it will NOT undo any other entries, revisions or deletions! All other data will remain.

Libraries

Program libraries contain commonly used systems and components, and allow you to create, modify and store additional frequently used items, as well as specific entries needed for a particular project, as documented in the main Libraries topic. EnergyPro libraries contain several enhancements from previous versions, providing greater flexibility and streamlining the way in which library items are created and used. The libraries contain additional library command options and are displayed in a format that allows the user to easily view the list while editing an item.

The Assembly Library is used to define and calculate the R-Values, U-Factors and heat capacities of walls, ceilings, floors and doors based upon specified components, framing percentage and framing material.

The Fenestration Library is used to define glazing characteristics. Fenestration Library entries included with the software contain sample entries, as well as California Energy Commission (CEC) default U-Factors and Solar Heat Gain Coefficient (SHGC) values.

Overhang and Sidefin **Libraries** are used to define horizontal and vertical shading devices and contain sample entries for typical overhang and sidefin configurations.

The Central System Library is used to define the central system components of the HVAC system. This library lets you define standard HVAC system equipment.

The Zonal Library is used to define the zonal-level components of built-up HVAC systems, such as VAV boxes or Variable Refrigerant Flow units.

The **Plant Libraries** are used to define Chillers, Cooling Towers, and DHW/Boiler systems for both domestic hot water and space conditioning.

The Luminaire Library is used to define light fixtures, including total wattage for each fixture and whether the value is a CEC default or user-defined.

The Schedule Library is used to set weekly and yearly schedules associated with occupants, lights, equipment, infiltration, DHW, processes, heating, cooling, and fans for a typical week and year. In addition, you may use the Schedule Library to define utility rates. Schedules related to loads calculations and internal gains are used by the Loads and NR Performance noncompliance calculations. For Title 24 compliance, NR/MF T24 Performance uses internally fixed schedules. These schedules are set by the CEC and cannot be changed by the user. Utility rate schedules can be used to determine energy costs in any of the nonresidential performance calculations.

Export Library Items

EnergyPro allows the user to export library items from one project to another, eliminating the need to re-create an item for new projects. The user can export from the default libraries to any open project, or from any open project to another open project or to the default libraries for use in future projects.

CEC Construction Assemblies

The values shown onscreen are based upon the U-Factor tables in Joint Appendix 4. When doing performance modeling, the CEC's Compliance Manager calculates U-Factors based on the assembly description independent of the tables.

Modules and Calculations

EnergyPro has several calculation modules which may be purchased as packages or separately, generally categorized as Title 24 Modules and Other Calculations. Both categories contain Residential and Nonresidential (NR) Performance modules as well as Load Calculation modules.

Once you create a building description file, you may perform any of either the residential calculations or nonresidential calculations, depending on the occupancy type and the modules you have installed. You may select which calculations you would like to run by selecting the Calculations option in the lower left window pane, placing a check in the checkbox next to each calculation type and selecting the specific features of each calculation from the Calculation options window in the upper right window pane.

Title 24 Modules:

- Single Family Title 24 Prescriptive allows you to show compliance using the Prescriptive method for Additions and Alterations. EnergyPro will do the necessary calculations automatically to immediately inform you if your project complies. If it doesn't, EnergyPro provides a convenient list of items that need correction to comply with the prescriptive requirements. If the changes required to comply are not feasible for your project, you can instantly run a performance calculation without any re-entry or

duplication of effort! This is a much more streamlined method for additions and alterations that in many cases requires no CF-1R registration or HERS testing.

- Single Family Title 24 Performance, an hourly energy simulation used to determine and document Title 24 compliance of single family residential buildings. It shows compliance with the standards by comparing the proposed energy use to a standard energy budget based on the building design as documented in Chapter 8 of the Single Family Residential Compliance Manual.

- Residential Loads which calculates residential design heating and cooling loads including room by room load calculations, using ASHRAE Handbook of Fundamentals procedures to determine the proper size of the HVAC system.

- Nonresidential Title 24 Prescriptive modules which compute and document nonresidential and hotel/motel envelope, interior and outdoor lighting, and mechanical system compliance with Title 24 prescriptive requirements.

  - ➢ Envelope: evaluates building envelope compliance using the CEC Overall Envelope compliance method as described in Chapter 3 of the Nonresidential and Multifamily Compliance Manual.

  - ➢ Indoor Lighting: evaluates indoor lighting compliance using the Complete Building, Area Category, or Tailored compliance methods, as explained in Chapter 5 of the *Nonresidential Manual.*

  - ➢ Outdoor Lighting: evaluates outdoor lighting compliance, including signs, as described in Chapter 6 of the Nonresidential Manual.

  - ➢ HVAC and Loads: determines compliance of the HVAC system using the prescriptive method, as described in Chapter 4 of the Nonresidential Manual. The calculations also include nonresidential heating and cooling loads using the ASHRAE TFM sizing methodology as published in the ASHRAE Handbook of Fundamentals to determine the proper size of the HVAC system. The cooling analysis is an hourly analysis that explicitly models solar gain and response factors of all construction assemblies. In addition, the module can perform room by room load calculations for buildings with up to 1,024 user-defined zones.

- Nonresidential/Multifamily Title 24 Performance compliance calculation which predicts annual building energy performance based on an hourly simulation. It shows compliance with the standards by comparing the proposed energy use to a standard energy budget based on the building design as documented in Chapter 11 of the Nonresidential Compliance Manual.

- Nonresidential Title 24 Regulated Process module produces the Process (PRC) compliance forms for processes covered by the Standards including Commercial Kitchens, Parking Garages, Computer Rooms, Laboratory Exhaust, Commercial Refrigeration, Elevators and Escalators, Compressed Air, and Process Boilers.

- Nonresidential Title 24 Mandatory Measures module issues the Electrical Power Distribution (ELC), Solar and Battery (SAB) and Commissioning (CXR) forms that are required on most projects. In addition, you may use this module to complete the mandatory information required for the mechanical forms and indoor and outdoor lighting projects also.

Other Calculations Modules:

- Single Family Residential Performance allows you to calculate the energy performance of single family residential buildings when no code or compliance baselines are involved. This module will perform an hourly simulation on the building, and determine annual energy consumption and energy cost.

Single Family GreenPoint Rated. This module, developed in partnership with Build-It-Green, will calculate the energy point score used for compliance with the GreenPoint Rated scoring system used for rating new and existing homes. In addition, it will produce the form GPR-1 compliance certificate needed to demonstrate compliance with the GreenPoint Rated system.

- Single Family Load Calculations. Determine the size requirements of HVAC systems for single family residential buildings. Utilizing ASHRAE Handbook of Fundamentals procedures, this module will allow for room by room load calculations to determine the proper size of the system.

- Nonresidential Performance allows you to calculate the energy performance of nonresidential buildings when no code or compliance baselines are involved. This module will perform a DOE-2 hourly simulation on the building and determine annual site energy consumption and energy cost. In addition, this module can be used for programs to analyze non-code energy uses (under certain circumstances, check with the utility regarding eligibility). This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use.

- NR ASHRAE 90.1 Performance Compliance. Demonstrate compliance with the ASHRAE 90.1 Standard using the Appendix G compliance methodology. This module will automatically create the four baseline runs needed to show compliance with the 2019 version of the standard. For LEED compliance, the 90.1 methodology is used for projects outside of California and can optionally be used for projects inside California.

  This module uses the DOE-2.1E* v119 software engine licensed from the Department of Energy to provide a highly accurate hourly simulation of building energy use. Documentation produced by this module includes the EAC-1 worksheet which can be used to complete the LEED template

Residential Alternatives

EnergyPro allows you to test the impact of individual and multiple energy-saving measures for single family residential non-compliance projects (SF Performance module) in one action. Individual Alternatives simulate the savings from adding one individual measure to the base design at a time. Combined Alternatives simulate the cumulative impact of adding multiple measures, one after another.

Calibrating Results

For existing buildings, EnergyPro allows you to easily compare your simulation results to the building's actual energy usage. The Nonresidential and Residential Performance modules contain a Calibration Tab that will create a graph of the monthly simulated and actual energy usage and cost (both electricity and natural gas). Use this graph to compare your simulation to the actual usage and to identify significant differences between them. This will allow you to adjust your simulation as required to closely mirror the actual building usage profile.

Calculation Processing

EnergyPro uses the full capacity of your computer's processors. If you have a multiple core processor, EnergyPro will use all cores to run the calculations, dramatically increasing the speed of simulations, especially for parametric runs or very complicated models.

The optimized processing allows you to edit your project or another project while EnergyPro is running a simulation.

EnergyPro analyses provide:

- Ready-to-print/ready-to-register compliance reports and loads reports, including appropriate forms and supporting worksheets required for submittal to local enforcement agencies.

- Economic summaries, including time-of-use utility rates, for nonresidential and high-rise residential buildings and hotels/motels.

- A diagnostic check to detect input errors before running calculations.
- Comprehensive on-line documentation, including context-sensitive help (What's this?). The software's help system also includes a complete copy of the CEC Reference Manuals for your convenience.

Input Diagnostic

The Input Diagnostic feature provides five levels of diagnoses: **Error, Warning, Caution, HERS** and **Information**. When a calculation is run, the Diagnostic Wizard displays a message for each item in question in the lower right window pane. Diagnostics are shown on a separate tab for each level, which shows its location, names the Issue, and suggests a solution. In addition, the diagnostics feature includes a search function that displays the Building Tree or Library element that is the source of the message when the user double-clicks on the message in the Location box.

See also: Residential Compliance Modeling Techniques &

Nonresidential Compliance Modeling Techniques

Error Location

When a calculation is run, EnergyPro's Input Diagnostic tool displays messages for each data item in question in the lower right window pane. Messages range from Information to Errors and also include HERS-related messages. EnergyPro's Input Diagnostic now includes error location assistance. Double-click on the message in the Location list box, and EnergyPro automatically displays the Building Element that is the message's source. Refer to Error Messages for a complete list of error messages you may encounter.

Saving Detailed Data

EnergyPro allows you to save detailed data for each simulation module in the EnergyPro 9\Results sub-folder. The default setting removes all temporary and detailed data files after the simulation is complete. You may elect to save input and some output files for additional analysis outside the program. This feature can be a very helpful trouble-shooting tool also. The program creates a sub-folder for each calculation module that includes both the project name and calculation module for easy identification.

Residential modules create an input file and/or a comma separated values output file that includes hourly temperature and loads data for each end use. Nonresidential modules create the hourly loads data and the simulation input and output files.

Refer to the Detailed Calculation Data topic for additional details.

Printing Reports

Back to Building Tree Overview

Using the Report Wizard

The software's Report Wizard makes preparing a report as easy as clicking a button. Access the Report Wizard by selecting the Report Wizard icon from the toolbar or choosing **File/Report Wizard…** from the File Menu or by selecting the Report Wizard icon from the toolbar.

To begin: Select the report type you wish to print. You may only prepare one report type at a time. The Report Wizard guides you through the rest of the process of selecting the relevant forms you wish to include in the report.

To end: In the last box, **Report Complete**, you may either select "Finish" to exit the Report Wizard or select the Print Preview button to view your report." If you select Finish, you may still preview the report by selecting

the Print Preview icon from the toolbar or selecting **Print…** from the **File Menu.** EnergyPro creates a .pdf file and displays the report on-screen. Choose the print settings from the Acrobat® software to print the entire report, only selected pages, or vary the number of copies you wish to print.

Using the Menu or Toolbar

You may also view and print reports from the menu commands. Select Reports from the lower-left window pane. Expand the applicable report type to see the forms available and select the specific forms you wish to include from the list displayed in the upper-left pane.

Select **File/Print...** or **Print Preview.** Alternatively, you may select the Print Preview or Print icon from the toolbar. EnergyPro creates a .pdf file and displays the report on-screen. Choose the print settings from the Acrobat® software to print the entire report, only selected pages, or vary the number of copies you wish to print.

Report File Format, Adobe Acrobat

EnergyPro reports and forms are now created in Adobe Acrobat™ (.pdf) format, which greatly simplifies common report-related tasks such as printing and emailing reports and importing forms into AutoCAD™ or other applications.

EnergyPro also allows you to export file data for uploading to a HERS Provider web site, either for Title 24 registration or creating HERS Rating Reports.

Company Logo, Signature, and Stamps

You may place three files in the EnergyPro Forms folder to automatically include your signature, company logo, and/or a stamp such as the CABEC Certified Energy Analyst (CEA) stamp in your reports. You may modify the files at any time; changes take effect immediately.

Note that you must place the files in the "Forms" sub-folder. If you accept the installation defaults, as discussed in the Program Installation topic, the Forms subfolder will be located at C:\Program Files (x86)\EnergySoft\EnergyPro 9\. If the program was installed on a network drive, the Forms folder will be located in the EnergyPro 9 folder.

   Company Logo: You may include your company's logo on the cover page of each report. First, save the logo in the .jpg file format, name the file "logo.jpg", and place it in the EnergyPro 9 Forms sub-folder.

   Signature: To include your signature on the forms, save your electronic signature file in the .jpg format, name the file "signature.jpg", and place the signature.jpg file into the EnergyPro 9 Forms sub-folder.

   Stamp: The Title 24 compliance forms also include a space in which you may include a stamp following the same process as described above, except that you must name the file "stamp.jpg".

Mandatory Measures Forms

Title 24 mandatory measures are no longer printed as a checklist on a separate CEC form.

For nonresidential projects, EnergyPro offers a new Mandatory Measures module which issues the new Electrical Power Distribution (ELC), Solar and Battery (SAB) and Commissioning (CXR) forms that are required on most, if not all nonresidential projects. You must purchase the module separately to enable the mandatory measures features.

For single family projects: EnergyPro provides a form, entitled Form MF1R, Mandatory Measures Summary, which lists all residential mandatory measures in one place for your convenience. It is not an official CEC form.

When you prepare your reports, select Reports from the list in the lower left pane, and check the box to the left of the report name (Single Family Title 24 Performance, etc.). Click on the "+" sign next to the checkbox to display all available forms for that report. Place a check in the box adjacent to each form you wish to include in the report.

Acceptance Tests

Acceptance tests are funcitonal perfomance tests performed by a field technician that ensure equipment and systems installed in a nonresidential or multifamily building perform as specified and in compliance with the Standards requirements. A certified lighitng controls or mechanical Acceptance Test Technician (ATT) performs the lighting controls/mechanical acceptance tests. Mechanical ATTs may also perform field verification for a subset of measures that would normally be performed by HERS raters with the approval of the local jurisdiction. Acceptance tests for envelope and covered process measures do not require a certified ATT.

CF-1R Registration

When compliance requires HERS measure verification (whether mandatory or for compliance credit), you must register the compliance documentation with a HERS provider before applying for a building permit (see *Single Family Residential Compliance Manual*, Section 2.1.2). The Certificate of Compliance (CF-1R), produced by EnergyPro, is the primary document required at the time of permit application.

When a measure requiring HERS field verification is installed, the installation contractor completes and registers the appropriate certificate of installation (CF-2R) form. A HERS Rater confirms the measure is installed as required in the field, and completes and registers a certificate of verification (CF-3R) with a HERS Provider.

EnergyPro now offers an automated process that allows you to easily register CF1R forms with a CEC-approved HERS Provider. Select Register CF-1R from the Tools menu to open the Register CF-1R dialog box and click the link for additional information.

To set up the automated process, you must deposit funds in your account with EnergySoft, and establish an account with the HERS Provider. Then, in EnergyPro, select Register CF1R from the Tools menu to open the Register CF1R dialog box, and enter the required information. The data is stored in an encrypted format on your computer to allow instant access to your account. We recommend that you add at least enough for 10 projects so you do not have to repeat this process, but you can put any amount from $10 on up. You may deposit funds in your account from the Tools | Register CF-1R screen. You are now ready to register your project. Simply open the dialog box, click Register CF-1R and your project will be transmitted to the Provider. Once registered and signed by the appropriate entities, you may download the CF1R from the HERS Provider's site.

The CF1R form for all projects that include measures requiring HERS verification display a watermark stating "This Certificate of Compliance is not registered" when printed directly from EnergyPro. Once the form is registered and signed, the HERS Provider creates a registered form without the watermark.

Overview of the Building Tree

The Building Tree is used to describe building features, including HVAC systems, hot water systems, interior and exterior lighting systems, and the glazing and opaque surfaces associated with each room, zone and/or system. Building data is organized in a hierarchical stair-step pattern of elements and sub-elements (Building Tree), with the building itself as the top element.

The topics below include a general description of the Building Tree functions and the process of constructing a building tree and creating reports. Refer to the Building Tree Elements topic to view a detailed display of all the elements.

- General Instructions
- Editing Techniques
- Building Wizards
- File Management
- Running Calculations
- Input Diagnostic
- Replacing Building Features
- Working with the Rotation Input
- Building Tree Elements
- Tutorials and Sample Files
    - Single Family Sample
    - Multifamily Sample
    - Nonresidential Sample

General Building Tree Instructions

When you open EnergyPro, the program displays a blank screen under the Main Menu. Select **File/New** to open a new file; select **File/Open…** to open an existing file. All existing files, when first opened, display only the Building icon followed by the name of the Building (Undefined Building in the case of a New file). Select View/Expand Tree to view all Building Tree elements.

All new files contain only a Building Element. You must add all other elements that apply to your project. You may customize a set of default construction assemblies by selecting the Project Defaults option in the lower left window pane. Select assemblies you use most often to automatically populate specific Building Tree elements in each new project file and in the Building Wizards. Changes to Project Defaults will be applied in the next new project file. They will not change the data in an open project.

Click the left mouse button to select/highlight a Building Tree element for further action, for example: to edit the element's characteristics, or to copy an element from one place and paste it to another.

Describing a Building

Describe a building by defining the elements within it. To **define** an element, select it and the detailed data entry fields are displayed in the upper right window pane. Move through the entries within that element by clicking the mouse or using the <Tab> key to highlight each data field and enter the relevant data.

Some elements are defined within tabbed dialog boxes. Each tab is used to define a different characteristic of the element. Move from tab to tab within the main dialog box by clicking on the tabs you want to use, or press <Ctrl><Tab>.

Some fields require you to enter data directly while others require that you select the appropriate description from a **drop-down list**. There are two types of drop-down lists; those which require you choose an item from the list; keyboard input will <u>not</u> be accepted, and those which allow you to choose from the list <u>or</u> input your own data.

Display drop-down lists by clicking on the down arrow in the box, or by using the <Arrows> on the keyboard to move through the list item by item. To **make a selection** from a list, click on or press <Tab> on the highlighted list item.

T**o** access the **libraries from within the Building Tree,** click on the relevant multi-edit box or highlight it and press the <Space Bar>. **Select an item** from a library window list-box by clicking on it, or by highlighting it with the <Arrow> keys and choosing *Select*, or pressing <Enter>.

To Edit a library item, or to create a New item, see Libraries. After the library has been modified to your satisfaction, you can then choose the modified or new item from that library and continue working through the dialog box.

To **Close** a dialog box:

Select *OK;* your entries will be saved and you will return to the previous window <u>or</u> select *Cancel;* your entries will <u>not</u> be saved and you will return to the previous window.

Adding, Copying, Pasting, and Deleting Elements

Add an element to the Building Tree by right-clicking on the element to display the popup menu, then select the element you wish to add from the list. This function will add a sub-element (in the Building Tree) of the highlighted element, e.g., add a Zone below a System.

You may also select Insert from the Edit Menu or use the Insert key on the keyboard. The new sub-element will be appended to the sub-elements within the highlighted element.

Copy and Paste function: To Copy an element from one position to another on the Building Tree, highlight the element you want to copy; then:

a) Click the right mouse button and select **Copy**. Next, highlight the element under which you want to paste the selected element (you must select an element at the next higher level of the Building Tree, e.g., if you are copying a System, select the Zone within which you wish to paste the new System). Click the right mouse button and select **Paste**. The copied element appears at the end of the list of elements within that element. You may drag the element up or down the list to position it where you wish.

b) If you do not see the choice **Paste** on the menu after clicking the right mouse button, you have not highlighted an element at the proper level for insertion. For example, to copy a room element, you must paste it to a zone (highlight a zone element before pasting).

Delete an element from the Building Tree by highlighting the element you want to delete; then:

Click the right mouse button and select **Delete**; **or** Press the <Del> key; **or** From the Edit Menu, select **Delete**.

You may re-capture deleted elements using the "Undo" feature on the Edit Menu.

Move an element within one, or between elements by dragging it with your mouse. EnergyPro displays a yellow arrow indicating it is OK to drop the element at that place. Otherwise, it displays a white arrow.

Displaying Building Tree Elements

Display all elements in the Building Tree by selecting Expand Tree from the View Menu. In a New file, the Building element will be the <u>only</u> element in the Building Tree until you add additional elements.

Display sub-elements in the Building Tree by clicking the "+" in the small box to the left of an element icon. The "+" indicates the element contains sub-elements not currently displayed. The "-" in the small box indicates that all sub-elements within that element are displayed.

Display all elements at a specific level by first selecting any element at that level, then right-clicking and selecting "Show XXX" from the popup menu. For example, if you wish to view all Building Tree elements down to the Room element level, right-click on any Room element in the Tree and select "Show Rooms" from the popup menu. EnergyPro will display all Plants, Systems, Zones and Rooms in the Building Tree.

Organize elements in the Building Tree by dragging and dropping them with the mouse.

Moving sub-elements within one element: When moving sub-elements within a single element, you may drop them at the top of the list, any place within the group, or at the end. EnergyPro displays a yellow arrow indicating the element will be placed either above (as shown below) or beneath the highlighted element.
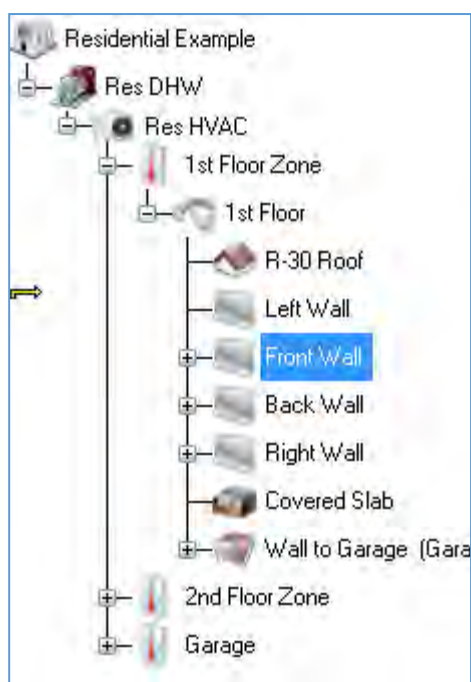
Moving sub-elements from one element to another: EnergyPro will place the sub-element at the bottom of the list of all sub-elements where you choose to drop it.Once you drop it, you can move it anywhere you like in the list
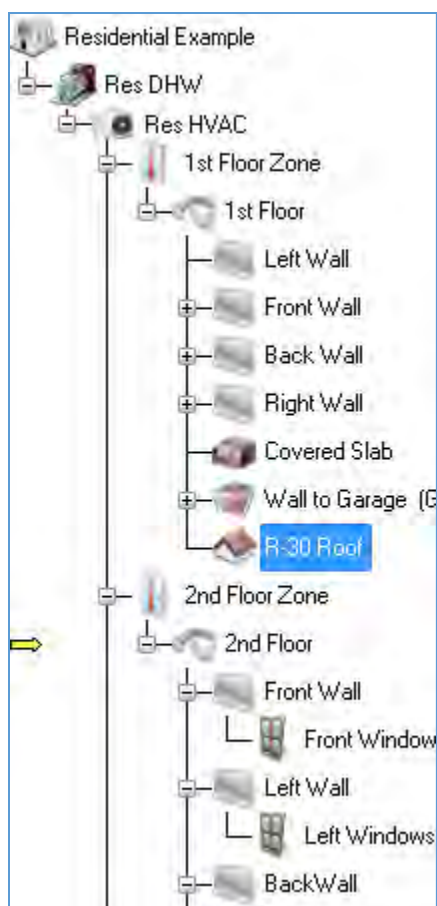
A Note about Displaying the Building Tree: To display the entire Building Tree, select Expand Tree from the View menu. The "+" in the small box to the left of an element icon indicates that there are elements embedded within that element which are not currently displayed. Click on the "+" to display those elements. The "-" sign in the small box to the left of an element icon indicates all sub-elements within that main element are displayed.

Editing Techniques (Mouse and Keyboard)

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EnergyPro uses standard Windows™ features as well as some techniques unique to the program. All standard alpha-numeric keys may be used to enter data in the program.

Listed below are standard techniques you will find especially useful in EnergyPro. You do not need to know every possible technique for every operation to use the program successfully. For most operations you have a choice of techniques, depending on your preferences (e.g., keyboard vs. mouse) and your experience with Windows™ programs. To begin using the program, choose a technique you are most familiar with. As you

become better acquainted with the program, you may wish to refer to this section again, to see if there is a technique that may work better for you.

Menu Selection

As in any Windows™ program, you may perform many menu commands using either the mouse or the keyboard. Use the left mouse button to select menu items.

If you prefer, use the <Alt> key to activate the menu bar. Select menu commands by either highlighting them using the <Arrow> keys and pressing <Enter>, or for some commands, you may use the keyboard shortcut shown next to the command (e.g., Ctrl+X).

PopUp (Shortcut) Menus

In the Building Tree and some entries in the Libraries, you may use the right mouse button to activate a pop-up menu containing common commands.

Navigating through the Software

Use the mouse as you would in any Windows™ program. Click the left mouse button to select items, move from one edit box to another, etc.

The <Space Bar> has several functions in EnergyPro. It opens a library from the multi-edit box field; it also checks a checkbox or fills a circular radio button.

Move forward or backward through a list or through the Building Tree with the <Arrow>, <PgUp>, <PgDn>, <Home> and <End> keys.

Use the <Tab> key to record an entry and move forward to the next item. <Shift><Tab> records the current data input and moves backward to the previous item.

Building Wizards

Back to Building Tree Overview

Use the Building Wizard to automatically create a Building Tree. Instead of inserting each element into the Building Tree individually, let the Building Wizard do it for you. Simply fill in the blanks and the software does the rest.

The **Residential Building Wizard's** focus is on one to three story structures whose zoning and use is most suited to residential design. Applicable buildings have a single HVAC system and a single occupancy type. You may input one construction assembly for each envelope component. If you typically use the same envelope assemblies (e.g., an R-13 wall assembly) across many projects, you may set default Building Wizard assemblies which will automatically be inserted in the Building Wizard each time you create a new file. Select **Options…** from the Tools Menu, then enter the default assemblies in the Construction Details tab

The **Nonresidential Building Wizard** allows users to enter building characteristics for a simple nonresidential building. The Wizard walks the user through the entries, beginning with the envelope features, then the lighting, and mechanical systems. The Wizard populates the envelope construction assemblies with the User Default selections specified in the Construction tab of Tools/Options dialog box.

In the Mechanical screen, select the "Calculate" button to calculate the heating and cooling loads for each zone before selecting an HVAC system. The software automatically uses default values for building operating assumptions, such as design temperatures, occupant densities, equipment loads, etc. Select an HVAC system sized to meet the calculated building heating and cooling loads and a domestic hot water system (if DHW is included in the calculation).

If your project requires additional building elements or special operating assumptions, you may change any input from within the Building Tree once you leave the Building Wizard. Once you exit the Building Wizard, you may not return to edit the same building. If you need to make further modifications, you must do so from within the Building Tree. If your project is complete and it complies, save the file and proceed to the Report Wizard to prepare your report.

EnergyPro also features a **Replace Wizard** to simplify changing project features. Select Replace from the Edit Menu to open the Replace Wizard. The wizard asks which feature you'd like to replace, then with what data you'd like to replace that feature, and finally, to which areas of the building you wish to apply the changes. You may replace features within a single branch of the building tree, globally, or from a specified point in the tree onward. Refer to Replacing Building Features for additional details.

The **Report Wizard** makes preparing a report easy. Simply open the Wizard, specify the type of report, and the forms you wish to include in it, and your report is ready! Refer to Printing Reports for additional details on printing reports.

File Management

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Opening a File

When you open the software, the program displays a blank screen under the Main Menu. Select **File/New** to open a new file; select **File/Open…** to open an existing file. All existing files, when first opened, display only the Building icon followed by the name of the Building (Undefined Building in the case of a New file).

Saving/Naming a File

File/Save or **Save As…** saves the file you are working in. The first time you save a New file you will be asked to name it. You may choose a name of any length.

It is wise to save each building data file often as you are working on a project and **before** you perform calculations or print reports. This prevents losing work should the program or the computer crash or some other problem occur. **Always save any file you wish to keep with an appropriate name before exiting the program.**

Warning: If you create a New file, the New file will carry the file name BLD000.bld until you re-name it with the Save As… command. The next New file will carry the name BLD001.bld etc. Once you leave the program, future New files will be given the same name(s) (BLD000…) and could thus be saved over existing files you do not want to lose. Be sure to assign a file name to each New file you open, as soon as you open it.

Creating your own Template Building File

1. One of the more flexible aspects of the software is the ease with which you can create your own Template Building file.

2. Select **File/New**. The software loads the file, *BLD000.bld* and displays the Undefined Building element and its icon. Do not use the sample files that come with the program to create templates. These files were designed to be used as tutorials only.

3. **Select File/Save As…** to name your template file. If you will have one template for residential jobs and another for nonresidential jobs, you might name the two templates *Template-res-(your initials)* and *Template-nonres-(your initials).* If you would like to have the Template file at the top of the list of files for easy access each time you open the program, you might want to start the name *111-…*, e.g., *111-Templ-res-…* because file lists are arranged in numerical order followed by alphabetical order.

4. Construct a Template **Building Tree.**

5. Within each element of the Building Tree, input your own standard set of values—any building data and report selections you ordinarily want to be there when you start a new building description. For example, under the General tab in the Zone element, select your most common residential occupancy type, e.g., Single Family Detached. You may also create placeholder elements, such as Front, Left, Right, and Back walls that specify your most common insulation value, such as R-13 or R-19.

6. Customize **libraries** if desired. The Template file's libraries may contain any frequently used items that are not already part of the libraries. You may choose to leave the file's libraries as-is, and add customized items only to the Default libraries. You can Export these special items from the Default libraries into project file libraries when you need them.

NOTE: Also see Customizing Default Libraries; do not confuse a Template file's libraries with Default libraries.

7. Save the file before closing it.

Customizing Default Libraries

You may choose to modify the Default libraries from time to time. This is a separate operation from modifying libraries in a particular file, e.g., your Template file or an active job file.

The primary advantage of the Default libraries is that they are quickly accessible from all building files. Using the *Export* button in a library menu, you can transfer information used in one project for later use in another project. For example, a particular building might use a packaged furnace/air conditioning unit from an unusual manufacturer. You could add this unit to the file's System Library <u>and</u> Export it to the Default System Library. Then, when another project needs that particular unit, you can Export it from the Default library to the current project file library.

Modify Default libraries judiciously. It's the Default libraries (including any modifications you have made to the Default libraries) which are automatically loaded into the program's **New File** each time you open the program. Access Default Libraries using the Tools…menu.

See LIBRARIES for step-by-step instructions on editing the various libraries.

Erasing (Deleting) Files

You cannot delete .bld files within the software. You must go to the Windows™ Explorer or File Manager to perform this operation.

Autosave Feature

You may set the software to automatically save all open files at a given time interval, provided there have been changes to the file. Select **Tools/Options…** from the main menu, and then click on the Misc. tab. Check the Auto Recover checkbox to enable the feature and enter the frequency (in minutes) at which you wish the softwarer to automatically save a temporary backup file in the event your system or the application crashes. The temporary file is saved in the temp folder and is given a .tmp filename extension.

Running Calculations

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Select Calculations from the list in the lower-left window pane and set the project's calculation options before you run the simulation the first time. Once you set Calculation Options, you may use the Calculate button to run all selected calculations with a single click. See Calculations for a detailed explanation of Calculations.

Options

To set calculation options, select Calculations from the choices in the lower-left window pane. Then select each calculation you wish to use for the project, and the analysis options. Calculation Options include whether to run alternative simulations, loads calculation design conditions and a calibration tab that allows you to compare the simulation to the project's billing data.

Calculate

Once you have set calculation options, Select the Calculate button on the toolbar to run the Calculation(s) for your project. If there are diagnostic messages, they will appear on a separate tab in the results window in the bottom-right window pane. Double-click on the message in the Location list box, and EnergyPro will automatically take you to the Building Element that is the message's source. If the Input Diagnostic identified an **Error** message, you must correct the Error before performing the calculation. For all other diagnostic message types, EnergyPro will perform the calculation and display the message.

Results

EnergyPro displays the most recent Calculation Results in tabbed format in the lower-left window pane. Each results tab is labeled with the calculation type (e.g., NR T24 Performance). Click on any tab to display the results for that calculation. You may adjust the results display size on the screen by dragging the upper bar of the results pane up to enlarge the display or down to show only the tabs at the bottom of the screen.

Input Diagnostic

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EnerygPro's **Input Diagnostic** tool provides five levels of diagnostic messages to assist you. When you run calculations, the Input Diagnostic displays a message for each item in question, shows its location, names the type of action that must be taken, and suggests a solution. Tthe diagnostics feature also includes a search function that displays the Building Tree or Library element that is the source of the message when you double-click on the message in the Location box.

An **Error** prevents a calculation from being run, e.g., no assembly was selected for a particular wall.

A **Warning** indicates that there is something in the data that will probably result in inaccurate calculations, e.g., no fan schedule selected for HVAC System 1.

A **Caution** indicates that one or more entries have been assigned a value outside the typical range, e.g., a wall absorptivity of 0.

HERS messages pertain to Home Energy Rating System (HERS) features that you have selected in a residential building that will require third party inspection by a certified HERS rater. These messages will also appear on the residential CF1R-PRF (-01-E for new construction or -02-E for additions and alterations) form.

Information messages provide information the California Energy Commission requires us to bring to your attention, e.g., Window Wall Ratio (WWR) > 40% in nonresidential compliance calculations.

Replacing Building Features

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The software allows you to quickly and easily replace specific building characteristics in order to analyze the effect on the building's energy use. Use the Replace Wizard to substitute almost any component of the Building Tree, including construction assemblies, window features, lighting characteristics, and operating schedules. For example, in just a few short steps, you can change the glazing from clear to tinted and

measure the effect on the building's cooling load or add insulation to an uninsulated construction assembly to measure the reduction in the heating load.

Simply select **Edit/Replace…** from the menu and let the Replace Wizard guide you through the process. The software's replace feature is very flexible. In addition to replacing an item everywhere it occurs in the file (**Global**), you may also limit the scope to include only those occurrences from the cursor forward (**From Cursor**) through the rest of the building; or only within the **Selected Branch**. If the replacement is not **Global,** remember to highlight the appropriate element in the Building Tree before opening the Replace Wizard. A message showing the number of replacements made will appear on-screen.

Working with the Rotation Input

Use one of two methods to model buildings with a reference (project) north that is not true north. Load a new project into memory by choosing **File/New** or by clicking the New File button on the tool bar. Click on the Undefined Building Icon in the Building Tree and you will see the Rotation field on the Project Design Data Tab of the Building Element.

Method One: Leave the rotation set to zero (0) and either enter the reference front orientation or select from the drop-down list, as appropriate. Enter all the reference north, east, south and west walls and roofs at 0°, 90°, 180°, and 270° respectively. After wall inputs are complete, go back to the Rotation input and enter the number of degrees that reference north is rotated clockwise from true north. For example, if reference north is 15° east of north, enter all the orientations as mentioned above and then enter a Rotation of 15°. If the reference north is 15° west of true north, the rotation would be (360°-15°) = 345°. Note: If you rotate the building more than 22° degrees in either direction from true north, your descriptive wall names may not match those the program selects, e.g., a reference north wall will be designated northwest in the program report after a rotation of 23° degrees west (to 337°).

Method Two: Leave the Rotation set to zero (0) and enter the actual orientation (azimuth) of the front and all walls and roofs. For example, if the front of the building is facing 15°, enter 15° in the Front Orientation box and enter 15°, 105°, 195° and 285° for the north, east, south and west walls, respectively (assuming, of course, that the building is square).

NOTE: All performance simulations use the actual orientation of all exterior surfaces. (The exception is when showing Title 24 compliance for a residential unit plan in four cardinal orientations, as explained in Section 7.6.2 of the state's Residential Manual.)

To run calculations on a residential building in all four cardinal orientations, do not use the Rotation feature. Instead, check the Run Four Orientations box in Calculation Options.

Single Family Sample Building

This section illustrates how to input and calculate a newly constructed single family building for compliance using the software. The sample building is a single-family, detached, two-story dwelling which complies with the residential standards using EnergyPro's Single Family T24 Performance calculation module. For further information on residential zoning and modeling techniques, see Single Family Compliance Modeling Topics. The EnergyPro Building Tree Overview includes instructions for working through the program for any type of building.

NOTE: Certain inputs are treated differently within the program depending upon which set of standards—single family, multifamily, or nonresidential--applies to the building being modeled. See the Building Tree and Libraries for detailed information on each program input.

We will use the Single Family Sample file that comes with EnergyPro as a model for this tutorial. Single Family Sample.bld is a single family, detached, two-story dwelling. **For practice:**

Open the Single Family Sample file and give it a name of your choice, to use as a practice file. Following the step-by-step procedures listed here, move through the sample input for the initial elements. Make the few minor input changes to identify the file as yours. Next, follow the instructions to delete the 1st Floor Zone element, and then insert an Undefined Zone and re-input the 1st Floor Zone (and Room) data from scratch. After you have completed inputs, run calculations. Compare your calculation Results to the Results of the existing Single Family Sample file. Check your practice file input against that of the existing file if there are discrepancies.

Do not use the sample files that come with the program to create templates for future use. The sample files are designed to be used only as tutorials.

Use the Arrow buttons located either at the top right of the Help window or at the bottom of each page to advance through the tutorial.

Text in [brackets] indicates that a [drop-down list] or [library] will be displayed from which you make a selection.

Text in (parentheses) contain directions.

All data inputs are shown in bold italics.

Data previously input is in _underlined italics_.

Practice data to input is shown in *blue italics*.

1. To begin, select **File/Open…** from the Main Menu. Select Single Family Sample.bld. Immediately choose **File/Save As…** and give the file a new name. The data you enter will be in your practice file, not the sample file that comes with the program.

2. Click on the Building Element named **Residential Example** for the sample building.

3. You can see the entire Building Tree by clicking on **View/Expand Tree**.

Editing the Building Element (Single Family Sample)

Note: Remember that the sample file is already a complete file. These initial entries are for review only. At the Zone Element level, we will delete and re-create the first floor Zone from scratch.

1. Click on the Building Element named **Residential Example** if you haven't done so already. The first tab in the building element is **Project Design Data**. Move from one entry to the next with the mouse or the <Tab> key. If you are practicing, write over the existing input with the data *in blue*. Leave the remaining inputs in place.

   General

   > **Building Name:** *Residential Example*
   >
   > **Building Type** [from drop-down list]: *New*
   >
   > **Job Number:** *(your choice)*
   >
   > **Front Orientation** [from drop-down list or keyboard input]: *90 (East)*
   >
   > **Rotation:** *0* degrees
   >
   > **Number of Dwelling Units**: *1*

   Location [from Location Library]: *San Bernardino*

   Fuel Available at Site: *Natural Gas*

2. Click on the next tab, **Project Title**.

   Building Name: *Sample Residence* This name and address information appears on report forms.

   You can either leave the rest of the fields on this page as is or change them for practice.

3. Click on the next tab, **Designer**

   The name and address for the designer affiliated with the project is already entered. (You do not use the Lighting, Mechanical, or Forms tabs for residential buildings.)

4. The next tab, **Misc** (Miscellaneous); is used to enter data on building-level HERS measures, to describe the crawlspace, identify the type of ventilation cooling system, and a handful of other measures. The project uses this to indicate a new kitchen hood is being installed, which will require HERS verification. If the project is an Existing+Addition+Alteration project, and the project will include HERS verification of the existing conditions in the home (prior to demolition), use this tab to specify which measures will be verified.

5. The **Utility, Outdoor, Exterior Uses, and Pools** tabs are used for HERS II, GreenPoint Rated, and Single Family Performance calculations. We will not change any of the entries in this exercise, but you may wish to review the data and the requirements for the various entries.

6. The **PV+Batt** tab is used to describe the photovoltaic (PV) system and any associated battery storage system components. Note that this residential project includes a 3 kW photovoltaic system with a 12 kWh storage battery that employs a basic control strategy.

    EnergyPro can accept detailed PV system inputs, as shown in the image above, denoting the array type, orientation, tilt, inverter efficiency and other system features. Depending on the site conditions, the PV system may also be eligible to use one of the California Flexible Installation default values. Refer to Photovoltaic Systems for additional information about modeling residential PV systems.

    This tab is also used to specify the methodology for PV system sizing, and whether the project is eligible for any of the PV exceptions (mostly caused by insufficient solar access). In this case, the user has elected to "Specify PV Size" which means EnergyPro will use the inputs here irrespective of the impacts. Use caution if using this option as it may result in an under-sized system that doesn't comply or in an over-sized system that produces more electricity than the home can use.

    You must select the type of control strategy for the storage battery and determine how to apply the compliance credit. Batteries are the only measure with flexibility to apply some of the compliance credit to the Efficiency EDR2 score or apply it all to the Total EDR2 score.

7. You have completed data input for the Residential Example Building element. Click on the Plant element to continue.

Editing the Plant Element (Single Family Sample)

1. Use the Plant element, **Domestic Hot Water** tab to access inputs for the residential sample building's Domestic Hot Water (DHW) features.

2. The first tab in the dialog box is **Heating Hot Water**. Although there is no Hot Water Boiler or Pump in your residential sample building (nor in most typical residential buildings), use this tab to name the Plant element.

   Name: *Res DHW*

4. Click on the tab, **Domestic Hot Water** to view the DHW system characteristics.

   Leave all DHW entries at their current values.

   You will not use the remaining Plant tabs (Chilled Water, Hydronic, and Exceptional) in this example.

5. Refer to the Plant Element in the Building Tree for detailed explanations of these entries.

7. Click on the System element, **Res HVAC** to continue.

Editing the System Element (Single Family Sample)

1. Click on the System Element, **Res HVAC** to view the HVAC System for this residence, which has already been defined. Compliance rules apply to how you aggregate different zones into a single HVAC system. These rules and related design issues are discussed in Residential Compliance Modeling Topics

Note: If this were an actual building you were entering from scratch, you would probably wait to choose a System until after you had entered all the building envelope features and run Load Calculations to determine sizing for HVAC unit(s). In this sample building file, the HVAC unit has already been selected.

2. **General**

    You can review the HVAC System details in the Central System Library by clicking in the New System field. In this case we've selected a high efficiency CARRIER Split DX system. When you specify a system with a higher than minimum SEER or EER rating, the software automatically specifies HERS verification. The system efficiency must be verified by a HERS rater to obtain compliance credit.

    The cooling system is rated using the new SEER2 rating, effective January 1, 2023. Air conditioners installed in California on or after January 1, 2023, must comply with the new standards. For heat pumps, the new standards apply to products manufactured on or after January 1, 2023.

3. **Distribution**

    Review the data describing the HVAC distribution system (ducts). This tab is used to identify the type of distribution system, its location, the insulation value, and the duct sealing status. The entries on the Distribution tab specify that the ducts are located entirely within the conditioned space, which requires HERS verification. HERS verification of new system duct sealing is a mandatory measure.

4. **Residential**

    Leave all entries on this tab set at default values. This building does not have a ventilation cooling system, wood heating, or a variable capacity heat pump.

5. **HERS Credits**

This HVAC system will claim the Verified Refrigerant Charge compliance credit which requires field verification by a certified HERS Rater. Cooling coil airflow and fan power are set to default levels, so there is no compliance credit, but HERS verification is still required for these features (mandatory).

6. MCH and Fan Power Tabs

These tabs are not used for single family projects.

You have finished reviewing the Res HVAC System input. Next you'll edit the Zone Element, 1st Floor Zone.

Editing the Zone Element (Single Family Sample)

Deleting the 1st Floor Zone and its sub-elements for practice.

1. Click on the Zone Element **1st Floor Zone**. Click the right mouse button, select **Delete**.

2. Create a new **1st Floor Zone Element** by selecting the **Res HVAC** System element, click the right mouse button, and select **Add Zone**. An Undefined Zone element appears at the bottom of the list below the **Res HVAC** System Element.

3. Click on the **Undefined Zone Element** to define the General Zone information. Only the **General** and **Dwelling Unit** tabs are used for single family residential buildings. You do not use the **Lighting, Mechanical or Schedules** tabs.

4... On the **General** tab, input:

Name: *1st Floor Zone*

Zone Type: *Single Family Dwelling*

Conditioning: *Conditioned*

Occupancy [drop-down list]: *Single Family (only enabled for multifamily common and nonresidential areas)*

90.1 Envelope and Type and Lighting Occupancy: Not used in single family projects.

# of Floors: *1* (for the zone only)

Envelope Status: *New*

Lighting Status: Not used in single family projects

Accessory Dwelling Unit: *No*

Year Built: Enter *2023*, as this is a new home

Leave the Rotation Field set to 0.

Building Story: Click on the "Select" button.
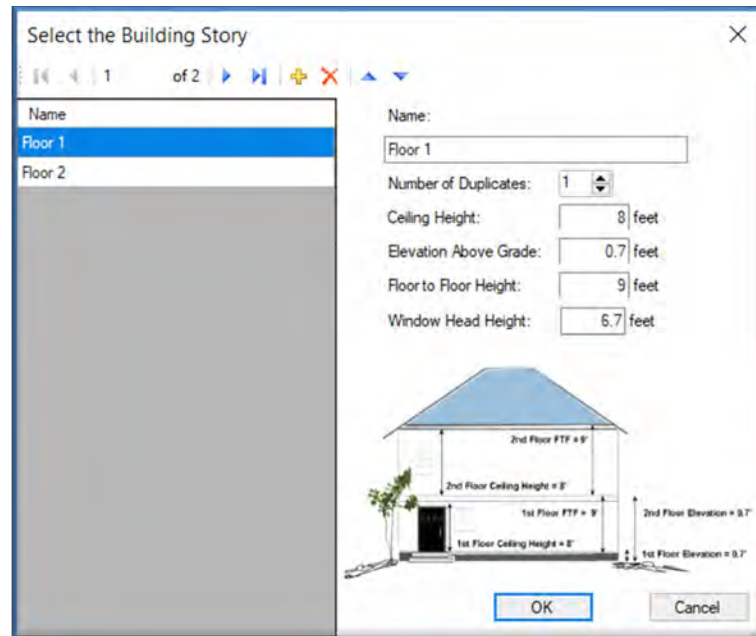
Complete the entries in the Select the Building Story dialog box to specify the features of the building story of the Zone.

    a.   **Name**: *Floor 1*

    b.   **Story Multiplier**: *1*

    c.   **Ceiling Height**: *8 feet*

    d.   **Elevation Above Grade**: *0.7 feet*

    e.   **Floor to Floor Height**: *9 feet*

    f.   **Window Head Height**: *6.7 feet*

5. Click on the **Dwelling Units** tab. Indicate the number of bedrooms and which major appliances are located in each zone. In addition, if you are using a non-default IAQ fan, enable the data fields in the Miscellaneous tab of the Building element and enter the fan characteristics here. In this sample building, there are no bedrooms on the first floor, but all major appliances are located in this zone. The project will use a default IAQ fan; the data fields for non-default fans are not enabled.
For multi-family buildings, you must provide additional information on this tab, as explained in Dwelling Units.

Leave the remaining **1ˢᵗ Floor Zone** inputs set to their default values. You have completed zonal data input for the **1st Floor Zone**.

6.   Next you'll add a **Room Element**

Editing the Room Element (Single Family Sample)

Now you will add a **Room Element** to the **1st Floor Zone Element**

1.   Right click on the **1st Floor Zone Element**. Select Add Room.

2.   Click on the new element **Undefined Room** to define the information specific to the building at this level. In this case, there is no need to list the zone by rooms; the data you input under Room will apply to the whole 1st Floor.

3.   The **General** tab is the first tab displayed. Input:

Name: *1st Floor*

Area: *1,200* ft² (111.5m²). This is the total gross area of the Room/space being modeled, measured from the outside surface of the exterior walls.

4... Leave the Winter and Summer Indoor Temp inputs on the **General** tab at their default values.

5... Leave all inputs in the remaining tabs set to their default values.

6... You have completed your entries for the **1st Floor Room Element**.

7.   Click the right mouse button and select **Add** to select the Building Tree elements within the Room. The list of new components drops down. You may add them one at a time.

First you'll add a **Roof Element.**

Editing the Roof Element (Single Family Sample)

Now you will add a **Roof Element** to the **1st Floor Room Element**

1. Click on the **1st Floor Room Element** and right click. Highlight **Add** and select **Roof** to add a **Roof element**.

2. Click on the **Roof Element**.

3. On the **General** tab input:

    Name: *R-38 Roof.* The roof assembly we will select is a high performance attic assembly with R-38 at the ceiling and R-19 at the roof deck, and a radiant barrier.

    Area: *500* ft² (46.5 m²)

    Status: *New*

    New Assembly: [Assembly Library]: *R-38 HP Attic* You may view the details of the assembly on the Res T24 Performance Tab.

    Orientation [drop-down list or user input]: *0* (leave at default value)

    Slope: *4* /12

5. (There are no skylights in this building. If there were, you would define the Skylight element by highlighting the Roof element, right-clicking and selecting **Add Skylight**.).

Next you will add an **Exterior Wall Element**.

Editing the Exterior Wall Element (Single Family Sample)

1. Click on the **1st Floor Room Element** then right click and then select <u>Add</u>. Choose the Exterior Wall **Element** from the list. It will be added after the Roof **Element**. You may also use the <u>Insert</u> key to accomplish the same thing.

2. Click on the **Exterior Wall Element.**

   Name: *Front Wall* (We are working in a clockwise direction around the building, Front, Left, Back, Right, as viewed facing the front of the building.

   Area: *320* ft²² (29.7 m²²)
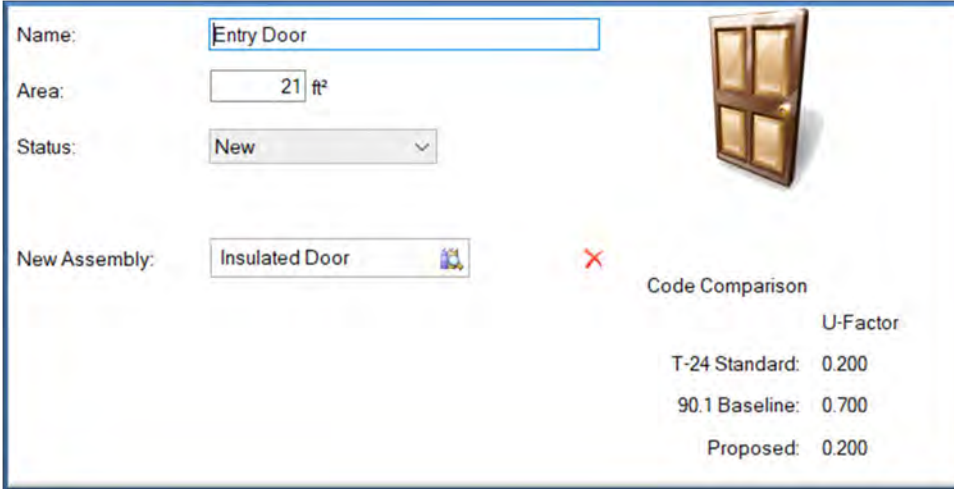
   Status: *New*

   New Assembly: [Assembly Library]: *R-21 Wall w/R-2. (*Click on this field to select the assembly from the Library and then click on *OK)*

   Orientation [drop-down list or user input]: *0* (leave at default value)

   Tilt: *90* (leave at default value)

3. Next **Add** a **Window** and a **Door** sub-element to the **Front Wall**. (Doors or portions of doors made of glass are input as windows.) Click on the **Front Wall Element,** right click and highlight **Add Window.** Repeat these steps to **Add Door**

4. Next you'll edit the window and door you've just added to the **Front Wall Element**.

Editing the Door Element (Single Family Sample)
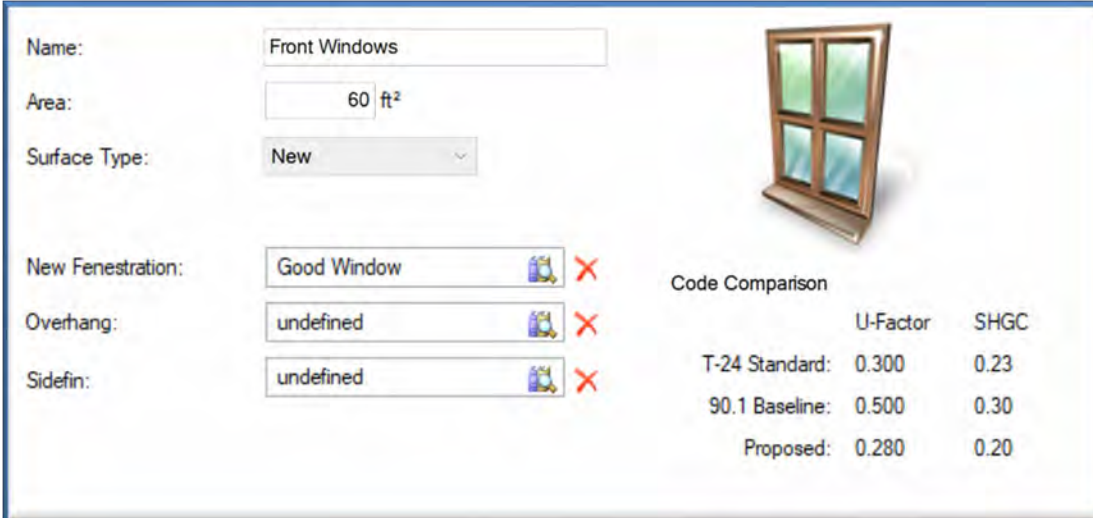
1. Click on the **Door Element** to input:

   Name: *Entry Door*

   Area: *21* ft² (2.0 m²)

   Status: _New_

   New Assembly: [Assembly Library]: **_Insulated Door_**

2. Next you'll edit the **Window Element** you just added.

Editing the Window Element (Single Family Sample)

1. Click on the **Window Element**. The **General** tab is displayed. Input:

   Name: *Front Windows*

   Area: *60* ft^2 (5.6 m^2)

   Status: *New*

   New Fenestration [Fenestration Library]: *Good Window. Click in this field to choose Good Window from the library (U-factor 0.28, SHGC 0.2), then click OK.*

2. Leave the Overhangs and Sidefins Undefined. There are no overhangs or sidefins in this example.

Editing the Remaining Walls and Openings (Single Family Sample)

Continue adding **Walls and the Window and Door Elements** that belong to each wall to the **1st Floor Room Element** and inputting data.

1. Add another **Exterior Wall Element** by following instruction number 1 above under Editing the Exterior Wall Element. Click on the new wall to input:

   Name: *Left Wall*

   Area: *240* ft^2 (22.3m^2)

   Status: *New*

   New Assembly: [Assembly Library]: *R-21 Wall w/R-2. (*Click on this field to select R-21 Wall w/R-2 from the Library and then click on *OK)*
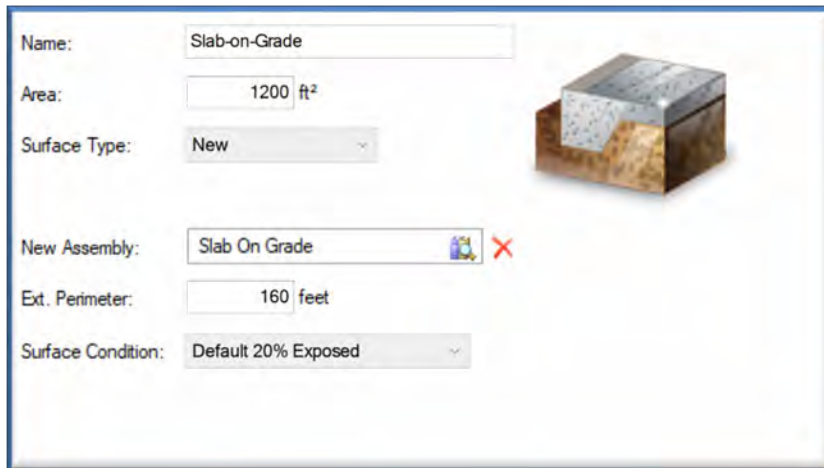
   Orientation [drop-down list or user input]: *East*

   Tilt: *90* degrees

2. Add a **Window Element,** then input:

   Name: *Left Windows*

   Area: *40* ft² (3.7 m²)

   Surface Type: *New*

   New Fenestration [Fenestration Library]: *Good Window (Click in this field to choose Good Window from the library, then click OK)*

   Leave the Overhangs and Sidefins undefined.

3. Add another **Exterior Wall Element and** input:

   Name: *Back Wall*

   Area: *320* ft² (29.7 m²)

   Status: *New*

   New Assembly: [Assembly Library]: *R-21 Wall w/R-2. (*Click on this field to select the wall from the Library and then click *OK)*

   Orientation: [drop-down list or user input]: *South (180 degrees)*

   Tilt: *90* degrees

4. Add a **Window** and a **Door Element to the Back Wall Element** and select the new **Door element** to input:

   Name: *Back Door*

   Area: *16.7* ft² (1.6 m²)

   Status: *New*

   New Assembly: [drop-down list]: *Wood Door*

5. In the **Window element**, input:

   Name: *Back Windows*

   Area: *72* ft² (6.7 m²)

   Surface Type: *New*

   New Fenestration [Fenestration Library]: *Good Window (Click in this field to choose Good Window, then click OK)*

   Leave the Overhangs and Sidefins undefined.

6. Add another **Exterior Wall Element** and input:

   Name: *Right Wall*

   Area: *240* ft² (22.3 m²)

   Surface Type: *New*

   New Assembly: [drop-down list]: *R-21 Wall w/R-2.*

   Orientation [drop-down list or user input]: *West*

   Tilt: *90* degrees

7. Add to the **Right Wall Element**, a **Window Element** and input:

   Name: *Right Windows*

   Area: *32* ft² (3.0 m²)

New Fenestration [Fenestration Library]: *Good Window.*

Editing the Slab Element (Single Family Sample)

1. Add the next component to the **1st Floor Room: Slab on Grade** and input the slab data.

    Name: *Covered Slab*

    Area: **1,200** ft²

    Surface Type: *New*

    New Assembly: [Assembly Library]: *Slab on Grade*

    Ext. Perimeter: *160* feet (48.8 meters)

    Surface Condition: Select *Default 20% Exposed* from the drop-down list.

Editing the Interior Surface Element (Single Family Sample)

1. The 2019 Standards require that you model interior surfaces between zones in residential projects. Add an Interior Surface to the **1st Floor Room** and input the following data.

    Name: _**Wall to Garage**_

    Area: _**100**_ ft² (9.3 m²²)

    Surface Type: _**New**_

    New Assembly: [Assembly Library]: _**R-13 Wall**_

    Floor Elevation: _**0**_ feet

2. Next you will indicate the location of the zone relative to the adjacent area. If the adjacent area is an attic, or a dwelling unit that is not within the scope of the model, check the relevant checkbox. If the zone adjacent to the 1st Floor Zone is a garage, or another conditioned zone, you must first create the other zone, then select it here. **Select Garage from the list of adjacent zones.**

You have completed practice data input for the 1st Floor Zone.

Review the 2nd Floor and Garage Zone data. Now that the Building Tree is complete, **Save** the file and run calculations.

Running Calculations (Single Family Sample)

Initiate calculations from the Calculations list in the lower-left window pane. Once you select which calculations to run for a particular project, you can use the Calculate button on the toolbar. The first time you run calculations for any file, you must set the calculation Options. Once Options are set, click the Calculate button to initiate all selected Calculations.

1. Select Calculations from the choices in the lower-left window pane. Please Note: You may only run the types of calculations associated with the EnergyPro modules you have purchased. Select Activated Modules from the Help menu to verify the status for each module.

2. Select the Res T24 Performance calculation.

The applicable boxes have been checked: Run Standard and Run Proposed.

NOTE: If you have not purchased the Single Family T24 Performance module, you will not able to run the Single Family T24 Performance calculation.

4. Now you are ready to run the Calculations. Select the Calculate button on the toolbar.

6. **EnergyPro** displays results for each type of calculation you have selected in a tabbed format in the bottom-right window pane.

The Residential Sample Building complies with the *Standards* as shown in the Single Family T24 Performance Results tab.

Preparing and Printing Reports (Single Family Sample)
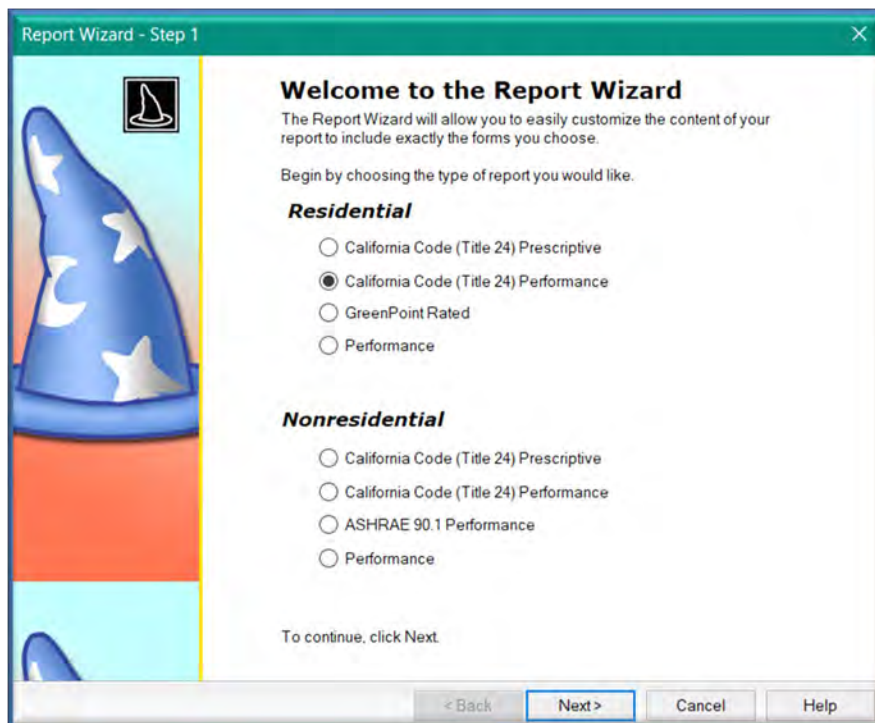
1. You may either use the Report Wizard to prepare a report for printing or select Reports from the choices in the bottom-right window pane. Select **File/Report Wizard…** from the Main Menu or click on the Report Wizard icon in the toolbar.

2. Select California Code (Title 24) Performance from the list of Residential reports and Next to continue.

3. Select the Forms you wish to include in your report by clicking the appropriate boxes, then select Next.

4. In the last box, Report Complete, click Finish to close the Wizard without viewing the report, or the Print Preview button to view your report. The report will have a watermark indicating that the CF1R form needs to be registered with a HERS Provider before submitting to the enforcement agency for permit. If this was an actual project, you would select "Register CF1R" from the Tools menu to start the registration process.

Nonresidential Sample Building

This section illustrates how to input and calculate a nonresidential building for Nonresidential Prescriptive compliance (Envelope, Lighting and Mechanical) in EnergyPro. For further information on nonresidential zoning and modeling techniques, see Nonresidential Compliance Modeling Techniques. Running EnergyPro includes instructions for working through the program for any type of building.

NOTE: Certain inputs are treated differently within the program depending upon which set of standards-- residential or nonresidential--applies to the building being modeled. See the Building Tree and Libraries for detailed information on each program input.

We will use the software's NonRes Sample file that comes with the program as a model for this tutorial. *NonRes Sample.bld* is a **mixed occupancy, nonresidential building.** The two-story sample building is made up of three conditioned occupancy types: an office and a retail space on the ground floor, and a restaurant above the retail space, and an unconditioned storage area. You may use the procedures listed here in two ways:

- **For practice:** Open the *NonRes Sample* file and give it a name of your choice, to use as a practice file. Following the step-by-step procedures listed here, move through the sample input for the initial elements. Make the few minor input changes to identify the file as yours. Next, follow the instructions to delete the **Office Zone**, and then insert an Undefined Zone and re-input the Office data from scratch. Leave the other areas intact. After you have completed **Office Zone** input and viewed the input for the other two systems, run calculations. Compare your calculation Results for the whole building to the Results of the existing *NonRes Sample* file. Check your practice file input against that of the existing file if there are discrepancies.

- **To follow along:** Open the *NonRes Sample* file and follow along on-screen as you read the text here.

The step-by-step procedures listed here assume you are using the **for-practice** method, but apply equally well should you choose to simply follow along with the existing file on-screen.

Use the Arrow buttons located either at the top of the Help screen or the bottom of each page to advance through the tutorial.

> **Text in [brackets] indicates that a [drop-down list] or [library] will be displayed from which you make a selection.**
>
> **Text in (parentheses) contain directions.**
>
> ***All data inputs are shown in bold italics.***
>
> **Data previously input is in *<u>underlined italics</u>*.**
>
> **Practice data to input is shown in *blue italics*.**

1. To begin, select **File/Open…** from the Main Menu. Select *NonRes Sample.bld*. Immediately choose **File/Save As…** and give the file a new name. The data you enter will be in your practice file, not the sample file that comes with the program.

2. Click on the **Building** Element icon named **Nonresidential Sample** to open the Building Tree.

3. Select **View/Expand Tree** to display the entire Building Tree for the sample building.

Editing the Building Element (NR Sample)

The first tab in the building element **Nonresidential Sample** is **Project Design Data**. Move from one entry to the next with the mouse or the <Tab> key. If you are practicing, write over the existing input with the data *in blue*. Leave the remaining inputs in place.

1. **General**

    Building Name: *Nonresidential Sample*

    Status [from drop-down list]: *New*

    ASHRAE Building Type [from drop-down list]: *Office*

    Job Number: *(your choice)*

    Front Orientation [from drop-down list or keyboard input]: *0 (North)*

    Rotation: *0* degrees

    Fuel Available at Site: *Natural Gas*

    Relocatable Public School Building Used in All Climate Zones: *Leave Blank*

2. **Location**

    [from Location Library]: *Sacramento CO*

3. Click on the next tab, **Project Title.** Enter a project name such as *Nonresidential Sample Building.* If this was a real project, you would also enter the address at this time. This is the name and address that appears on report forms.

    The names and addresses for the designers affiliated with the project are entered in the **Designer**, **Lighting Designer** and **Mechanical Designer** tabs. This sample file already contains this information.

4. Click on the next tab, **Forms.**

Note: You must purchase the Forms module to automatically populate the Mandatory and Covered Process forms.

The project uses all the Forms tabs except the PRC (Process) tab. At this point in the data entry process, you may be able to complete some of the information, but will likely need to return to this tab after completing the data entry to complete the remaining data, depending on the project-specific features required. The required fields have already been completed for this project; you may review them here.

.

5. The **Misc, Utility, Outdoor, Exterior Uses, and Pools** tabs are not used in this example.

6. The **PV+Batt** tab is used to describe the photovoltaic (PV) system and any associated battery storage system components. Note that this nonresidential project includes a 20 kW photovoltaic system with a 16 kWh storage battery that employs a basic control strategy. The proposed system is larger than the minimum required and results in a compliance credit in the TDVtotal metric.

    EnergyPro can accept detailed PV system inputs, as shown in the image above, denoting the array type, orientation, tilt, inverter efficiency and other system features. Depending on the site conditions, the PV system may also be eligible to use one of the California Flexible Installation default values. Refer to Photovoltaic Systems for additional information about modeling residential PV systems.

    This tab is also used to specify the methodology for PV system sizing, and whether the project is eligible for any of the PV exceptions (mostly caused by insufficient solar access). In this case, the user has elected to "Specify PV Size" which means EnergyPro will use the inputs here irrespective of the impacts. Use caution if using this option as it may result in an under-sized system that doesn't comply or in an over-sized system that produces more electricity than the building can use.

    Select the type of control strategy for the storage battery also.

You have completed data input for the Nonresidential Sample Building element. Select the Plant element, **Plant - DHW** to continue.

Editing the Plant Element (NR Sample)

Click on the Plant element, **Plant – DHW** to access inputs for the Nonresidential Sample building's Domestic Hot Water (DHW) features.

1. The first tab in the dialog box is **Heating Hot Water**. Although there is no Heating Boiler in your sample building, use this tab to name the Plant. For this sample:

    Plant Name: *Plant - DHW*

2. Click on the **Domestic Hot Water** tab to view the DHW system characteristics.

Leave all DHW entries at their current values.

You will not use the other Plant tabs (Chilled Water, Hydronic, and DHW 2) in this example.

2. Click on the second System element in the Tree, **Office Mech System** to continue.

Editing the System Element (NR Sample)

Select the **Office Mech. System** Element for this portion of the tutorial.

1. The **Office Mechanical System** (Heating, Ventilation and Air Conditioning) has already been defined. Refer to Nonresidential Compliance Modeling for information regarding compliance rules and related design issues with respect to the way different zones are aggregated into a single HVAC System.

NOTE: If this were an actual building you were entering from scratch, you would probably wait to choose a **System** until after you had entered all the building envelope features and run Load Calculations to determine sizing for HVAC unit(s). In this sample building file, all HVAC units have already been selected.

2. The HVAC selection is a Packaged DX, Single Zone VAV heat pump system from the default Central System Library. You can review HVAC System details in the Central System Library.

    The cooling system is rated using the new SEER2 rating, effective January 1, 2023. Air conditioners installed in California on or after January 1, 2023, must comply with the new standards. For heat pumps, the new standards apply to products manufactured on or after January 1, 2023.

3. Leave all inputs at their current settings.

4. Now you will edit the Zone Element **Office Zone**

Editing the Zone Element (NR Sample)

If you are just following along, skip the next two steps. Also skip all instructions to add or insert elements. Instead, simply select the element being discussed to view input.

Deleting the Office Zone and its sub-elements for practice.

1. Click on **Office Zone**, right-click, and select **Delete** from the pop-up menu.

2. To create a new Office **Zone,** highlight the **Office Mechanical System** element, click the right mouse button, and select **Add Zone.** An Undefined Zone element appears below the Office Mechanical System.

3. Select the new **Undefined Zone** to define the General, Lighting, and Mechanical Zone information, and (if the model was for non-compliance) to set Schedules for the zone. Only the **General** tab is shown here.

   On the **General** tab, input:

   Name: *Office Zone*

   Zone Type: *Nonresidential.*

   Conditioning: *Conditioned.*

   Occupancy [button]: *Office Area (>250 square feet)* This is an Area Category occupancy; you must use either the Area Category or Tailored Method when modeling indoor lighting for performance compliance. Leave the 90.1 Ltg. Occupancy field as it is for the sample project.

   Selecting the correct occupancy is an extremely important subject covered in the Building Tree: Zone Element and in Special Topics. Read these sections carefully before selecting an occupancy for a real project.

4. Set the **Floor Number** to *1*, and select *New* from the **Envelope Status** and **Lighting Status** drop-down lists.

5. Click the Select button to open the Select Building Story dialog box. The inputs here are used to define the geometry of the Zone. Enter the following data for the Office Zone.
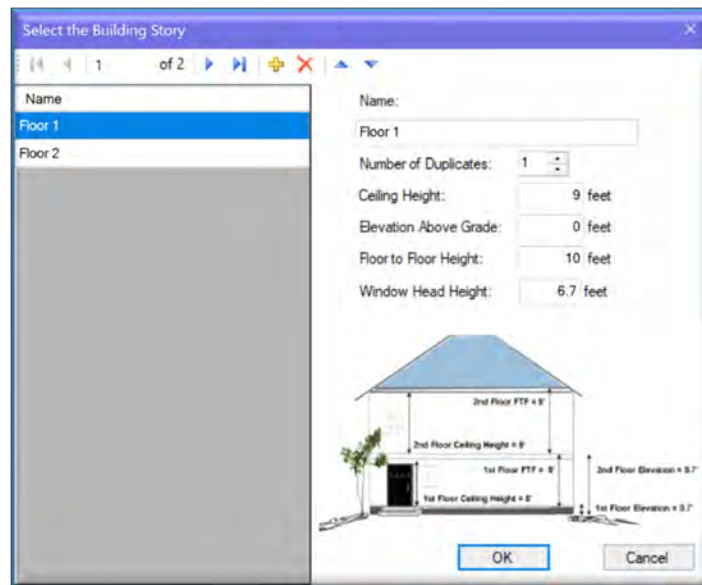
Floor Multiplier: *1*

Ceiling Height: *9* feet (2.74 meters). This value is used to calculate the volume of the room.

Floor Elevation: *0* feet (0 meters).

Floor to Floor Height: *10* feet (3.05 meters).

Window Head Height: *6.7* feet (2.04 meters).

Leave the remaining General Zone inputs set to their default values.

6. Click on the next tab, **Lighting**. In this tab you will find two large sections: **Standard** Lighting, to determine what lighting level is used in the Standard (Budget) calculation; and **Proposed** Lighting, to determine how much lighting will be used in the Proposed (Actual) calculation.

   Under **Standard** Lighting, do not select anything. *Leave this blank*.

   Under **Proposed** Lighting, select *Use Installed LPD*. If the lighting calculations were completed separately, you may use the final values in the performance simulation by selecting "User Input LPD" and entering the value for this space. The zone would be modeled with the User Input LPD regardless of any fixtures that were selected.

   If you are **following along**, note that the program has calculated the Installed LPD at 0.394 watts/sqft. If you are doing **practice** input, you can return to this tab after you have entered actual lighting fixtures under the Room element, to confirm that the LPD is indeed 0.394 watts/sqft.

7. Click on the **Mechanical** tab. Leave all Mechanical System Data entries set to their default values.

8. Click on the **Schedules** tab. In this tab you will find two types of schedules: Load Profiles, and HVAC Operations. If you are modeling the building for Title 24 compliance, the schedules are fixed. If you enter a schedule here, it will not be used in the T24 calculations.

The Dwelling Units tab is not used in this project. You have completed zonal data input for the **Office Zone Element**. Next you will add a **Room Element** to this Zone.

Editing the Room Element (NR Sample)

1. Now you will Add a **Room element** to the **Office Zone Element** by clicking on the **Office Zone**, then right click and select **Add Room**

2. Click on **Undefined Room** to define the information specific to the building at this level. In this case, there is no need to list the zone by rooms; the data you input under Room will apply to the whole **Office Zone**.

3. The **General** tab is the first tab displayed. Input:

   Name: *Office*

   Area: *1,920* ft^2 (178.4 m^2). This is the total gross area of the Room/space being modeled.

   Leave the rest of the inputs at their default values.

4. Review the default data in the **Infiltration and Occupant tabs**. Leave inputs set to their default values.

6. Click on the next tab**, Receptacle/Process**. The equipment (receptacle) power density is used only in NR Loads. This value is fixed for compliance calculations. Process Equipment Sensible and Latent loads are used in the compliance calculations but must be documented. Leave the default settings on this tab also.

7. Skip the last two tabs, **Domestic Hot Water and Lighting**. You have completed your entries for the **Office Room Element**.

9. At this point you have a choice of Building Tree elements under the Room element level. Select the Room element, right-click, and select **Add** to display the list of new components. Choose each component one at a time, as we will do in the next part of this example.

Editing the Lighting Element (NR Sample)

Now you will **Add** a **Lighting Element** to your **Room Element, Office.** Click on the **Office Element,** right click and select **Add,** then select the **Lighting Element.**

1. **Lighting** input:

    Name: *Lighting, Office*

    Status: *New*

    Luminaire: [Luminaire Library]: *Suspended LED*

    Multiplier: *27*

    Reference Code: *A-1.* This entry will appear on the compliance forms.

    Controls for Credit [drop-down]: *No Lighting Controls*

    Additional Allowance [drop-down]: *No Additional Allowance*

You have completed inputs for **Lighting, Office**.

To continue adding elements to this **Room Element,** highlight the element and, using the right mouse button, select Add. In this example, we will add a **Roof** from the Components list next.

Editing the Roof Element (NR Sample)

If you haven't done so already, highlight the **Room** Element, **Office**, and add a **Roof** from the Components list.

1. Click on the **Roof** element. Input:

    Name: *R-30 Roof*

    Area: *1,600* ft² (148.6 m²)

    Status: *New*

    New Assembly [Assembly Library]: *R-30 Roof Attic*

    Orientation [drop-down list or user input]: *0* (leave at default value)

    Slope: *4.8* /12

    Replacing > 50% of Roof Surface (or >2,000 sqft Nonres, 1,000 sqft Res: Leave this box un-checked. It is only enabled if the Roof Status is "Altered".

There are no skylights in this building. If there were, you would define the Skylight element by Inserting a Skylight in the Roof.

You've completed the **Roof Element** and now you will add the remaining elements to the **Room Element**.

Editing the Exterior Wall Element (NR Sample)

Right-click on the **Room Element**, **Office** and **Add** an **Exterior Wall.** Click on the **Wall** Element, **Exterior Wall** and input:

Name: *East Wall* (We are working in a clockwise direction around the building, N, E, S, W. The North wall of the retail space is a shared wall with the Retail space and is thus not shown here.)

Area: *400* ft² (37.2 m²)

Status: *New*

New Assembly [Assembly Library]: *R-13 Wall*

Orientation [drop-down list or user input]: *East* (The program will change this to 90 degrees on-screen.)

Tilt: *90* degrees

Wall Exception: (Not used; residential projects only.)

If there are overhangs or sidefins on this wall, you will need to return to the Wall element to enter the wall surface geometry inputs. These fields only appear on-screen AFTER you specify an overhang or sidefin in the associated Window element.

---

2. You have completed input for the East Wall for now.

3. You may insert two types of **sub-components** for each wall, as applicable: **Windows** and **Doors**. (Doors with more than 25% glass or portions of doors made of glass are input using the Windows element, as shown under the Retail Zone. **Insert a** Window element in the East Wall.

(←) (→)

Editing the Window Element (NR Sample)

With the **Exterior Wall Element**, **East Wall** highlighted, right click and select **Add Window**

1. Click on **Window** and Input:

    Name: *East Windows*

    Area: *160* ft² (14.9 m²)

    Status: *New*

    Fenestration: [Fenestration Library]: *Double Metal Tinted*

Overhangs and Sidefins

    Specify the window geometry in the Overhangs and Sidefins section
    Overhang: [Overhang Library]: *6' Overhang/0.1' Above.* When you specify an overhang or sidefin for NR T24 Performance calculations, you must enter the surface geometry.

    Surface Geometry:

        Window Width: *20 feet*

        Window Height: *8 feet*

        X Pos on Wall: *0 feet* (the window begins at the bottom, left corner of the wall)

        Y Pos on Wall: *0 feet*

Completing the Shading Device Fields (NR Sample)

Select the **Exterior Wall Element**, **East Wall**, and enter the surface geometry (width and height) of the wall.

1. **Wall Width:** *50* ft (15.2 m)

   Wall Height: *8* ft (2.44 m)

2. You have completed input for the East Wall.

Editing the Remaining Walls and Windows (NR Sample)

1. Select the **Room Element**, **Office,** right click, select **Add** and then select **Exterior Wall.** Click on the **Wall** Element, **Exterior Wall**. On the **General** tab input:

   Name: *South Wall*

   Area: *400* ft² (37.2 m²)

   Surface Type: *New*

   New Assembly: [Assembly Library]: *R-13 Wall*

   Orientation [drop-down list or user input]: *South*

   Tilt: *90* degrees

   After adding a window and overhang, complete the **Surface Geometry for Shading Devices:** *Wall Width = 50 feet, Wall Height = 8 feet.* Note that the surface geometry inputs only appear on-screen AFTER you specify an overhang or sidefin for windows on the wall.

2. With the **Exterior Wall Element**, **South Wall** highlighted, right click and select **Add Window**

   Name: *South Windows*

Area: *160* ft²² (14.9 m²²)

Fenestration: [Fenestration Library]: *Double Metal Tinted*

Window Width: *20 feet*

Window Height: *8 feet*

Overhang: [Overhang Library] *6' Overhang/0.1' Above.*

Surface Geometry:

    Window Width: *20 feet*

    Window Height: *8 feet*

    X Pos on Wall: *15 feet*

    Y Pos on Wall: *0 feet*

Leave all other inputs set to default values.

3. With the **Room Element**, **Office** selected, **Add** an **Exterior Wall.** Click on the **Wall** Element and input:

Name: *West Wall*

Area: *400* ft² (37.2 m²)

Surface Type: *New*

New Assembly: [Assembly Library]: *R-13 Wall*

Orientation [drop-down list or user input]: *West*

Tilt: *90* degrees

You have completed the input for the **Wall Elements** for the **Office Zone.** Next you will Add a door to the West Wall

Editing the Door Element (NR Sample)

Now you will insert another **sub-component,** a door. With the **West Wall Element** highlighted, click the right mouse button and select **Add Door**. The **Door Element** will be added under the West Wall.

1. Click on the **Door** element to input:

    Name: *Wood Door, Office*
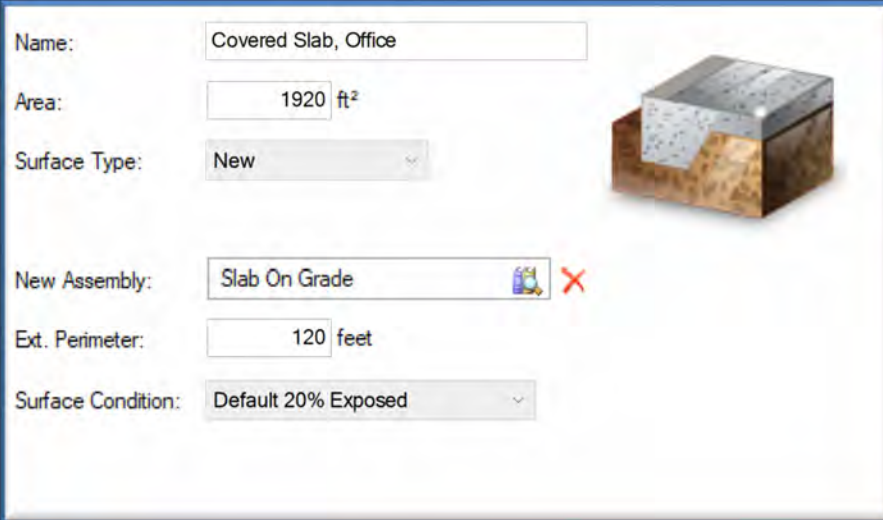
    Area: *24* ft² (2.2 m²)

    Surface Type: *New*

    New Assembly: [drop-down list]: *Wood Door*

2. You have completed the door for the West Wall. Next you will Add a **Slab on Grade Element** to the **Room Element**, **Office.**

Editing the Slab Element (NR Sample)

Click on the **Room Element**, **Office, Add** a **Slab on Grade,** and input:

    Name: *Covered Slab, Office*

    Area: *1,920* ft² (²((148.6 m²)²

    Surface Type: *New*

    New Assembly: [Assembly Library]: *Slab on Grade*

    Ext. Perimeter *120* feet (36.6 meters)

    Surface Condition: [drop-down list] *Default, 20% Exposed*

2. **You have completed practice data input for the Office Zone.**

Continue reviewing the Retail and Restaurant systems and their sub-elements.

Note that the **Retail area** of the building has glass entry doors (to the north) which are entered using the Window element. Also note that it has no Roof input because it is beneath conditioned space, the Restaurant area. There is no south wall because it shares that wall with the Office.

Note that in the **Restaurant**, in the **Room** element under the **Receptacle/Process** tab, there is a Process Equipment Load of 2.5 watts/square foot, and a Process Lighting load equal to 1.5 watts/sqft; the other Room elements have no process loads.

Now that the Building Tree is complete, **S**ave the file and run calculations.

Running Calculations (NR Sample)

Initiate calculations from the Calculations list in the lower-left window pane. The first time you run calculations for any file, you must set the calculation Options. Once Options are set, click on the Calculate button on the toolbar to initiate Calculations in one step.

1. Select Calculations from the choices in the lower-left window pane.

    Please Note: You may only run calculations for modules that you have purchased. Select Activated Modules from the Help menu to verify the status for each module.

2. Select (check the checkbox) the Nonresidential/MF Title 24 Performance calculation. The applicable boxes have been checked for you: Run Standard and Run Proposed, including the Envelope, Indoor Lighting, Mechanical, and DHW in the scope.

3. Now you are ready to run Calculations. Select the Calculate button on the toolbar.

4. **EnergyPro** displays results for each type of calculation you have selected in a tabbed format in the bottom-right window pane

The Nonresidential Sample Building complies with the *Standards* under all three Performance Method metrics, as shown in the NR T24 Performance Results box. Although the proposed heating and cooling TDV energy use are greater than the Standard design, lighting and fans show a compliance credit under the TDVefficiency metric. The larger than required PV and battery storage system results in a compliance credit, impacting the TDVtotal metric. Efficiency, renewable, and load flexibility/storage measures all impact the new Hourly Source Energy metric, which reflects emissions results.

Preparing and Printing Reports (NR Sample)
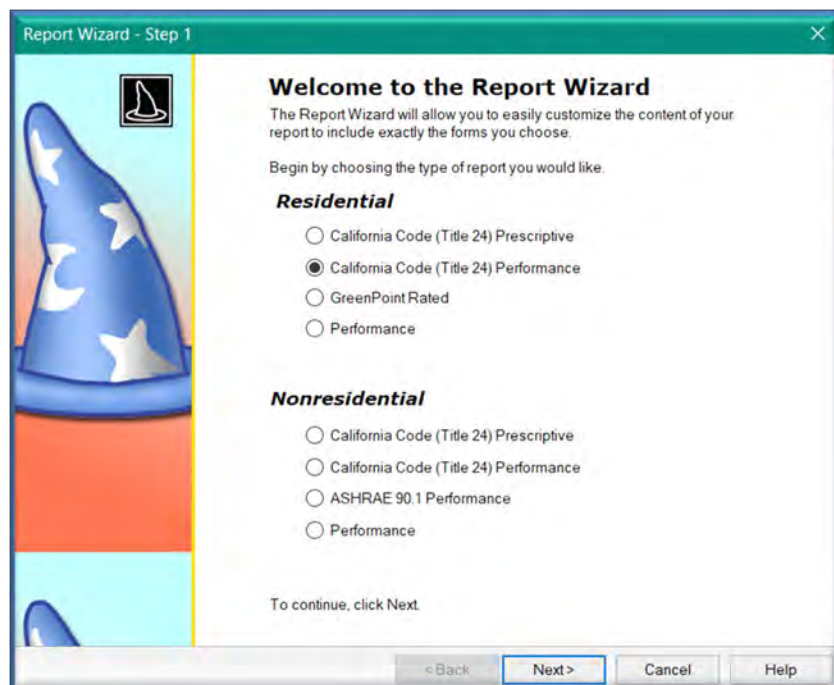
1. You may either use the Report Wizard to prepare a report for printing or select Reports from the choices in the bottom-right window pane. Select **File/Report Wizard…** from the Main Menu or click on the Report Wizard icon in the toolbar. A wizard welcomes you to the Select Report Type dialog box.

2. Select California Code (Title 24) Performance from the list of Nonresidential reports then select Next.

3. Select the Forms you wish to include in your report by clicking the appropriate boxes, then select Next.

4. In the last box, Report Complete, click Finish to close the Wizard without viewing the report, or the Print Preview button to view your report. It is ready to print, unless you choose to make changes after viewing the Report.

Building Tree

The Building Tree is the backbone of the software. It is a graphical representation of the various elements of the building you will be modeling. Each building element is represented on the screen with an icon that represents that portion of the modeled building. The Building Tree is presented in a hierarchical manner. Each parent element contains information pertinent to all its sub-elements, while each subordinate element in the tree is considered a more detailed part of its parent element. Open the Building Element to display the total conditioned floor area for the building on the status bar at the bottom of the window. Enable the status bar by placing a check mark next to Status Indicator in the Tools Menu.

Click on the calculator icon preceding each input heading to determine which, if any, calculations use the input.

Select an element from the Building Tree image below for detailed information regarding the information and inputs in that element:

Building

Exterior Application

Signs

Plant

System

Zone

Room

Roof

Skylight

Exterior Wall

Window

Door

Interior Surface

Raised Floor

Slab-on-Grade

Lighting

Lighting Task

Underground Wall

Underground Floor
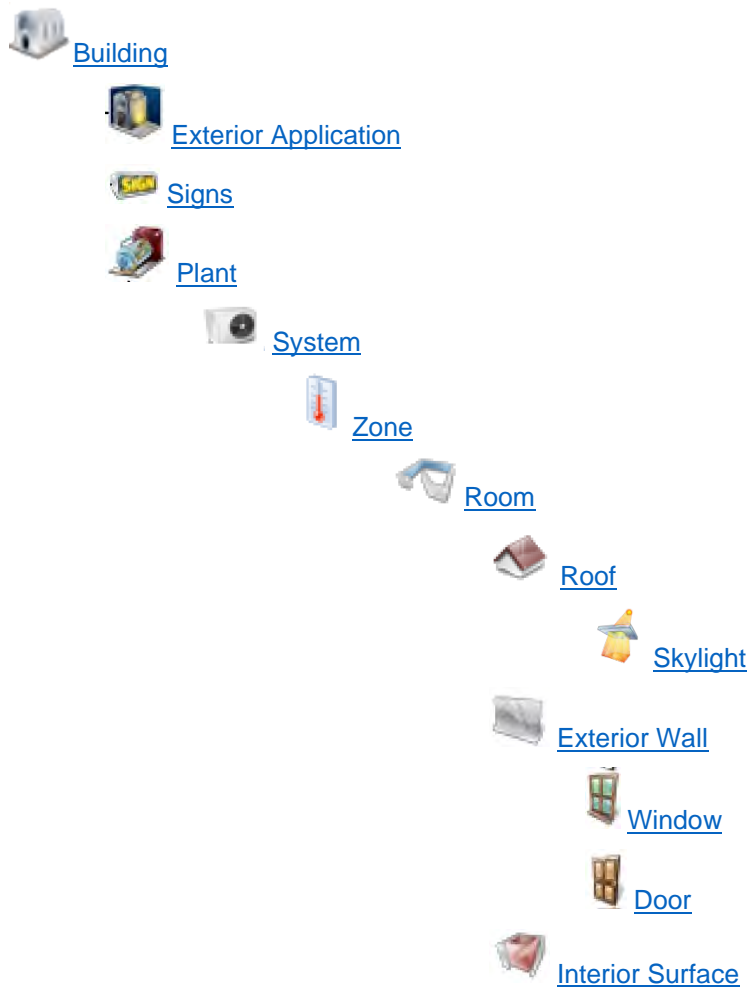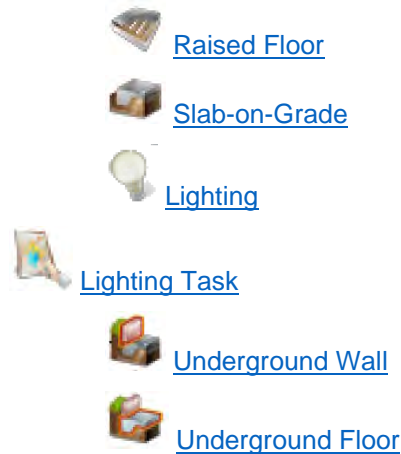
Building Element

Use the Building Element of the Building Tree to enter the building's general information. Open the Building element to display the total conditioned floor area for the building on the status bar at the bottom of the window. Enable the status bar by placing a check mark next to Status Indicator in the Tools Menu.

Project Design Data Tab

Building Name

Enter a descriptive name of the project. This should be the title of the project as shown on the plans and as known to the building department. This entry is for display only, it will not appear on the compliance forms.

Status (Building)

Choose a Building Type from one of the following:

- Existing - Used in Existing-plus-Addition calculations
- New - Applies to any new building or newly conditioned space that is not an addition
- Addition - Any newly conditioned floor area and volume which is associated with an existing building or an existing tenant space and is modeled alone, for compliance
- Existing + Addition/Alteration - See Special Topics section for a detailed description

ASHRAE Building Type

Select the ASHRAE 90.1 space use classification here to use the Building Type category in ASHRAE 90.1 calculations. If using the Space Type category, select the Envelope and Lighting space use types in the Zone Element. The user may specify either the Building Type or Space Type, but may not combine them.

Job Number

Enter any combination of numbers and/or letters used to identify the job file.

▦ Front Orientation

Enter the front orientation (azimuth) of the building in degrees or select one of the eight orientations from the drop-down list. This input is used as a reference on the residential Certificate of Compliance (CF1R) form; and to designate each wall input as front, left, right, or back on the compliance forms. It does not affect the actual orientation of the walls, windows, doors, and roofs. The Front Orientation can be changed with the building Rotation input.

See also: Working with Rotation Inputs in the Building Tree Overview.

▦ Rotation

Enter a value, in degrees, to rotate the front orientation, walls, windows, doors, and roofs in the building clockwise when reference (project) north is not true north. You may wish to use this input sparingly, and when used, be sure to confirm that the orientations are correct in the report.

Range & Units: 0 - 360°

See also: Working with Rotation Inputs.

▦ Existing Floor Area

This field is used only when using the "Addition Alone" compliance method. Enter the floor area of the existing home, without the addition. Refer to Section 9.3 of the Single Family Residential Compliance Manual or Section 12.5 of the Nonresidential/Multifamily Compliance Manual for additional details regarding the Addition Alone method.

Range & Units: 0 – 9,999,999 sqft

▦ Number of Existing Bedrooms

This field is used only when using the "Addition Alone" compliance method. Enter the number of bedrooms in the existing home. Refer to the Section 9.3 of the Residential Compliance Manual or Section 12.5 of the Nonresidential/Multifamily Compliance Manual for additional details regarding the Addition Alone method.

Range & Units: 0 - 100

▦ Relocatable Public School Building Used in All Climate Zones

Check the box if the building is a relocatable public school building that is intended for use in all climate zones. The building must meet the requirements in the Standards, Section 140.3(a)8, including the labeling requirements and the performance requirements in Table 140.3-D for all climate zones.

▦ Fuel Available at Site

Select the type of gas available, if any, to be used as the principal project heating source. For newly constructed single family homes, specify Natural Gas if available, or Propane if natural gas is not available. Natural gas is available for addition alone projects if a gas service line can be connected to the site without a gas main extension. Natural gas is available for existing plus addition/alteration projects if a gas service line is connected to the existing building.

Specify the fuel used for space and water heating, cooking and clothes drying in the Dwelling Units Tab of the Zone Element.

▦ Location Data

EnergyPro stores weather data in the Location List. The database includes entries from all 50 states in the United States as well as weather data from countries worldwide. Click "Select" to open the Location List and select the project location.

The list is not a standard EnergyPro library. You may customize existing or create new locations by selecting User Defined, then the Edit button to open the Edit Location Dialog Box.

Country

The Country in which the project is located will be displayed after you select a location from the location List. Click on the Select button to open the Select Location dialog box.

State/Region

The State or Region in which the project is located will be displayed after you select a location from the location List. Click on the Select button to open the Select Location dialog box.

City

The City in which the project is located will be displayed after you select a location from the location list. Click on the Select button to open the Select Location dialog box.

Zone

The Zone in which the project is located will be displayed after you select a location from the location list. Click on the Select button to open the Select Location dialog box.

User Defined Location

You must use the CEC weather files for Title 24 calculations, but you may use alternative files for non-compliance simulations. Check the User Defined checkbox and select Edit to edit the weather characteristics of the selected location.

To create a new location, select a city which is close in proximity to the city you want to identify by clicking *Select* under Location. An international list of cities will appear. Click on the city and click OK. Then check the box named *User Defined* and select *Edit* to open the Edit Location Dialog Box.

Edit

You must check the User Defined box to enable the Edit button. Click on the Edit button to open the Edit Location Dialog Box to add a new location or customize the characteristics of the selected location. You must complete the data in each of the four tabs and provide the appropriate weather data file if different from the existing file for the program to reference when performing calculations.

For non-compliance calculations, you may add locations that aren't included in the EnergyPro location database. Download the BIN file for the location from the following web site https://doe2.com/index_Wth.html. Place the files in the EnergyPro weather folder, usually located at the following path if installed locally-- C:\Program Files (x86)\EnergySoft\EnergyPro 9\Weather.

Return to the Project Design Data tab of the Building Element, check the User Defined Location box, and select Edit. Browse to the Weather File list and select your file. Note that the BIN files do not replace the Design Data on the Seasonal Data tab; you must input the ASHRAE design conditions for the location, from the Handbook of Fundamentals.

Select

Click on the Select button to Select the project location from the location list.

Project Title Tab

Project

Enter the Project name and address. The information found on this tab will appear on the residential and nonresidential compliance forms. Any item left blank will be omitted from the report.

Remarks

Enter any remarks and/or special project features here. Remarks appear on the NRCC-PRF-01 form in Section F. Additional Remarks for nonresidential projects and on the CF-1R form under Project Notes in residential reports.

Designer, Lighting Designer and Mechanical Designer Tabs

Designer

Enter the (Primary, Lighting or Mechanical as appropriate) Designer's name, company name, address, and contact information. The information on these tabs will appear on the residential and nonresidential compliance forms, except for the email address. Any item left blank will be omitted.

NOTE: To avoid repeating the designer entries for future projects, you may wish to create a Contact Database. Start by clicking the Select Contact button to open the Contact Database. Select the plus sign to create a new contact and complete the information, then click Select. Alternatively, you may select "Add to Contacts" to add a new contact to your database after you complete the information on this screen.

Select Contact

Click the Select button to choose a Designer from the Contact Database. You may build a contact database of Designers with whom you work regularly so that for future projects, you can simply select the contact, and the information will automatically be completed.

Add to Contacts

Click the Add to Contacts button to add a Designer to the Contact Database. You may enter the detailed information for the contact either before you click the button or after, in the Select Contact dialog box.

Forms Tab

Note that you must purchase the Nonresidential Mandatory Measures and/or the Nonresidential Process modules to activate the Forms Tab.

Use the Forms Tab to populate applicable mandatory measures forms for your project as well as any forms required to document processes covered by the Standards.

You may complete the following Nonresidential forms in the Forms Tab:

- **CXR**: Enter the following three types of Nonresidential Building Commissioning data:
- ✓ Design Review Meeting: Enter the meeting date, key attendees, construction schedule milestones, and project energy efficiency goals.
- ✓ Commissioning Documentation Authors
- ✓ Equipment and Operational Tests
- **ELC**: Enter the following four types of data for the Electrical Power Distribution system:
- ✓ Metering – Enter the location and a descriptive name for each service meter.

- ✓ Circuit Separation – For each type of electrical service, specify the name and method of compliance.
- ✓ Controlled Receptacles – Check all boxes that apply.
- ✓ Documentation – Enter the document number, title, sheet number, and Standards Section references.
- **LTI**: Enter the following two types of Indoor Lighting Control data:
- ✓ Controls Installed – Check the box next to each type of control used in the project.
- ✓ Controls Details – For each type of control, specify the location, type, and quantity installed.
- **LTO**: Enter the following two types of data for the Outdoor Lighting Controls:
- ✓ Controls Installed – Check the box next to each type of control used in the project.
- ✓ Controls Details – For each type of control, specify the location, type, and quantity installed.
- **MCH**: Enter the Sheet Name(s) that include documentation of mandatory mechanical requirements.
- **PRC**: Complete the Process Load data for the following covered processes:
    - ✓ Commercial Kitchen Exhaust:
        - o Exhaust System Information – Enter the Hood Exhaust, Makeup Air (MUA), Transfer Air, and other applicable details about the exhaust system.
        - o Exhaust Equipment Details – For each fan, specify Equipment Tag, Number of Units and Plan Reference.
    - ✓ Garage Exhaust:
        - o Total Exhaust Airflow – For each fan, enter the total garage exhaust airflow, in cfm.
        - o Exhaust Equipment Details – For each fan, specify Equipment Tag, Number of Units and Plan Reference.
    - ✓ Computer Room:
        - o For each Economizer, specify type, humidification, capacity and fan data.
    - ✓ Compressed Air
        - o xxxxxxxxx
    - ✓ Elevators:
        - o For each elevator, enter the lighting and fan characteristics.
    - ✓ Escalators:
        - o Specify if escalators exist, and if within an airport, hotel, or transportation occupancy.
    - ✓ Process Boilers:
        - o For each process boiler, enter fuel input and control system features.
    - ✓ Laboratory Exhaust:
        - o For each exhaust fan, specify airflow control type, transfer air requirements, fan size, and compliance strategy.
- SRA: Enter the following two types of data for the Solar Ready Areas:
- ✓ Solar Ready Compliance Path – Select the compliance path used to document the mandatory solar ready requirements.
- ✓ SRA Subareas – For each subarea, specify an ID, note the Plan Reference, whether the roof is Low Sloped, Orientation, Dimensions, and Area.

Miscellaneous Tab

HERS Measures

Quality Insulation Installation

Check the box if the building will have high quality insulation installation certified by the installer and field-verified to comply with Reference Appendix RA3.5. Quality Insulation Installation (QII) pertains to the manner in which the insulation in the home has been installed. For example, it is important to maintain contact between the ceiling insulation and the interior sheetrock that forms the air barrier to prevent convection from reducing the effectiveness of the insulation.

In the 2022 Standards, QII is a prescriptive requirement for newly constructed single family residential buildings and additions greater than 700 square feet (with some exceptions) in all climate zones. In addition, it's a prescriptive requirement for new multifamily low-rise residential buildings and additions greater than 700 square feet in climate zones 1-6 and 8-16 (all except climate zone 7). The measure requires HERS verification.

When used in an E+A+A project, EnergyPro automatically calculates and applies the QII compliance credit only to the new zones. For E+A+A projects, you will receive an error if you use the same assembly in both the Existing and New zones. You will need to make a copy of the assembly in the library to use different entries in each zone type.

Envelope Leakage Testing

Check the Envelope Leakage Testing check box if the building will have a lower envelope leakage rate than the standard assumption. If you check this box, you must also specify whether the leakage will be measured on a new or existing home and the target leakage rate.

Single family and multifamily projects with three or less habitable stories are eligible for compliance credit for reducing the envelope leakage below the basecase values. An approved HERS rater must perform a blower door test to verify the leakage rate in the field. For additional details regarding reduced envelope leakage:

- Single Family: *Single Family Residential Compliance Manual*, Section 3.9.5, Reference Appendices, Section RA3.8

- Multifamily: Nonresidential/Multifamily Compliance Manual, Section XXXX, Reference Appendices, Section NA2.3.

Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

Only create the Existing component if the existing condition for that component will be field-verified prior to the alteration. Otherwise, the software sets the baseline as shown in Table 141.0-E for nonresidential projects, and Table 150.2-D for single family projects. You must check the box in the Miscellaneous Tab of the Building

Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

▦ Existing / New Leakage

Enter the existing and/or new target leakage rate, as air changes per hour at 50 pascals of pressure (ACH50). ACH50 is equal to the airflow (cfm50) times 60 minutes divided by the building volume. For new single family building and townhomes, the default ACH50 value is 5. The value is 7 for other buildings with HVAC duct systems located outside the conditioned zone or cooling only systems. If there are no ducts in unconditioned space, the default values are 4.4 and 6.2 respectively.

To receive the credit, an approved HERS rater must perform a blower door test to verify the leakage rate in the field. Check the Building Leakage checkbox in the HERS Verified Existing Conditions Being Altered to enable the entry for the existing condition. For additional details regarding reduced envelope leakage, refer to the *Residential Manual*, Section 3.9.5, and Reference Appendices, Section RA3.8.

Range & Units: 0 - 99

▦ Project Includes New or Replaced Kitchen Hoods

Check the box if the project includes a new or replacement kitchen ventilation fan. The 2022 Standards include mandatory requirements for new and replacement kitchen ventilation fans in residential buildings. The specific requirements depend on the original permitting requirements for the existing fan.

Local Kitchen Mechanical Exhaust:

New Single Family Buildings, Section 150.0(o); Alterations, Section 150.2(b)

New Multifamily Buildings, Section 160.2(b), Alterations, Section 180.2(b)

HERS Verified Existing Conditions Being Altered

Refer to Standards §150.2, and to Chapter 9 and Appendix G of the Residential Manual for additional information regarding HERS verification of existing conditions. You must check the relevant checkboxes in this section to enable the data fields describing the existing conditions in other areas of the Building Tree.

Wall/Door Construction

Check the box if the walls will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Roof Construction

Check the box if the roof will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Attic Construction

Check the box if the attic will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Floor Construction

Check the box if the floor will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Fenestration

Check the box if the fenestration will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

HVAC

Check the box if the HVAC system will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Domestic Hot Water

Check the box if the domestic hot water system will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Building Leakage

Check the box if the building leakage will be altered as part of the project, and the existing condition has been verified by a HERS rater. Refer to Section 9.5 of the Residential Manual, and Existing Plus Addition Plus Alteration Analysis for additional details.

Crawlspace

Height

Enter the height of the crawl space, in feet. Note: Do not create a zone for the crawlspace; it is created automatically in the CBECC calculation engine. EnergyPro needs only the crawlspace height and exterior perimeter.

Range & Units: 2 – 99 ft

Exterior Perimeter

Enter the length of the exterior perimeter of the crawl space, excluding the edge between the house and the garage. In the garage zone, the perimeter is the length of edge between the garage and the exterior. Do not create a zone for the crawlspace; it is created automatically in the CBECC calculation engine.

Range & Units: 0 – 9,999 ft

Ventilation Cooling

Specify the type of ventilation cooling system, or None if none exists. Choices include: None, Default Whole House Fan, Specify Whole House Fan, Central Fan Integrated (Fixed Flow), and Central Fan Integrated (Variable Flow).

Whole house fans are a prescriptive requirement for new single family homes in Climate Zones 8-14, and require HERS verification in most cases. New dwelling units with a conditioned floor area equal to or less than 500 sqft. and additions less than 1,000 square feet are exempt from the ventilation cooling requirements.

If the project includes a Default system, the user may elect to forego the HERS verification. However, the software de-rates the system performance and fan capacity is reduced by a factor of 0.67 (33% reduction). The system must be HERS-verified to receive full credit. For non-default systems, select "Specify Whole House Fan" and enter the system airflow (cfm), power (watts), and venting characteristics in the Residential Tab of the System Element.

For additional details regarding ventilation cooling requirements, refer to Section 150.1(c)12 in the Standards, and Chapter 4.3.3 of the Single Family Residential Compliance Manual.

Whole House Fan Will Be HERS-Verified

Check the box when specifying a default whole house fan if the system will be field-verified by a HERS Rater. If not verified, the software de-rates the system performance and fan capacity is reduced by a factor of 0.67 (33%). The system must be HERS-verified to receive full credit.

Other

NR/MF: Air Barrier

An air barrier must be installed for all newly constructed nonresidential and multifamily buildings. Indicate whether an air barrier is installed, and select the verification method. Choices include: None, Air Barrier: Not Verified, Air Barrier: Verified by Visual Inspection, Air Barrier: Verified by Air Leakage Testing. Under the Performance Approach, EnergyPro will adjust the infiltration rate as documented in Section 5.4.2 of the Nonresidential/Multifamily ACM Reference Manual depending on the selection. Nonresidential air barrier requirements may not be traded off in the performance approach.

In existing buildings, if 25 percent or more of the building envelope's wall area is altered it needs to meet the air barrier design and material requirements for newly constructed buildings.

Input Non-Default IAQ Fans at Zone Level

Check the box to specify custom (non-default) characteristics of the indoor air quality (IAQ) fans. Enter the fan data (type, flow, power, heat recovery efficiency, if present) in the Dwelling Unit tab of the Zone Element. If you leave this checkbox blank, the program will use the default values for the IAQ fan. Additional details are available in Chapter 4.6 of the Single Family Residential Compliance Manual and Reference Residential Appendix RA3.7.

All HRV/ERV Components are Accessible

Check the box if all of the HRV or ERV system components are accessible. All individual IAQ systems with a supply fan must specify whether the system meets the IAQ System Component Accessibility Criteria as outlined in Section 6.8.6 of the Nonresidential/Multifamily ACM Reference Manual. In multifamily buildings, if the proposed IAQ system is balanced, supply, or HRV/ERV, the accessibility of the maintenance components of the system determines the basecase fan efficacy assumption used in the Standard Design.

IAQ System has Fault Indictor Display

Check the box if the IAQ system has a fault indicator display (FID). All individual IAQ systems with a supply fan must specify if the system includes an FID that meets the minimum requirements as described in Section 6.8.6 of the Nonresidential/Multifamily ACM Reference Manual. Systems without an FID or where the maintenance components are not accessible are modeled with reduced efficiency.

Occupant Controlled Smart Thermostat for Pre-Cooling

Check the box to indicate that the project will employ a precooling strategy. Precooling cools the house lower than the setpoint in the hours prior to the peak time-of-use (TOU) periods, when the electricity rates are lower, and then turning off the air conditioning during the TOU peak hours, resulting in significant cost savings for the building occupants.

To obtain this credit, a JA5 compliant communicating thermostat must be installed in the dwelling unit and indicated on both CF1R and CF2R forms. The precooling credit may only be used to lower the EDR2total score; this credit cannot be used to tradeoff the energy efficiency features of the building.

Additional information is available in Chapter 7.3.3 of the Single Family Residential Compliance Manual

Utility Tab

Use the Utility tab to specify the building's fuel source, corresponding Utility Rate, and to customize which DOE-2.1E reports will be included in the simulation output (.sim) file.

Utility Rate Schedules

▦ Electricity Rate

Click in this field to select the appropriate Utility Electricity Rate. Utility rates are part of the Schedule Library.

▦ Fossil Fuel Rate

Click in this field to select the appropriate Utility Fossil Fuel Rate. Utility rates are part of the Schedule Library.

DOE-2 Reports

Select the DOE-2 Reports you wish to include in the simulation results file. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

Outdoor Tab

▦ Outdoor Lighting Zone

Select the appropriate Outdoor Lighting Zone (0-4) for the project. The least power is allowed in Zone 0, which covers undeveloped areas of wildlife preserves or national parks, with increasingly more power allowed in Zones 1, (developed areas of parks, wildlife preserves, etc.), 2 (rural areas/urban clusters), 3 (urban areas), and 4 (special use districts).

Exterior lighting applications addressed by the Standards are shown in Table 6-1, Scope of the Outdoor Lighting Requirements.

▦ Standard Outdoor Lighting

Select the methodology for determining the Standard lighting power allowance.

Select "Use Standard" to use lighting power values designated in either Title 24 or ASHRAE 90.1 standard as appropriate for the calculation. EnergyPro automatically determines the allowable lighting power to be used in the Standard (Budget) Energy calculation for both the Title 24 and ASHRAE standards. This is the most common selection.

Select "Use Override" if you are modeling a project for which allowed outdoor lighting levels have already been determined (i.e., by another lighting consultant) and enter the allowed lighting power (Watts) in the Use Override field.

Proposed Outdoor Lighting

Select "Use Standard" when no outdoor lighting plans or specifications are submitted for permit.

Select "Use Installed" when the Proposed (Actual) calculation will be based on the outdoor light fixtures as input in the Exterior Task Element of the Building Tree. The installed LPD (including control credits) is shown to the right for both the Title 24 and ASHRAE standards.

Select "Use Override" if you are modeling a project for which the installed outdoor lighting levels have already been determined (e.g., installed lighting levels have been calculated by another lighting consultant), and enter the actual lighting power (Watts) in the User Input Use Override box.

Operating Schedule

Click in this box to select the Outdoor Lighting operating schedule from the Schedule Library.

Exterior Uses Tab

Electricity Uses

Use this tool to create a list of exterior energy-using features that are electricity driven. Click the Add button to add a new feature and enter a description in the first cell. Also, enter the energy use, in watts, for the feature and create a schedule. Refer to the Schedule Library for additional information about creating Schedules.

Fossil Fuel Uses

Use this tool to create a list of exterior energy-using features that are fossil-fuel driven. Click the Add button to add a new feature and enter a description in the first cell. Also, enter the energy use, in Btu/hour, for the feature and create a schedule. Refer to the Schedule Library for additional information about creating Schedules.

Pools Tab

The Standards now include many mandatory requirements for residential swimming pools and pool filtration equipment. Enter the pool system data in the Pools Tab.

General

Pool Type

If the project has a swimming pool, select the swimming pool characteristics from the drop-down list. Choices include:

- None
- Unheated
- Heated with no cover, and

- Heated with cover

If there is no swimming pool, select None.

Surface Area

Enter the surface area of the pool, in square feet.

Range & Units: 0 – 999,999 square feet

Pool Volume

Enter the volume of the pool, in gallons.

Filter Type

Select the filter type from the drop-down list. Choices include: Sand, Diatomaceous Earth (DE), or Cartridge.

Suction Pipe Diameter

Enter the diameter of the suction pipe, in inches. Pool piping must be sized according to the maximum flow rate needed for all auxiliary loads. The maximum velocity allowed is 6 fps in the suction line. Refer to Section 5.10 in the Single Family Residential Compliance Manual and 4.8.5 in the Nonresidential/Multifamily Compliance Manual for details regarding the mandatory requirements for pools.

Return Pipe Diameter

Enter the diameter of the return pipe. Pool piping must be sized according to the maximum flow rate needed for all auxiliary loads. The maximum velocity allowed is 8 fps in the return line. Refer to Section 5.10 in the Single Family Residential Compliance Manual and 4.8.5 in the Nonresidential/Multifamily Compliance Manual for details regarding the mandatory requirements for pools.

Flow Rates

[Not a Program Input] Turns Per Day

EnergyPro automatically calculates the number of turns per day based on the pool volume and filter pump operating characteristics.

Filter Pump

Type

Select the filter pump type from the drop-down list. Choices include Single Speed, Two Speed, and Variable Speed.

Rated Power

Enter the rated power capacity of the filtration pump, in horsepower.

Number of Pumps

Enter the number of identical filtration pumps in the system.

Motor Watts Verified in Field

Check the box if the motor power will be verified in the field. This will enable the fields to enter the actual wattage for the pump. If the pump motor is two-speed or variable speed, you must enter the relevant data for both high and low speeds.

High Speed RPM

For variable speed pumps, enter the motor rotation speed in RPM, at the high speed setting. The demand and the number of hours the pump runs at high speed are used to calculate the High Speed Flow Rate.

High Speed Watts

If the pump motor power demand will be field-verified, enter the motor power demand, in watts, at the high speed setting. The demand and the number of hours the pump runs at high speed are used to calculate the High Speed Flow Rate. The pool filtration flow rate may not be greater than the rate needed to turn over the pool water volume in 6 hours or 36 gpm, whichever is greater.

Low Speed RPM

For variable speed pumps, enter the motor rotation speed in RPM, at the lowest speed. The demand and the number of hours the pump runs at low speed are used to calculate the Low Speed Flow Rate.

Low Speed Watts

If the pump motor power demand will be field-verified, enter the motor power demand, in watts, at the low speed setting. The demand and the number of hours the pump runs at low speed are used to calculate the Low Speed Flow Rate.

High Speed Hours Per Day

Enter the number of hours per day the pump will operate at high speed.

[Not a Program Input] High Speed Flow Rate

EnergyPro automatically calculates the high speed flow rate based on the motor size and pipe diameter. The pool filtration flow rate may not be greater than the rate needed to turn over the pool water volume in 6 hours or 36 gpm, whichever is greater.

Low Speed Hours Per Day

Enter the number of hours per day the pump will operate at low speed.

[Not a Program Input] Low Speed Flow Rate

EnergyPro automatically calculates the low speed flow rate based on the motor size and pipe diameter.

Cleaner Booster Pump

Rated Power

Enter the rated power capacity of the cleaner booster pump, in horsepower.

Number of Pumps

Enter the number of identical cleaner booster pumps in the system.

Hours Per Day

Enter the number of hours per day the cleaner booster pump operates.

Motor Watts Verified in Field

Check the box if the motor power will be verified in the field.

Total Watts

Enter the total power demand, in watts, for the cleaner booster pump.

Heater

Boiler

Enter the characteristics of the pool heater.

Heating Schedule

Enter the hourly operating schedule for the pool heater.

PV+Batt Tab

In addition to the prescriptive requirements for photovoltaic systems for new single family and low-rise multifamily projects, the 2022 Standards require new high-rise multifamily and most new nonresidential projects to install a PV system and a storage battery. Enter the specifications for the photovoltaic (PV) and storage system in the PV+Batt Tab.

Refer to Section 7.2 in the Residential Compliance Manual and Sections 2.1.4.1 – 2.1.4.3 in the Residential ACM Reference Manual for additional details.

Use Community Solar (Zones 11 & 12 Only)

Check the box to use the Community Solar Compliance Option to provide compliance with the on-site solar electric generation system required in Section 150.1(c)14. As of February 2021, the only CEC-approved community solar program is Neighborhood SolarShares (NSS) program in Sacramento Municipal Utility District (SMUD) service territory. By checking this option, and confirming it is in an appropriate climate zone, EnergyPro automatically calculates the required PV using the NSS program's site PV characteristics to size the required PV system for the building. You must also check the checkbox indicating the project is located in the Neighborhood SolarShares territory to enable this feature.

This project is located in the SMUD Neighborhood SolarShares territory to the best of my knowledge

Check the box indicating that to the best of your knowledge, the project is located in the SMUD SolarShares territory. As of September 2021, the Neighborhood SolarShares program is the only CEC-approved community solar program. You must also check the Use Community Solar checkbox to enable this feature.

PV and Batteries

PV System

System Sizing

Select the method for sizing the proposed PV system in the compliance calculation. In 2019, PV systems became a prescriptive requirement for newly constructed single family and low-rise multifamily residential buildings. In 2022, newly constructed high-rise multifamily and certain nonresidential occupancies (grocery, office, financial institutions, unleased tenant space, retail, school, warehouse, auditorium, convent center, hotel/motel, library, medical office building/clinic, restaurant, theater) are prescriptively required to install both PV systems and battery storage. There are several exceptions in the Standards.

The Standard Design system size assumes the California Flexible Installation (CFI) assumptions. The minimum system size is based on the following equations in the Standards:

- Single family and low-rise multifamily residential ($\leq$3 habitable stories): Equation 150.1-C Annual Photovoltaic Electric Output

- High-rise multifamily residential: Equation 170.2-D Photovoltaic Direct Current Size

- Covered nonresidential buildings: Equation 140.10-A Photovoltaic Direct Current Size

There are three options for sizing single family PV systems:

Specify PV Size: When the user specifies the system size, the simulation uses the size specified in the PV Array Details fields, capped at 1.0 times the estimated proposed design electricity use if there is no battery, and 1.6 times the estimated electricity use if the system includes a battery. If the user selects the Apply Excess PV Production to EDR Score checkbox, the system can be oversized, and can receive additional EDR credits, capped at an EDR Score equal to zero.

Use Standard PV Size: When Use Standard PV Size is selected, the Proposed Design PV system size is equal to the Standard Design system. The system may be over- or under-sized relative to the Proposed Design electricity load, depending on the specific features of the proposed project. The CF-1R Required PV System section indicates "Simplified" when using this selection.

Maximize PV Credit: The PV system is automatically sized to offset 100% of the estimated Proposed Design electricity usage if there is no battery, and 160% of the estimated usage if the system includes a battery.

SF PV Exception

Select the appropriate exception from the drop-down list if the project meets the conditions for one of the four possible exceptions to the prescriptive PV requirements. Depending on the exception, the user may need to enter the capacity of the reduced PV system in the Reduced PV field. Choices include:

No exception

(1) Solar Access Roof Area (SARA) < 80 ft^2

(2) No PV Required When Less than 1.5 kWdc

(3) Excessive Snow Load

(4) Building Approved by Local Planning Department Prior to 1/1/2020.

Refer to Standards Section 150.1(c)14 for additional details.

Lowrise MF PV Exception

Select the appropriate exception from the drop-down list if the project meets the conditions for one of the four possible exceptions to the prescriptive PV requirements. Depending on the exception, the user may need to enter the capacity of the reduced PV system in the Reduced PV field. Choices include:

Limited by Solar Access Roof Area (SARA) Provided

(Exc. 1) Limited SARA for Steep Sloped Roofs

(Exc.2) No PV Required When Prescribed System < 1.8 kWdc

(Exc. 3) Excessive Snow Load

(Exc. 4) Roof Shading, Disallowed PVs, and Approved Before 1/1/2020.

Refer to Standards Section 170.2(f) for additional details.

NR/Highrise MF PV Exception

Select the appropriate exception from the drop-down list if the project meets the conditions for one of the four possible exceptions to the prescriptive PV requirements. Depending on the exception, the user may need to enter the capacity of the reduced PV system in the Reduced PV field. Choices include:

Limited by Solar Access Roof Area (SARA) Provided

(Exc. 1)No PV Required When SARA <3% of Conditioned Floor Area

(Exc.2) No PV Required When Prescribed System <4 kWdc

(Exc. 3) No PV Required When SARA <80 Contiguous Square Feet

(Exc. 4) Excessive Snow Load

(Exc. 5) Multi-tenant Buildings with No VNEM or Community Solar.

Refer to Standards Section 140.10 for additional details.

Solar Access Roof Area

Enter the Solar Access Roof Area (SARA) to calculate the minimum PV system size when solar access is limited. SARA is the area of the building's roof, covered parking areas, carports, and all other newly constructed structures that are capable of structurally supporting a PV system per Title 24, Part 2, Section 1511.2. SARA does not include any roof area with less than 70 percent annual solar access.

Apply Excess PV Production to EDR Score

Check the box to override the limits on EDR credit for PV systems that exceed the estimated annual site electricity usage.

When the box is unchecked, the EDR credit available is limited to a PV system size equal to the estimated site annual electricity use. If the PV system is coupled with battery storage that has a capacity equal to or greater than 5 kWh, the EDR credit is limited to a system size equal to 1.6 times the estimated site annual electricity usage. Note that oversizing the PV system may violate NEM rules.

Reduced PV

Enter the reduced capacity of the PV system in kW if the project qualifies for an exception to the prescriptive PV requirement. You must select the applicable exception from the Single Family, Low-rise Multifamily, or Nonresidential Exception to PV Requirement… field above.

Battery Storage

Use this section to enter the characteristics of the battery storage system and controls.

Control

Select the type of control for the storage battery from the drop-down list. Choice include:

- Basic (Does not feed to the Grid): Batteries are charged anytime PV generation is greater than the house load, and conversely, the batteries are discharged when load exceeds generation. This control strategy does not allow the batteries to discharge into the grid.

- Time of Use: The system begins discharging during the highest priced TOU hours of the day, which varies by time of year and local utility. The system must be capable of programming at least three separate seasonal TOU schedules, such as spring, summer, and winter.

- Advanced DR Control: The battery storage system has the capability to change charging and discharging periods in response to signals from the local utility or a third-party aggregator. Upon receiving a demand response signal from a grid operator, this option allows discharging directly into the grid.

Capacity

Enter the rated capacity of the battery storage system. The battery capacity must be equal to or greater than 6 kWh to receive EDR credit and to allow an increase in the maximum PV system size to 1.6 times the estimated annual site electricity use (from 1.0).

Range and Units: 0-999,999 kWh

Start Month

When the battery control is Time of Use, use the start month and end month fields to program three seasonal schedules. Enter the start month to designate the transition from the spring (first) to the summer (second) schedule.

End Month

When the battery control is Time of Use, use the start month and end month fields to program three seasonal schedules. Enter the end month to designate the transition from the summer (second) to the winter (third) schedule.

Charging/Discharging Efficiency

Enter the efficiency with which the battery charges and discharges, as a percentage. The design charge and discharge efficiencies in the Standard Design are 95%.

Charging/Discharging Rate

Enter the efficiency with which the battery charges and discharges, as a percentage. This equals the building load (power) that can be offset when the battery is discharging. Typical batteries have rated power storage for 2 to 4 hours of discharge capacity.

Apply Battery Savings to Single Family EDR Efficiency Score (Self Utilization Credit)

Check the box to apply the savings from the battery to the Efficiency EDR2 score. When the PV system is coupled with at least a 5 kWh battery storage system, a portion of the battery credit, normally applied to the PV/Demand Flexibility portion of the EDR2 score (EDR2total), to be traded against the Efficiency EDR2 instead. This is also known as the "self-utilization" credit. When selected, the credit can be used for tradeoffs with the project efficiency features. The credit is equal to 90 percent of the difference between the 2022 and 2016 Standards envelope improvements.

PV Array Details

Module Type

Specify the type of PV module using the dropdown list. Choices include: Standard, Premium, or Thin Film. Select the most appropriate option based on information on the module data sheet:

- Standard is a typical poly- or mono-crystalline silicon module, with efficiencies of 14-17 percent.

- Premium is appropriate for modeling high efficiency (approximately 18-20 percent) monocrystalline silicon modules that have anti-reflective coatings and lower temperature coefficients.

- Thin film assumes a low efficiency (about 11 percent), and a significantly lower temperature coefficient which is representative of most installed thin film modules.

▦ Output (kW)

Enter the nameplate DC power rating of the photovoltaic system, in kilowatts (kW).

▦ Array Type

Select the array type from the drop-down list. Choices include:

- Fixed (open rack)
- Tracking (One Axis)
- Tracking (Two Axis)

▦ Electronics

Select the type of power electronics (Microinverters or DC Power Optimizers) installed as part of the system. Power electronics are used to help minimize efficiency losses when the output of sub-array components (e.g., modules or cells) operate under different conditions. The largest driver of variation in conditions across a PV array is partial shading from nearby obstacles. A small fraction of shaded cells could lead to disproportionate reductions in PV power output.

▦ California Flexible Installation

When California Flexible Installation (CFI) is selected, inputs are simplified and specific orientation, tilt and shading conditions are not required. There are two CFI options:

- CFI1 allows the PV installation at any orientation with an azimuth from 150 to 270 degrees on a roof with a pitch from 0:12 to 7:12.
- CFI2 allows the PV installation at any orientation with an azimuth from 105 to 300 degrees on a roof with a pitch from 0:12 to 7:12.

When performance of the PV system is based on CFI, the HERS rater will verify that the modules are installed with any azimuth and any tilt within the acceptable range.

▦ Tilt

Enter the tilt at which the PV system is installed.

Range & Units: 0 – 90 degrees

▦ Azimuth

Enter the direction the PV array faces.

Range & Units: 0 – 359 degrees

▦ Inverter Efficiency

Enter the DC to AC conversion efficiency of the inverter, as a percent.

Range & Units: 0 – 99.9 percent

▦ Percent Shaded

Enter the percent the PV module is shaded by adjacent buildings, chimneys, or other permanent obstructions on an annual basis. This value is equal to 100 – (100 * incident solar energy given shading divided by incident solar energy with no shading). This value is converted to the Annual Solar Access Percent on the CF-1R form.

Horizon shading is already accounted for in the standard design. This value is confirmed during installation by an approved third-party PV sizing/shading tool (see JA11.4a). Shading has a disproportionate impact on the PV system output and Proposed Design total EDR score, which can be mitigated by using power electronics such as microinverters or DC Power Optimizers.

Range & Units: 0 – 99.9 percent

Exterior Application Element

The Standards include requirements for general site illumination and specific outdoor lighting applications (Section 140.7). You may use EnergyPro to document compliance for nonresidential exterior lighting applications addressed by the Standards, as shown in the Nonresidential/Multifamily Compliance Manual, Table 6-1, Scope of the Outdoor Lighting Requirements. The first column is general site illumination applications, which allow for tradeoffs. The second column is specific outdoor lighting applications, each of which must comply on their own without tradeoffs. The lighting applications listed in the third column are not regulated. The Standards include control requirements as well as limits on installed lighting power

More information pertaining to nonresidential outdoor lighting and signs can be found in Chapter 6 of the Nonresidential/Multifamily Compliance Manual. Multifamily outdoor lighting is addressed in Chapter 11.7, and single family outdoor lighting in Chapter 6.4 of the Single Family Compliance Manual.

Name
Type in a user defined name for the exterior task. This is only used to identify the task in the tree.

Application Information

Lighting Application
Select the appropriate lighting application from the dropdown list.

Refer to Standards Table 140.7-A: General Hardscape Lighting Power Allowance, or Table 140.7-B: Additional Lighting Power Allowance For Specific Applications for details regarding the allowable lighting power for each exterior application.

For more detailed information on each of the tasks, refer to Chapter 6, Outdoor Lighting, in the Nonresidential/Multifamily Compliance Manual.

Area

Depending on the application, the user may be prompted to enter the area related to the application.
Range & Units:
      Imperial (US): 0.0 - 999,999 square feet

Perimeter/Length/Width

Depending on the application, the user may be prompted to enter the perimeter/length/width of the area related to the application.

Range & Units:

   Imperial (US): 0.0 - 99,999 feet

   SI (Metric):   0.00 - 30,476.6 meters

⊞ Quantity

Depending on the application, the user may be prompted to enter the quantity of identical outdoor lighting applications.

Range: 0 100

Code Comparison (Not a Program Input)

T-24 Standard: Displays the maximum lighting power (Watts) allowed by Title 24 based upon the Lighting Zone selected in the Outdoor Tab of the Building Element, and the Exterior Lighting Application type at the site.

Proposed: EnergyPro automatically calculates and displays the lighting power for the Proposed task (Watts).

Signs Element

The Standards requirements for signs apply to all internally illuminated (cabinet) and externally illuminated signs, whether they are used indoors or outdoors. Examples are internally illuminated and externally illuminated signs, including billboards, off-premise and on-premise signs. They do not apply to unfiltered signs, traffic signs or exit signs. Exit signs must meet the requirements of the *Appliance Efficiency Regulations*. The sign requirements are the same throughout the state and are independent of outdoor Lighting Zones. New signs must meet the requirements of §130.0 and 130.3 (mandatory requirements) and Luminaire Power requirements in §140.8, which provides two alternative ways to comply with the sign Standards. Both alternatives encourage the use of readily available, cost-effective lighting technology.

More information pertaining to Signs requirements can be found in Chapter 7 of the Nonresidential/Multifamily Compliance Manual.

⊞ Name

Type in a user defined name for the sign. This is only used to identify the task in the tree.

⊞ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Sign Application

Select the application that most closely matches the sign design being submitted for compliance from the drop-down list. Options include: Internally Illuminated, Externally Illuminated, or Alternate. Signs may comply using either the Maximum Allowed Lighting Power, or Alternate Lighting Sources method.

- Internally illuminated - Allows 12 W/ft^2 times the area of the sign face. Use only one sign face to calculate the area for double-sided internally illuminated signs.
- Externally illuminated - Allows 2.3 W/ft^2 times the area of the sign face.

Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with the Alternate Lighting Sources requirements.

- Alternate Lighting Technology. Requires that the sign be illuminated only with one (or more) of the following light sources. Selecting Alternate enables the list of eligible lighting technologies. Note that some of the sources listed below have additional requirements. Refer to Section 140.8 of the Standards for details.

High Pressure Sodium

Pulse Start or Ceramic Metal Halide

Neon or Cold Cathode

Light Emitting Diode (LED)

Barrier Coat (T-5 and T-8)

Compact Fluorescent

Electronic Ballast

Location

Select the location of the sign from the drop-down list. Options include: Outdoor, Indoor, Message Center.

Sign Symbol or Code

Enter a code that identifies each sign type on the Lighting Compliance Forms.

Quantity of Signs

Enter the number of identical signs of the selected type.

Range & Units: 0 - 99,999 (units N/A)

Area

Enter the total area for the face or faces of the sign for internally and externally illuminated signs.

Range & Units:

> **Imperial (US):** 0.0 - 999,999 ft²
>
> **SI (Metric):**   0.00 - 92,899.9 m²

Plant Element

Use the Plant element of the Building Tree to enter the building's Boiler, Chilled Water, Hydronic, and DHW System information.

Heating Hot Water Tab

Name

Enter a descriptive name for the Plant. Use this box to name the Plant element, whether or not the project has a Boiler, for example, "Residential DHW" for a residential project.

Hot Water Boiler

Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option, the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Existing/New Boiler

Click in this multi-edit box to choose a Boiler from the DHW/Boiler Library. Only one type of Boiler is allowed per building, although multiple identical units are allowed.

NOTE: When there is no Central Boiler in the nonresidential project scope (e.g., when modeling the envelope-only or a tenant space linked to an existing Central Boiler, Chiller and/or Cooling Tower for nonresidential compliance), you may leave plant inputs set to undefined.

Multiplier

Enter an integer value to specify the number of identical Boiler units in the building.

Range & Units: 0 - 99 (units N/A)

📊 Loop Setpoint Temperature

Enter the setpoint temperature for the hot water loop.

Range & Units: 32°F – 210°F

📊 Outside Air Temperature Reset

Check the box if the boiler temperature setpoint is based on the outside air temperature.

Range & Units: 32°F – 210°F

Hot Water Pump

📊 Flow Rate per Pump

Enter the Boiler pump flow rate.

Range & Units:

Imperial (US):   0 - 99,999 gpm

SI (Metric):   0.0 - 6,309.9 L/s

📊 (Hot Water) Pump Multiplier

Enter an integer value to specify the number of identical Boiler pumps in the system.

Range & Units: 0 - 99 (units N/A)

📊 (Pump Motor) Design Power

Enter the power output of the water loop pump at design conditions.

If pump energy is expressed in kilowatts (kW), you may either enter the power as watts or divide kilowatts by 0.746 to convert to brake horsepower (bhp).

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

Input as Watts

Check the Input as Watts checkbox to enable the watts field to enter the pump motor data as watts as an alternative to entering the design power (bhp).

Range & Units: 1 – 9,999,999 watts

Watts

Enter the pump motor data as watts as an alternative to entering the design power (bhp).

Range & Units: 1 – 9,999,999 watts

[Head]

This is not a program input. Head is calculated automatically by EnergyPro based upon the pump Flow Rate and Design Power inputs.

⊞ Flow Control

Choose one of the three control options: One-Speed/2 Way Valves; One-Speed/3 Way Valves, or Variable Speed.

⊞ Minimum Flow Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Chilled Water Tab

You must change the "Number of Chiller Types" entry to at least "1" to enable the Chiller graphic button. Click on the graphic buttons to define each of the components of the chilled water system. You may define up to four types of chillers, a cooling tower, thermal energy storage system, secondary pumps and a chiller EMS system if one exists.

Chillers   Thermal Energy Storage   Secondary Pumps   Chiller EMS

⊞ Status
Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

⊞ Number of Chiller Types

Enter the number of chiller types used in your project. You may define up to four different chiller types.

⊞ Chilled Water Supply

Enter the temperature of the chilled water supply at design conditions. Enter the chilled water supply temperature at the ARI (or alternate) rating conditions in the Chiller Library.

⊞ Outside Air Temperature Reset

Check the box if the chilled water supply temperature is reset based on outside air temperature.

Chiller Entries

Click on each chiller to define the chiller characteristics and the associated primary pumping.

Chiller

Click in this field to choose a Chiller from the Chiller Library. You may select up to four chiller types per building.

Chiller Multiplier

Enter an integer value to specify the number of identical chiller units in the central plant of the building.

Range & Units: 0 - 99 (units N/A)

Primary Pump

Flow Rate per Pump

Enter the chilled water pump flow rate, in gallons per minute.

Range & Units:

Imperial (US):   0 - 99,999 gpm

SI (Metric):   0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical primary chiller pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Primary Pump Motor) Design Power

Enter the power output of the water loop pump at design conditions.

If pump energy is expressed in kilowatts (kW), you may either enter the power as watts or divide kilowatts by 0.746 to convert to brake horsepower (bhp).

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599 kW

Input as Watts

Select the checkbox to enter the fan motor data in Watts as an alternative to the design power (bhp).

Watts

Enter the fan motor power, in watts.

Range & Units: 1 – 9,999,999 watts

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed, 2 Way Valves; One-Speed, 3 Way Valves, or Variable Speed.

Minimum Flow Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Thermal Energy Storage Entries

Click on the thermal energy storage icon to define the thermal energy storage system characteristics.

Name

Enter a descriptive name of the thermal energy storage system. This entry is for display only, it will not appear on the compliance forms.

Storage Type

Select the storage type from the drop-down list. Choices include:

- Chilled Water
- Ice-on-Coil
- Ice Harvester
- Brine
- Ice-Slurry
- Eutectic
- CHS (Clathrate Hydrate Slurry)

Number of Tanks

Enter the number of storage tanks in the thermal energy storage system.

Capacity

Enter the capacity of the system in ton-hours.

Supply Rate

Enter the supply rate, or the rate at which cooling energy can be extracted from the storage tank.

Charge Schedule

Click in this field to select a charge schedule for the thermal energy storage system.

Auxiliary Energy

Enter the electricity demand from any auxiliary energy components used for pumping or devices such as air blowers used in the TES system, in kilowatts.

Tank Area

Enter the area of the wall and floor surfaces of the storage tank, in square feet. This data is used to calculate the heat transfer from the tank to the surrounding area.

Tank Insulation

Enter the R-Value of the tank insulation. This data is used to calculate the heat transfer from the tank to the surrounding area.

Secondary Chilled Water Pump Entries

Click on the pump to define the chilled water secondary pump characteristics.

Flow Rate per Pump

Enter the secondary pump flow rate.

Range & Units:

Imperial (US):   0 - 99,999 gpm

SI (Metric):   0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical secondary pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the secondary pump at design conditions.

If pump energy is expressed in kilowatts (kW), you may either enter the power in watts or divide kilowatts by 0.746 to convert to brake horsepower (bhp).

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

Input as Watts

Select the checkbox to enter the fan motor data in Watts as an alternative to brake horsepower (bhp).

Watts

Enter the pump motor power, in watts.

Range & Units: 1 – 9,999,999 watts

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed / 2 Way Valves; One-Speed / 3 Way Valves, or Variable Speed.

Minimum Flow Ratio

Enter the ratio (expressed as a decimal) of the minimum operating flow rate to the maximum pump flow rate for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Chiller EMS Entries

Click on the Chiller EMS graphic to define the chiller EMS schedule and sequence operation.

Sequences Tab

You must first click on the "+" sign to add a sequence to the table.

Sequence Name

Enter a descriptive name for each sequence.

Range

Click on the "+" sign to add a range to the table.

Load Range

Operate Chillers in this Load Range Up to:

Enter the maximum load for each load range.

Range & Units:

Imperial (US): 0 - 9,999 tons

SI (Metric):   0.00 - 74,599.25 kW

Chiller

Select chiller(s) from the drop-down list which will operate in this load range.

Chiller Multiplier

Enter the number of identical chillers which will operate within this load range.

Range & Units: 0 - 9 (units N/A)

[Total Capacity Available]

This is not a program input. The total available plant capacity at each load range is calculated automatically by the program, based on the specific chiller characteristics defined in the Chiller Dialog, and the chiller multiplier entered in the Load Range Dialog.

Schedule Tab

Sequence (defined hourly)

Select the operation Sequence Name from the drop-down list for each hour of the day.

Hydronic Tab

Ground Coupled System

Check this box if the system is a ground-coupled system. This will enable the Ground Temperatures input field to the right.

Ground Temperatures

For ground coupled systems, click in this box to select a temperature schedule from the Schedule Library. Leave this entry set to Undefined to use Ground Temperatures from the weather file.

Economizer / Condenser (Water)

If your project includes a central water-cooled condenser (which serves all systems in the building from a central location), model the condenser pump energy here. If the water-cooled condenser is part of an individual system, enter the pump energy in the Central System Library.

Flow Rate per Pump

Enter the water side economizer or water-cooled condenser pump flow rate.

Range & Units:

Imperial (US):   0 - 99,999 gpm

SI (Metric):   0.0 - 6,309.9 L/s

Pump Multiplier

Enter an integer value to specify the number of identical pumps in the system.

Range & Units: 0 - 99 (units N/A)

(Pump Motor) Design Power

Enter the power output of the pump at design conditions.

If pump energy is expressed in kilowatts (kW), you may either enter the power in watts or divide kilowatts by 0.746 to convert to brake horsepower (bhp).

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

Input as Watts

Select the checkbox to enter the pump motor data in Watts as an alternative to the design power (bhp).

Watts

Enter the pump motor power, in watts.

Range & Units: 1 – 9,999,999 watts

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

Flow Control

Choose one of the three control options: One-Speed, 2 Way Valves; One-Speed, 3 Way Valves, or Variable Speed.

Minimum Flow Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Cooling Tower

Cooling Tower

Click this field to choose a Cooling Tower from the Cooling Tower Library. Only one type of Cooling Tower is allowed per building, although multiple identical units are allowed.

The Hydronic Cooling Tower is used to define the tower specifically connected to:

- a water loop condenser;
- a water side economizer; or,
- a water loop (water source or hydronic) heat pump system.

While one Cooling Tower may physically serve several of these functions, it may be necessary to model it as two towers for the NR Performance simulation.

Tower Multiplier

Enter an integer value to specify the number of identical Cooling Towers in the central plant of the building.

Range & Units: 0 - 99 (units N/A)

Cooling Tower Pump

Flow Rate per Pump

Enter the Cooling Tower pump flow rate.

Range & Units:

Imperial (US):   0 - 99,999 gpm

SI (Metric):   0.0 - 6,309.9 L/s

⊞ Pump Multiplier

Enter an integer value to specify the number of identical pumps in the system.

Range & Units: 0 - 99 (units N/A)

⊞ (Pump Motor) Design Power

Enter the power output of the pump at design conditions.

If pump energy is expressed in kilowatts (kW), you may either enter the power in watts or divide kilowatts by 0.746 to convert to brake horsepower (bhp).

Range & Units:

Imperial (US):   0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

Input as Watts

Select the checkbox to enter the pump motor data in Watts as an alternative to the design power (bhp).

Watts

Enter the pump motor power, in watts.

Range & Units: 1 – 9,999,999 watts

[Head]

This is not a program input. Head is calculated automatically by the program based upon the pump Flow Rate and Design Power inputs.

⊞ Flow Control

Choose one of the three control options: One-Speed, 2 Way Valve; One-Speed, 3 Way Valve, or Variable Speed.

⊞ Minimum Flow Ratio

Enter the ratio (expressed as a decimal) of the minimum operating speed to the maximum pump speed for variable-speed pumps.

Range & Units: 0.0 - 1.0 (units N/A)

Domestic Hot Water Tabs

DHW Boiler

⊞ Status
Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Existing/New DHW Boiler

Depending on the application, click in the multi-edit box (Existing Boiler and/or New Boiler) to choose a Water Heater or Boiler from the DHW/Boiler Library.

Multiplier

Enter an integer value to specify the number of identical water heating units in the building.

Range & Units: 0 - 99 (units N/A)

Specify Residential Solar System Details

Check the box to specify the detailed features of the solar water heating system.

If the system serves a single family building, you may either enter the details for an SRCC OG-100 approved system, or leave the checkbox blank, and use the SRCC OG-300 rating. If the system serves a multifamily building, you must check the checkbox and specify the system details below.

Name (Single Family Only):

Enter the name of the solar thermal water heating system for single family homes.

Solar Savings Fraction

For systems serving single family buildings, you have the option to enter the SRCC OG-300 certified solar savings fraction instead of the specific system details. Enter the percentage of domestic hot water heating load that is met by the solar water heating system. See Chapter 5.9 of the Single Family Compliance Manual for the guidelines and the use of an approved program (e.g., f-Chart) to calculate annual solar performance.

Range & Units: 0 – 100%

System Details

You may specify the solar water heating system details for systems serving either single or multifamily buildings. Check the Specify System Details checkbox to enable the following fields.

Select Solar Panel

Click the Select Panel button to open the Select Solar DHW System dialog box and select the manufacturer, brand, and model number of the system. Select OK to close the dialog box.

Number of Panels

Enter the number of panels in the system.

Range & Units: 0 – 9,999

Tank Volume

Enter the volume of the tank, in gallons.

Range & Units: 0 – 9,999 gal

Azimuth

Enter the azimuth (in degrees from North) of the solar collector panel(s).

Range & Units: 0 -359 degrees

Tilt

Enter the roof or solar collector panel tilt. Typical values of various roof pitches are:

1:12 = 4.8	5:12 = 22.6
2:12 = 9.5	6:12 = 26.6
3:12 = 14	7:12 = 30.3
4:12 = 18.4	8:12 = 33.7.

Residential Heat Pump Water Heater

Tank
Select the location of the water heater if the unit is a heat pump. Choices include: Garage, Outside, Inside, Crawlspace, and Attic.

Room
If the unit is located inside, specify the room where the equipment is installed. If located in the attic, specify the room beneath the attic space.

Condenser Outside
Check the box if the heat pump water heater condenser is installed outside.

Central System Serving Multifamily
Check this option when the proposed design has a central water heating system serving multiple dwelling units, which requires that you describe the system components.

HP Water Heating System
Check this option when the proposed system is a central water heating system that is a heat pump system serving multiple dwellings.

(Central System) Pump

Pump Multiplier

Enter an integer value to specify the number of identical DHW pumps in this system.

Range & Units: 0 - 999 (units N/A)

Pump Watts

Enter the power output of the hot water pump at design conditions, brake horsepower or bhp.

If pump energy is expressed in kilowatts (kW), divide kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

      Imperial (US): 0.00 - 99,999.00 hp (brake horsepower)
      SI (Metric):   0.00 - 74,599.25 kW

(Central System) Piping

Loop Count

Enter the number of recirculation loops in the central DHW system. The Standard Design system has one recirculation loop.

Range & Units: 0 - 99

Insulation Thickness

Enter the thickness, in inches, of the central DHW system piping insulation.

Range & Units:

      Imperial (US): 0 - 9,999 in

      SI (Metric):   0 – 25,397 cm

Location

Select the location of the DHW system piping from the drop-down list. Options include:

- Conditioned

- Semi-conditioned

- Unconditioned

- Underground

Residential

Distribution

For residential systems serving individual dwelling units, choose the type of distribution system associated with the water heater. The choices are:

- Standard (all pipes insulated)
  - Parallel Piping
  - Point of Use
  - Recirculation: Demand Push Button
  - Recirculation: Demand Motion

- Recirculation: Non-Demand
- All Pipes Insulated (HERS)
- Parallel Piping (HERS)
- Recirculation: Demand Push Button (HERS)
- Recirculation: Demand Motion (HERS)

Refer to Section 5.5 of the Residential Compliance Manual *and Section11.66 of the NR/MF Compliance Manual* for multifamily Performance Method distribution system multipliers.

Compact Distribution

For residential systems serving individual dwelling units, indicate if the distribution system qualifies as compact, and whether it qualifies for the Basic or Expanded credit. HERS field verification is required for the Expanded Credit.

Central Heat Pump Water Heating

System Type

Select the type of water heating system from the drop-down list. Choices include Residential NEEA Rated Product, Commercial Product, Single Pass Primary, or Multi Pass Primary. Select the specific equipment from the enabled drop-down list.

Select NEEA HP

If the central HPWH system is a Residential NEEA Rated Product, click the Select NEEA HP button to open the Select Heat Pump Water Heater dialog box and select the proposed equipment from the list of NEEA certified equipment.

Single Pass Primary System Mfr/Model (Drop Down List)

If the central HPWH system is designed as a single pass system, select approved equipment from the drop-down list.

Multi Pass Primary System Mfr/Model (Drop Down List)

If the central HPWH system is designed as a multi pass system, select approved equipment from the drop-down list.

HP Count

Enter the number of identical heat pumps in the system.

Range & Units: 1 - 99

Tank Count

Enter the number of identical tanks in the system.

Range & Units: 1 - 99

Tank Volume

Enter the volume of the tank, in gallons.

Range & Units: 0 – 200,000

Tank R-Value

Enter the R-Value of the tank insulation.

Range & Units: 0 - 50

Tank Inside

Check the checkbox if the tank will be located indoors. You must specify the zone in which the equipment is located.

Tank Location (Drop Down List)

If the HP tank is located inside, select the zone in which the tank is located. If you don't specify a zone (or select None), EnergyPro assumes the tank is outdoors.

Condenser Inside

Check the checkbox if the condenser will be located indoors. You must specify the zone in which the equipment is located.

Condenser Location (Drop Down List)

If the condenser is located inside, specify the zone in which the equipment is located. If you don't specify a zone (or select None), EnergyPro assumes the condenser is outdoors.

Secondary Tank Configuration

Select the secondary tank configuration. Options include: None (Return to Primary), Series (Swing), and Parallel.

Secondary Loop

Tank Type

Select the water heating system secondary loop tank type from the drop-down list. Choices include Electric Resistance, Residential (NEEA Rated) Product, Commercial HPWH, Single Pass Primary, and Multi Pass Primary. Select the specific equipment from the enabled drop-down list.

Select NEEA HP

If the central HPWH system is a residential, NEEA rated product, click the Select NEEA HP button to open the Select Heat Pump Water Heater dialog box and select the NEEA-rated heat pump from the list of equipment.

Single Pass System Name (Drop Down List)

If the loop tank is designed as a large single pass system, select approved equipment from the drop-down list.

Multi Pass Primary System Mfr/Model (Drop Down List)

If the central HPWH system is designed as a multi pass system, select approved equipment from the drop-down list..

Heater Count

Enter the number of identical water heaters in the system.

Range & Units: 1 - 99

Tank Count

Enter the number of identical tanks in the system.

Range & Units: 1 - 99

Tank Volume

Enter the volume of the tank, in gallons.

Range & Units: 1 - 99

Tank R-Value

Enter the R-Value of the tank insulation.

Range & Units: 0 - 50

Tank Inside

Check the checkbox if the tank will be located indoors. You must specify the zone in which the equipment is located.

Tank Location (Drop Down List)

If the HP tank is located inside, select the zone in which the tank is located. If you don't specify a zone (or select None), EnergyPro assumes the tank is outdoors.

Condenser Inside

Check the checkbox if the condenser will be located indoors. You must specify the zone in which the equipment is located.

Condenser Location (Drop Down List)

If the condenser is located inside, specify the zone in which the equipment is located. If you don't specify a zone (or select None), EnergyPro assumes the condenser is outdoors.

System Element

Use the System element of the Building Tree to enter the Heating, Ventilating, and Air Conditioning System information. The System element contains six tabs, General, Distribution, Residential, HERS Credits, MCH, and Fan Power. Use the General tab to define the System Details, the Distribution Tab to define the distribution system location and characteristics.. The Residential Tab is used to define residential system features. The HERS Credits Tab includes residential credits that require a Home Energy Rating System inspection. The MCH Tab contains information that will appear on the Title 24 NRCC-MCH-E nonresidential

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form. Use the Fan Power tab to enter information a<mark>bout the HVAC and Exhaust System distribution, filtration and control features that impact the pressure drop.</mark>

System Details

🏢 Name

Enter a descriptive name for the System. The system name will appear on both residential and nonresidential compliance and loads documentation.

🏢 Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

🏢 New/Existing HVAC System

Depending on the application and System Type designation above, click in the multi-edit box (Existing System and/or New System) to choose an HVAC System from the Central System Library.

🏢 Multiplier

Enter an integer value to specify the number of identical HVAC units in the building.

The System Multiplier should always equal the total number of pieces of equipment used to heat and/or cool all the Zone elements listed under the System element.

In multi-family projects, if the duct leakage or other system characteristics differ in each dwelling unit, create a system for each unit to model the unique features of each system separately rather than using the multiplier feature.

Range & Units: 0 - 99 (units N/A)

🏢 Use Supply Air Temperatures Specified in Central System for Load Calculations

Check the box if you want the load calculations to use the supply air temperature specified in the Central System library. If you leave the box unchecked (the default assumption) the load calculations will calculate the supply air temperature depending on the system capacity and airflow.

Serves I-2 Occupancies (Healthcare)

Check the box if the project is an I-2 healthcare occupancy. Healthcare facilities are exempt from many of the mechanical equipment requirements. If you check this box, EnergyPro will automatically set HVAC system assumptions to the default healthcare assumptions. The Standard Design system in healthcare facilities is the same system type as the proposed design.

DOAS

Enter the fan power that is exempt from the fan power consumption requirements

ASHRAE 90.1 HVAC System Type Exception

Check the box if the HVAC equipment is eligible for an exception under ASHRAE 90.1 rules. Some examples include equipment that is being relocated, or refrigerant changes in existing equipment.

90.1 Exempted Fan Power

Enter the fan power that is exempt from the fan power consumption requirements

Heated Only Storage

Check the box if the space is a storage space with mechanical heating, but no mechanical cooling.

Space >5,000 square feet, AND Ceiling Height >15 feet AND LPD $\geq$ 0.5 Watts per square foot (Section 140.3).

Section 140.3 of the Standards requires that spaces in Climate Zones 2-15 which comply prescriptively with the Nonresidential Standards that are greater than 5,000 sqft, directly under a roof with ceiling heights > 15 feet and Lighting Power Densities $\geq$ 0.5 W/sqft must incorporate daylighting and lighting controls into the design. Check this box if your space meets these criteria. Under the Performance Approach, this will set the baseline.

Residential Hydronic Space Heating

Select the hydronic heating source, if one exists. This selection applies to residential occupancies only.

- Choose **None** if there is no hydronic heating in the building.

- Choose **DHW Boiler Provides Heat** for a combined residential space and water heating system that uses the specified hot water system for space heating as described in the Plant element, DHW Tabs of the Building Tree.

- Choose **Heating Boiler Provides Heat** for a dedicated (separate) space heating system that uses the heating boiler specified in the Plant element, Heating Hot Water Tab of the Building Tree.

See Also:

Hydronic Systems

Outside Air From:

Section 120.1 of the Standards lists requirements for mechanical ventilation and indoor air quality. The default value is "Outside", indicating the outside air is supplied directly from the outdoors. If the outside air requirements for this system are supplied via one of the other HVAC systems in the building, click on the box to select one of the other Systems defined in the Building Tree. Click "X" beside the box to revert back to the default condition.

Distribution Tab

▦ Existing Ductwork not being Altered with Duct Extensions Added

You must select "Altered" as the Distribution Type to enable this field.

Check the box if there are no alterations to the existing ductwork, but new ducts will be added to extend the existing distribution system. The software assumes the duct extension is greater than 40 feet, and that HERS verification of duct sealing is required. If the extension is less than or equal to 40 feet, check the "Duct Extension less than 40 feet" box.

▦ Duct Extension less than 25 feet.

You must select "Altered" as the Distribution Type, and the Checkbox indicating the Existing Ductwork will be extended to enable this field.

Check the box if the project will include new ducts, but the extension will be less than 25 feet.

▦ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Existing and/or New Distribution Systems

▦ Heating Distribution:

Select one of the Heating Distribution types. The choices are:

- Ducted

- Ductless / with Fan

- Ductless / No Fan

- Radiant Floor

- Baseboard

▦ Cooling Distribution

Select one of the Cooling Distribution types. The choices are:

- Ducted

- Ductless

▦ Less than 12 Feet of Duct in Unconditioned Space

Check the box if less than twelve lineal feet of ducts lie outside conditioned space. You may not use this checkbox if you have selected Ducts in Conditioned or an unducted system in the System Element, General Tab. This credit requires field verification by an approved HERS rater.

▦ Duct Location

Select one of the duct location types. This input is used for both residential and nonresidential calculations. Refer to Section 4.4 of the Residential Manual or Section 4.4 of the Nonresidential Manual for additional details. The choices are:

- Conditioned
- Outdoors
- Crawlspace
- Garage
- Attic
- Indirectly Conditioned

▦ Duct Leakage

Select one of the duct leakage conditions from the drop-down list. The choices are:

- Duct Leakage Not Verified. If no duct leakage test is performed for the existing duct system, EnergyPro assumes a default leakage value. Duct leakage factors for untested and tested duct systems are shown in the Residential ACM Manual.

- Sealed Ducts with Leakage Verified. Ducts in new single family homes must be sealed to limit leakage to a maximum of 5% if the air handler is installed and 4% if not. Ducts in new multifamily projects must be sealed to 12% maximum leakage, or 6% to the outside. The ducts must be tested and certified by the installer and tested and verified by an approved HERS rater. Refer to the *Residential Manual*, Chapter 2.5 for more details regarding all HERS requirements.

- Low Leakage AHU with Leakage Verified. Select this item if the air handler is tested and certified by the CEC as a low leakage air handler. The air handler must achieve a 2 percent or less leakage rate at 1-inch water gauge when all air inlets, air outlets and condensate drain port(s), when present, are sealed. This credit must be used in combination with the verified duct leakage credit.

- Ducts in Conditioned Space with Leakage to Outside $\leq$25 cfm. Select this item if the ducts are entirely in conditioned space, and have verified low leakage rates to the outside conditions. This measure requires field verification that the leakage rates to the outside are equal to or less than 25 cfm when measured at CEC-specified conditions by an approved HERS rater.

▦ Duct Insulation
Input the rated R-Value of the duct insulation.

Range & Units:
  Imperial (US): 0.0-999.0 (hr)(ft²)(°F)/Btu
  SI (Metric):   0.00 - 174.2 (m²)(°C)/W

Percent (%)

You may take credit for installation of a factory sealed air handling unit tested by the manufacturer and certified to the Energy Commission to meet the requirements for a Low Leakage Air-Handler. Field verification of the air handler's model number is required. A Low Leakage Air Handler is reported on the compliance report and field verified in accordance with the procedures specified in Reference Appendices.

Verified Duct Design

Check the box if the project will seek compliance credit for an efficient duct design, as verified by a HERS rater. Credit is available for duct systems designed with reduced surface areas, located in advantageous areas, and/or systems that have higher insulation than required. Checking this box enables the fields allowing you to enter the supply and return duct features as well as key information regarding the attic. Refer to Reference Residential Appendix 3.1.4.1 for additional information regarding the duct design requirements. Specify if the ducts are buried in the attic insulation, insulation value and type, and the duct diameter, length, and insulation R-Values.

Nonresidential Ducts

>25% of Ducts in Unconditioned

Check the box if the ducts are part of a single zone system serving less than 5,000 sqft, and more than 25% of the ducts are located in unconditioned space. This condition requires sealing ducts to limit leakage and field verification by an approved HERS Rater. For new ducts, leakage must be equal to or less than 6%. For new ducts added to an existing system, the leakage criteria vary depending on the specific situation. Refer to Chapter 4 of the Nonresidential Manual for additional information.

Heating Duct Losses

Enter the heating duct losses, as a percent of the total fan flow.

Cooling Duct Losses

Enter the cooling duct losses as a percent of the total fan flow.

Supply Air Path

Select the method of distribution for the supply air. Options include: Ducted, Not Applicable, Direct, or Plenum Zone.

Return Air Path

Select the distribution method for the return air. Options include: Ducted, Not Applicable, Direct, or Plenum Zone.

Residential Tab

Lowrise Residential

Ventilation Cooling

Ventilation cooling can reduce the energy used for cooling by bringing in outside air to cool the house when conditions allow. Whole House Fans are required prescriptively in Climate Zones 8-14. You may specify the

airflow and W/cfm for the system or a default prescriptive whole house fan. Non-default fans must be field-verified. In addition, when the default capacity is selected, you may specify HERS field verification or none. If HERS verification is NOT selected, the fan capacity is reduced by a factor of 0.67 (33 percent). Whole house fans are listed as a Special Feature on the CF1R form. A variable speed ventilation cooling system requires HERS verification of the make/model number and controls.

Fans must be listed in the California Energy Commission's Appliance Efficiency Database at https://cacertappliances.energy.ca.gov/Login.aspx

Ventilation Cooling systems may also be integrated with the central HVAC system fan (Central Fan Integrated), and may be either fixed or variable speed.

Refer to Section 4.7.10 in the Single Family Compliance Manual for additional information regarding whole house fans and ventilation cooling requirements.

Ventilation Cooling Airflow (cfm)

If the house has a ventilation cooling system, you must specify a non-default whole house fan type in the Miscellaneous Tab of the Building Element to enable the Airflow and Power input fields. This data requires HERS field verification.

Enter the airflow of the whole house fan, or Central Fan Integrated (CFI) system, in cfm. Prescriptive requirements in Climate Zones 8-14 include a whole house fan. The baseline whole house fan system has listed airflow equal to 1.5 cfm per square foot of conditioned floor area, and uses 0.14 watts per cfm. The house must have a minimum attic net free vent area to outdoors of one square foot per 750 cfm of Whole House Fan(s) rated airflow, or greater if manufacturer specifies greater free vent area.

Central Fan Integrated Systems may be either fixed or variable flow. For variable speed systems, enter the maximum airflow.

Power

If the house has a ventilation cooling system, you must specify a non-default whole house fan type in the Miscellaneous Tab of the Building Element to enable the Airflow and Power input fields.

Enter the ventilation cooling system power demand, in watts.

Vents Directly to Outside

Check the box if the whole house fan vents directly to the outside.

Wood Heat

Check the box if wood heating is the primary source for space heating. In areas with no natural gas available, a wood heating system with any back-up heating system, is allowed to be installed if exceptional method criteria described in the Residential Compliance Manual are met.

Variable Capacity Heat Pump

Check the box if the heat pump is a variable capacity heat pump (VCHP). VCHP systems are required to be modeled as minimum efficiency systems unless the VCHP compliance option is taken. The VCHP compliance option requires that the equipment meet several requirements, which must be field-verified by a HERS rater.

First, specify a heat pump system in the General Tab, including both heating and cooling capacity. The efficiency values you input for the system are shown on the CF-1R but are ignored for the compliance calculation as the compliance option credit is fixed relative to a standard efficiency heat pump. Because VCHP systems must meet specific requirements regarding the distribution system (non-ducted or ducted), the

compliance calculation uses the specifications on the Residential Tab and ignores inputs on the Distribution Tab.

Click here for more information regarding the VCHP compliance option, eligibility requirements, and field verification requirements. For single family systems: refer to Section 4.7.9 of the Single Family Compliance Manual and Section 2.4.1 of the Single Family ACM Reference Manual. For multifamily systems, refer to Section 11.5.6.1 of the NR/MF Compliance Manual and Section 6.8.1 of the NR/MF ACM Reference Manual for additional information.

Certified as Having an Automatic Fan

For ducted systems, check the box if the VCHP system manufacturer has certified to the CEC that the indoor system fan does not run continuously by default. The compliance credit is only available for systems that cycle the fan on and off automatically. If the fan runs continuously, there is a significant energy penalty equal to 50W per ton of cooling capacity whenever there is no heating or cooling load.

Click here for more information regarding the VCHP compliance option, eligibility requirements, and field verification requirements.

VCHP Ducting

Select the appropriate entry indicating whether the VCHP system is non-ducted, ducted or partially ducted. Note that these entries override the entries on the Distribution Tab.

Click here for more information regarding the VCHP compliance option, eligibility requirements, and field verification requirements.

HERS Credits Tab

There are several compliance credits available for improving the efficiency of heating and cooling systems and distribution system (ducts), and for improving practices to achieve higher performance and less leakage than results from standard construction practices. These HERS measures require diagnostic testing and field verification by a certified HERS rater.

All of the following credits will appear on printed compliance documentation.

Related Topics:

Measures That Require HERS Verification

NOTE: All HERS credits require field inspection and verification by an approved HERS rater. Also refer to the Single Family Compliance Manual, Section 2.5 and the NR/MF Compliance Manual, Section 11.5.8.3 for more details regarding HERS credits and requirements.

Measures Requiring HERS Testing

Note that this is a subset of HERS measures related to HVAC systems. All HERS Measures require field verification. View complete list of HERS measures.

Verified Refrigerant Charge Verification
Select to take the HERS credit. Refrigerant charge refers to the actual amount of refrigerant present in the system. Excessive refrigerant charge can lead to premature compressor failure and insufficient charge can cause compressors to overheat. This credit requires field verification by an approved HERS Rater.

Cooling Coil Tested Airflow

Enter the system airflow across the cooling coil, in cfm per ton. Systems that use forced air ducts to supply cooling must demonstrate adequate airflow (and air handling unit fan efficacy, see entry below). The airflow for each system must be tested and verified by a HERS rater using one of the methods described in Reference Appendix RA3.3. Alternatively, standard systems (those with no zoning dampers) may comply by meeting the requirements in Tables 150.0-B and 150.0-C (Return Duct and Filter Grille Sizing).

Zoned systems (multiple zones served by a single air handler with motorized zone dampers), with or without bypass dampers, usually do not meet the airflow and fan efficacy requirements when less than all zones are calling. The energy penalty that results from this is greater than the benefit of having zonal control, therefore zonal control is no longer simply assumed to be a "better than minimum" condition and there are special compliance requirements for them.

The default airflow for a zoned system with a single speed compressor drops to 150 cfm/ton. Because the standard design uses 350 cfm/ton, there is a penalty unless the user specifies a value of 350 or higher. Entering a value between 150 and 350 can lessen the penalty. Refer to Zonal Controls, Section 4.4.1.19 of the Residential Manual, and Standards Section 150.0(m)13 for details about zonally controlled systems.

Cooling Fan Power

Enter the fan power, in Watts per cfm. The mandatory requirement in Section 150.0(m)13 requires the air-handling unit fan efficacy to be verified by a HERS rater. The minimum fan efficacy for a gas furnace is equal to 0.45 Watts/cfm. For air handlers that are not gas furnaces, 0.58 Watts/cfm. Credit is available for demonstrating that a high efficiency fan and duct system with a lower wattage fan has been installed. This credit requires HERS rater field verification to show that it is equal or less than the value in the compliance analysis.

Bypass Ducts

Check the box if the HVAC system is using bypass ducts. Under the performance approach, there is a compliance penalty for systems choosing to utilize bypass ducts for zonal control. If a project that has automatic zonal control, and is using the prescriptive approach, it is prohibited from using bypass ducts that divert supply air directly back to the return air stream. Refer to Standards Section 150.1(c)13 for additional details.

Zonally Controlled

Check the box to specify that the HVAC system is zonally controlled.

Do not use this checkbox for the Living/Sleeping area zonal control compliance credit. To model that credit, specify the Zone Type (Res Living/Res Sleeping) within each zone and ensure the data on the Dwelling Unit tab is consistent with the Zone Type.

Refer to Zonal Controls and to Section 4.5.2 in the Single Family Manual for additional information regarding the requirements for the zonal control credit.

Multi-Speed Compressor

Check the box if the HVAC system has a multi-speed compressor. Zonally controlled central forced-air cooling systems (except for small duct high velocity systems) must be able to deliver, in every zonal control mode, an airflow to the dwelling of $\geq$ 350 CFM per ton of nominal cooling capacity. Gas furnaces must operate at an air-handling unit fan efficacy of $\leq$ 0.45 W/cfm, and non-furnaces at $\leq$ 0.58 W/cfm. An exception allows multispeed or variable speed compressor systems, or single speed compressor systems to meet the mandatory airflow (cfm/ton) and fan efficacy (Watt/cfm) requirements by operating the system at maximum compressor capacity and system fan speed with all zones calling for conditioning, rather than in every zonal control mode.

MCH Tab

Ues the MCH Tab to complete the NRCC-MCH-E form.

System Features

▦ Thermostat

Select the type of thermostatic control for the system from the drop-down list. The choices include:

- EMCS – Energy Management Control System.
- NA: Room AC/Heat pump
- Setback plus DR
- Setback Thermostat

▦ Shutoff Controls

Select the type of shutoff controls for the system from the drop-down list. The choices include:

- 24 Hour Operation
- 4 Hour Timer
- NA: Altered per Sec 141.0(b)2E
- Auto Timeswitch
- Card Key (hotel/motel)
- EMCS – Energy Management Control System
- NA: Healthcare
- Hirise Residential
- Occupancy Sensor
- Other*

Selections with an asterisk MUST include text describing the reason for the exemption.

▦ Isolation Zone Controls

Select the type of isolation zone controls for the system from the drop-down list. The choices include:

- 4 Hour Timer
- NA: Altered per Sec 141.0(b)2E
- Auto Timeswitch
- NA: Continuous Heat/Cool
- EMCS
- NA: < 25,000 sqft
- Occupancy Sensor
- Other*
- NA: Single Zone

Selections with an asterisk MUST include text describing the reason for the exemption.

▦ Demand Response

Select the type of demand response controls for the system from the drop-down list. The choices include:

- EMCS
- NA: PTAC, PTHP or Room AC/HP

- NA: Healthcare
- Other*
- Temperature Sensitive Space
- Occupant Controlled Smart Thermostat

Selections with an asterisk MUST include text describing the reason for the exemption.

🖩 Supply Air Temp Reset

Select the type of temperature reset controls for the system supply air from the drop-down list. The choices include:

- NA: Alteration
- Meets 140.4(d)1
- NA: Healthcare
- Humidity Control
- Controls Would Increase Usage
- Exempt*
- Included
- NA: Single Zone

Selections with an asterisk MUST include text describing the reason for the exemption.

🖩 Window Interlocks

Select the type of window interlock controls for the system from the drop-down list. The choices include:

- NA: Alteration Project
- NA: Auto-closing Doors
- NA: Healthcare
- NA: Hirise Res
- Provided
- NA: No Operable Windows
- NA: No Thermostatic Control

🖩 Smallest System Able to Meet Load within Available System Selections

Check the box to indicate that the specified HVAC system is the smallest available within the selections.

Fan Power Tab

Maximum fan power is regulated in individual fan systems where the power of at least one fan or fan array in the fan system is greater than or equal to 1kW of fan electrical input power at design conditions (see Section 4.10 for definitions). A system consists of only the components that must function together to deliver air to a given area; fans that can operate independently of each other comprise separate systems. Included are all fans associated with moving air from a given space-conditioning system to the conditioned spaces and back to the source, or to exhaust air to the outdoors.

Supply Fan Adjustments

Check the appropriate boxes to indicate if the components are included in the fan system. Table 140.4-A is used for calculating the supply fan power adjustments for eligible fan systems. Choices include:

- MERV 13-16 filter located downstream (vs upstream) of coil

- MERV > 16 filter of HEPA filter

- Solid or Liquid Dessicant

- Reheat Coil for Dehumidification

- Coil runaround loop

- Gas phase Filtration

- Air Blender

- Sound attenuation section

- Feeding Downstream Terminal Unit

- Low Turndown Single Zone VAV

Return/Exhaust Fan Adjustments

Check the appropriate boxes to indicate if the components are included in the fan system. Table 140.4-B is used for calculating the return/exhaust fan power adjustments for eligible fan systems. Choices include:

- Return Exhaust Has Filter

- Coil Runaround Loop

- Fully Ducted Return or Exhaust

- Return/Exhaust control devices

- Lab/Vivarium Exhaust System

- Exhaust Filters or Scrubbers

- Sound Attenuation Section

Zone Element

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Use the Zone element of the Building Tree to enter the Zone's General, Lighting, Mechanical, Schedules and Dwelling Unit information. Note that the Mechanical, Lighting, and Schedule tabs are not used for residential compliance calculations.

General Tab

Zone Name

Enter a descriptive name of the Zone.

Zone Type

Select the Zone Type from the drop-down list. The choices are Single Family Dwelling, Single Family Garage, Multifamily Dwelling, Multifamily Common Area, Nonresidential and Hotel/Motel.

You must include unconditioned zones such as garages or crawlspaces adjacent to conditioned areas in the model. If the unconditioned zone is a garage, measures must be taken to ensure no air is able to migrate from the garage to the conditioned space. For single family buildings, refer to the Single Family Compliance Manual, Section 4.6 for additional information on indoor air quality requirements, and 4.6.9 for specific requirements for garages.

To obtain compliance credit for Residential HVAC systems that include zonal controls, specify Zonally Controlled in the HERS Credits tab of the System Element (zonal control is considered a special feature). You must also select either Res Living or Res Sleeping as the Zone Type in the Zone Element, and ensure the data in the Dwelling Unit tab matches the Zone Type. Refer to Section 4.5.2 of the Residential Manual and Zonal Controls in the Special Topics section for additional information regarding zonally-controlled systems.

For nonresidential performance calculations, DOE 2.1E requires the first zone to be conditioned.

Conditioning

Specify whether the Zone is conditioned from the drop-down list. The choices are Conditioned, Unconditioned, Indirectly Conditioned, and Plenum.

Occupancy

View Occupancy List

Select the specific occupancy type from the list for multifamily common areas and nonresidential buildings.

The Complete Building method is limited to occupancies listed in Standards Table 140.6-B. Select a Complete Building occupancy if all areas of the entire building are complete; the occupancy is listed in the table, the envelope, HVAC and lighting system are fully designed and submitted as part of the current permit AND the building consists of 90% one occupancy type. According to Section 5.3 of the Nonresidential Manual, you may also use the Complete Building method for tenant improvements, if 90% of the permitted space is one occupancy type (exclusive of support spaces) and the support spaces make up 15% or less of the total permitted space. You may not use the Complete Building method for high-rise residential, hotel/motel, or retail buildings.

You may select an Area Category occupancy type (Auditorium through Waiting Area and All Others, or for Hospitals, Anesthesia Storage through Lab, Physical Sciences) from the Zone Level Occupancy Types list) if the zone is a nonresidential occupancy and lighting plans or specifications are submitted with the permit. (Also see Area Category Notes.)

Ventilation Function

[Not a Program Input]. Specifies the Ventilation Function when defining the Occupancy.

90.1 Envelope Type

Select an occupancy type to set the envelope baseline for ASHRAE 90.1 calculations.

90.1 Lighting Occupancy

Select an Occupancy to set the standard for ASHRAE 90.1 calculations.

Number of Floors / Floor Number

The name of this field changes based on whether the Occupancy selected is residential or nonresidential.

For single family residential projects: Number of Floors - Enter the number of identical floors in the zone.

For multifamily residential and nonresidential projects: Floor Number – Enter the floor number of the zone. Specify the number of identical floors in the zone using the Building Story inputs.

Envelope Status

Assign the appropriate status for the zone envelope. If checking the Altered option the user will need to identify the status for each individual component within the zone. Select from the three options:

- Existing

Existing envelope that will not be altered.

- New

New envelope for new construction, or a zone that is part of an addition.

- Altered

Select Altered if any of the components (walls, windows, etc.) of the envelope in the zone are being altered from existing conditions but are not part of an addition.

Accessory Dwelling Unit

Use the drop-down box to indicate if the project is an Accessory Dwelling Unit (ADU). For compliance, an ADU may be treated as an addition or may be a new dwelling unit. Figure 9.2 (below) from the Single Family Compliance Manual provides a description of various ADU configurations with respect to the main dwelling unit for guidance in determining compliance options. Also refer to Section 9.3.5 of the Single Family Compliance Manual for additional details.

Figure 9-2: ADU Types
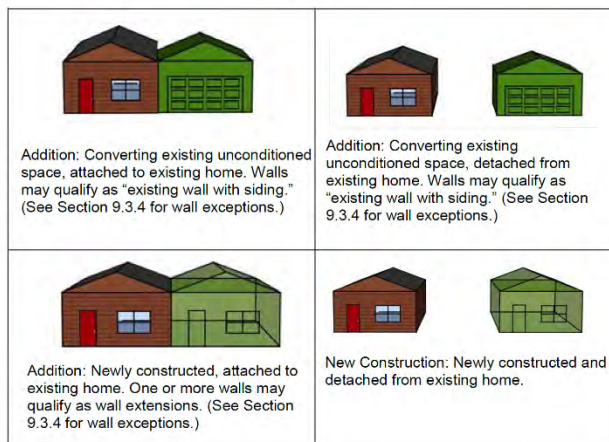
Lighting Status

Assign the appropriate status for the zone lighting. If checking the Altered option the user will need to identify the status for each individual component within the zone. Select from the three options:

- Existing

Existing lighting that will not be altered.

- New

New lighting for new construction or a zone that is part of an addition.

- Altered

Select Altered if the lighting in the zone is being altered from existing conditions but is not part of an addition.

🔲 Year Built

If you select an Existing or Altered Envelope or Lighting Status, enter the year the Zone was first built. Refer to Appendix B of the Residential Manual for additional information. Addition and alteration information is found within each individual chapter in the Nonresidential Compliance Manual.

🔲 Building Story

Use the entries in the "Select the Building Story" dialog box to describe the building story characteristics and to create multiple identical building stories in the simulation.

Click on the "Select" button to open the Select Building Story dialog box and enter the Name, Floor Multiplier, Ceiling Height, Floor Elevation, Floor to Floor Height, and Window Head Height in the dialog box.

Note that when you use the Floor Multiplier, <u>all</u> zones on that floor are multiplied by the number entered, even if served by a different HVAC system.

🔲 (Select Building Story) Name

Enter the Name for the building story.

🔲 (Select Building Story) Number of Duplicate Stories

Enter the number of identical floors, stacked vertically. Note that when you use the Number of Duplicates field, <u>all</u> zones on that floor are multiplied by the number entered, even if served by a different HVAC system.

The Number of Duplicates allows you to describe one floor then enter the number of times it occurs including the first occurrence, as a floor (vertical) multiplier. EnergyPro assumes that the duplicate floors are stacked directly above the bottom, which is assigned the floor number you enter in the General Tab of the Zone Element. Thus, if the original floor is on the second floor and the Number of Duplicates equals three, then the duplicate floors are assumed to be the second, third, and fourth floors.

The Number of Duplicates does not affect the areas of demising partitions (i.e., any surfaces between adjacent zones). To use multipliers properly, the floors must be absolutely identical, including their orientations and roof and floor exposures. The multiplier usually applies only to interior floors of multi-story buildings.

<u>Range & Units</u>: 1 - 100 (units N/A)

🔲 (Select Building Story) Ceiling Height

Enter the average ceiling height for the room or rooms. The program multiplies this value times the floor area to establish the volume of the room.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

🔲 (Select Building Story) Elevation Above Grade

Enter the elevation of the top surface of the floor relative to the ground. The elevation of the top and bottom of each zone is required to set up the air flow network. If you are modeling an underground space, such as a basement, the elevation will be negative.

Range & Units:

Imperial (US): -999.0 - 999.0 ft

SI (Metric): -304.5 - 304.5 m

⊞ (Select Building Story) Floor to Floor Height

If the building has multiple stories, enter the distance from the top surface of the floor to the top surface of the floor above it. The floor to floor height is equal to the ceiling height plus the thickness of the intermediate floor structure.

Range & Units:

Imperial (US): 8.0 - 19.0 ft

SI (Metric):   2.4 – 5.8 m

⊞ (Select Building Story) Window Head Height

Enter the window head height. Window head height is the distance from the top surface of the floor to the top of the window.

Residential Projects: Window head height is used in the infiltration and ventilation calculations. The simulation uses the AIRNET model, an airflow analysis tool created by National Institute of Standards and Technology (NIST). The AIRNET infiltration and ventilation algorithm calculates the instantaneous air flow throughout the building based on the air temperatures in the zones, and on the outside wind and air temperature. AIRNET also handles fan induced flows. You may find additional information on the AIRNET software at the NIST Multizone Modeling web site at http://www.bfrl.nist.gov/IAQanalysis/index.htm

Nonresidential Projects: Automatic daylighting controls are mandatory for luminaires located in daylit spaces. Window head height is used to calculate the primary and secondary sidelit daylit areas.

Range & Units:

Imperial (US): 5.0 - 19.0 ft

SI (Metric):   1.5 – 5.8 m

⊞ Display Perimeter (North, East, South)

Enter the North, East, South orientation length, in feet, of an exterior wall in a Group B, Group F, Division 1, or Group M occupancy that immediately abuts a public sidewalk measured at the sidewalk level for each story that abuts a public sidewalk.

The Display Perimeter is used for a special calculation of window area in the standard design building as explained in Sections 3.2.2 of the state's *Nonresidential Manual*. Refer also to the definition of Exterior Wall in the Glossary of the *Nonresidential Manual*. If you specify Display Perimeter, the maximum fenestration area in the standard design is equal to the greater of either the product of the length of the display perimeter times 6 ft in height or 40% of gross wall area.

Range & Units:
        Imperial (US): 0.0 - 99,999 feet
        SI (Metric):   0.0 - 30,479.7 meters

⊞ Display Perimeter (West)

Enter the West orientation length, in feet, of an exterior wall in a Group B, Group F, Division 1, or Group M occupancy that immediately abuts a public sidewalk measured at the sidewalk level for each story that abuts a public sidewalk.

The Display Perimeter is used for a special calculation of window area in the standard design building as explained in Sections 3.2.2 of the state's *Nonresidential Manual*. Refer also to the definition of Exterior Wall in the Glossary of the *Nonresidential Manual*. The maximum fenestration in a west-facing wall is 40% of the west-facing wall area. If you specify Display Perimeter, the maximum fenestration area in the standard

design is equal to the greater of either the product of the length of the display perimeter times 6 ft in height or 40% of gross wall area.

Range & Units:
>> **Imperial (US):** 0.0 - 99,999 feet
>> **SI (Metric):** 0.0 - 30,479.7 meters

Lighting Tab

Choose one from each of the two groups of choices on this tab: Standard Lighting, to determine the lighting level used in the Standard (Budget) calculation; and Proposed Lighting, to determine the lighting level in the Proposed (Actual) calculation. The default settings use the Standard lighting level based upon the selected occupancy type in the General Tab, and the Proposed lighting calculated from the Lighting Element entries in the Building Tree.

Standard Lighting

Use Tailored Lighting

If lighting is to be modeled using the Tailored method, check this item. The program calculates the amount of allowed lighting using the Tailored Method, and sets the Standard (Budget) Lighting Energy to the Allowed Tailored LPD, shown to the right.

Proposed Lighting

Use Standard LPD (No Plans)

When no lighting plans or specifications are submitted for permit, check this item.

Use Installed LPD

When the Proposed (Actual) Energy calculation will be based on the light fixtures as input in the Building Tree, check this item. The installed LPD (including control credits) is shown to the right.

User Input LPD

If you are modeling a building for which installed lighting levels have already been determined (e.g., installed lighting levels have been calculated by another lighting consultant), check this box and enter the actual LPD in the User Input LPD box. You may also use this input to quickly test the effects various lighting levels have on the building's overall energy performance.

Range & Units:

Imperial (US): 0.0 - 99.000 W/ft²

SI (Metric): 0.00 - 1,065.24 W/m²

Lighting Type

Select the lighting type and fixture location from the drop-down list. The choices are:

- Incandescent
- Recessed
- Suspended/Rec. Return Vent

- Rec Return / Supply Vent

Lighting Heat to Zone

If a portion of the lighting heat is designed to go to the return air rather than the zone, enter the fraction of heat from the lighting which goes to the zone, as a percent. You may only use this field when Recessed Fluorescent, Return Vent or Recessed Fluorescent, Return/Supply Vent fixture types are specified.

Range & Units: 0 - 100%

Mechanical Tab

Zone Level Mechanical System Data

Zonal System

Click in this multi-edit box to select a zonal system from the Zonal Library.

Zonal Multiplier

Enter the number of identical zonal systems, including VAV boxes or Fans, in the Zone.

Range & Units: 1 - 99 (units N/A)

VRF Pipe Length

For VRF systems, enter the equivalent pipe length between the farthest terminal unit and the condensing unit, including liquid refrigerant line length, fitting losses and other losses. Enter the number of identical zonal systems, including VAV boxes or Fans, in the Zone.

Range & Units: 0 - 999 feet

Demand Control Ventilation

Check this box if the zone has demand control ventilation (DCV). DCV systems vary the amount of ventilation air depending on the amount of carbon dioxide detected in the space. The standards require DCV systems to use CO_2 sensors, and do not allow VOC or other indoor air quality sensors to meet the requirement. The following text is an excerpt from Section 4.3.9 of the Nonresidential Manual. Refer to that section for additional details on DCV system requirements.

A. The Energy Standards require the use of DCV systems for spaces that have a design occupancy of 40 sq. ft./person or smaller (for areas without fixed seating where the design density for egress purposes is 40 sq. ft./person or smaller), and have at least one of the following:

1. An air economizer

2. Modulating outside air control

3. Design outdoor airflow rate greater than 3,000 cfm.

B. Exceptions to this requirement:

1. The space exhaust is greater than the required ventilation rate minus 0.2 cfm/ft^2. This relates to the fact that spaces with high exhaust requirements won't be able to provide sufficient turndown to justify the cost of the DCV controls. An example of this is a restaurant seating area where the seating area air is used as make-up air for the kitchen hood exhaust.

2. DCV devices are not allowed in spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation, such as indoor operation of

internal combustion engines, areas designated for unvented food service preparation, daycare, sickroom, science lab, barber shop, or beauty and nail salons.

This exception recognizes that some spaces may need additional ventilation due to contaminants that are not occupant borne. It addresses spaces like theater stages where theatrical fog may be used or movie theater lobbies where unvented popcorn machines may be emitting odors and vapors into the space in either case justifying the need for higher ventilation rates. DCV devices <u>shall not</u> be installed in spaces included in this exception.

3. Spaces with an area of less than 150 sq. ft., or a design occupancy of less than 10 people, per §120.1(c)3 (Table 4-12 above).

This recognizes the fact that DCV devices may not be cost effective in small spaces such as a 15 ft. by 10 ft. conference room or spaces with only a few occupants at design conditions.

Pressurization

Check this box if the zone has demand control ventilation (DCV). DCV systems vary the amount of ventilation air depending on the amount of carbon dioxide detected in the space. The standards require DCV systems to use CO_2 sensors, and do not allow VOC or other indoor air quality sensors to meet the requirement. The following text is an excerpt from Section 4.3.9 of the Nonresidential Manual. Refer to that section for additional details on DCV system requirements.

Operable Window Interlock

Check this box if the zone will include window interlocks. Interlocks are required in each nonresidential zone (excluding high-rise residential and healthcare facilities) that is directly conditioned, has operable windows, and a thermostat. The interlocks are required for both mechanical and natural ventilation systems.

Add Cooling

Check the box if a zonal cooling system should be added to meet or supplement meeting the cooling loads of the thermal zone. This box should be checked if the zone was not specifically designed to have cooling, or may have insufficient cooling to meet loads. If checked, an air-source, zonal system will be added to the proposed model, and the zone will be cooled to the prescribed cooling setpoint schedule.

Supply AC (Air Changes) per Hour

Ordinarily this value is set to zero and the program will automatically calculate it from other inputs (e.g., central system supply airflow). If you enter a non-zero value based on the airflow volume (cfm or L/s) per zone, the program uses this air change rate to set the quantity of supply air in the zone.

<u>Range & Units</u>: 0.00 - 20.00 AC/Hr

Occ Sensor Vent

Check the box if the ventilation system in the zone is controlled by occupant sensors. Refer to Section 4.3.10 in the Nonresidential Compliance Manual and Section 130.1(c) in the Standards for additional details.

Heating Supply Air Flowrate

Enter the Heating Supply Air Flowrate in the zone for nonresidential VAV systems.

Cooling Supply Air Flowrate

Enter the Cooling Supply Air Flowrate for nonresidential VAV systems.

Ventilation Type

Indicate the ventilation source. Choices include HVAC, None, Natural (operable openings), and Zone Exhaust.

Ventilation (from Room and Ventilation Fan Inputs)]

[Not a Program Input] Ventilation

EnergyPro automatically calculates the proposed ventilation rate per square foot for the zone based on the Ventilation and Occupant Density values in the Occupant tabs of the Room Element when running the NR T24 Performance compliance and NR Loads calculations. Otherwise, the software automatically calculates the mechanical ventilation based upon fixed default values for ventilation rates in both the Standard and Proposed NR T24 Performance computer runs as described in Section 4.4 of the Nonresidential Compliance Manual.

Air Changes per Hour

Enter the number of air changes per hour for the Air Change Basis.

Exhaust

This is not a Program input. The field displays the airflow per square foot of all exhaust fans in the zone. For more details regarding exhaust ventilation, refer to Section 4.1.1 in the Nonresidential Compliance Manual.

Zone Exhaust

Type

Select the type of exhaust fan. Options include: General, Laboratory, Commercial Kitchen, or Parking Garage Exhaust.

Quantity

Enter the number of identical ventilation fans in the Zone.

CO Sensors

Check the box if the ventilation fan is controlled by CO sensors. This input is only used for Parking Garage ventilation systems.

Flow Control

Select the type of ventilation fan airflow control. Options include: Constant Flow Constant Speed Fan, Variable Flow Constant Speed Fan, and Variable Flow Variable Speed Fan.

Fan Control

Select the type of ventilation fan control. Options include: Constant Volume, Variable Speed Drive, Discharge Dampers, Inlet Vanes, and Two Speed.

Fan Type

Select the ventilation fan type. Options include: Centrifugal Air Foil, Centrifugal Backward Inclined, Centrifugal Forward Curved, and Axial.

Configuration

Specify the ventilation fan configuration. Options include: Blow-Through, Draw-Through, or Outside Airflow.

Design Airflow

Enter the airflow rate for the ventilation fan.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

Minimum Airflow

For variable speed fans, enter the minimum airflow rate at which the fan operates.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

(Exhaust Fan Motor) Design Power

Enter the power output of the fan <u>at design conditions</u>.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

(Fan Motor) Drive Efficiency

Enter a value between zero and one hundred (%) to indicate the fan motor drive efficiency reflecting the losses associated with non-direct drive motors. A typical value for a belt-driven fan is 97%.

<u>Range & Units</u>: 0.0 - 100.0% (units N/A)

Input as Watts

Select the checkbox to enter the exhaust fan motor data in Watts as an alternative to the design power (bhp).

Watts

Enter the fan motor power, in watts.

<u>Range & Units</u>: 1 – 9,999,999 watts

Hoods

Enter the specifications for laboratory and kitchen exhaust hoods here. You must select either "Laboratory Exhaust" or "Commercial Kitchen Exhaust" as the Zone Exhaust Type to enable these data fields.

▦ Length

Enter the length of the hood, in feet.

▦ Hood Type

Commercial Kitchen Exhaust Hoods: Select the hood type from the drop-down list. Options include:

- Wall Mounted Canopy
- Single Island
- Double Island
- Eyebrow
- Backshelf or Passover.

▦ Duty

Commercial Kitchen Exhaust Hoods: Select the level of demand on the hood (duty) from the drop-down list. Options include:

- Light Duty
- Medium Duty
- Heavy Duty
- Extra Heavy Duty

▦ Fraction Controlled

Laboratory Exhaust Hoods: Enter the fraction of the hood that is controlled.

▦ Airflow

Laboratory Exhaust Hoods: Enter the airflow through the hood, in cfm.

▦ Anemometer Controls

Laboratory Exhaust Hoods: Check the box if the hood has anemometer controls.

▦ Contaminant Controls

Laboratory Exhaust Hoods: Check the box if the hood has contaminant controls.

Toilets/Showerheads

▦ Quantity

Specify the number of toilets and/or showerheads in the zone.

▦ Fans Run Continuously

Check the box if the restroom fans run continuously.

Schedules Tab

Load Profiles

▦ Lighting

Click in this multi-edit box to select a lighting schedule from the Schedule Library.

▦ Process Lighting

Click in this multi-edit box to select a process lighting schedule from the Schedule Library.

▦ Infiltration

Click in this multi-edit box to select an infiltration schedule from the Schedule Library.

▦ Occupant

Click in this multi-edit box to select a schedule from the Schedule Library that defines the time and duration of occupancy for the room.

▦ Receptacle

Click in this multi-edit box to select a receptacle schedule from the Schedule Library. The receptacle schedule specifies the percentage of total equipment power that is on at any given hour of the day.

▦ Process

Click in this multi-edit box to select a process schedule from the Schedule Library. The process schedule specifies the percentage of total process load at any given hour of the day.

▦ DHW

Click in this multi-edit box to select a domestic hot water schedule from the Schedule Library.

HVAC Operation

▦ Fan

Click in this multi-edit box to choose a schedule for the fans from the Schedule Library.

▦ Heating

Click in this multi-edit box to select a heating system schedule from the Schedule Library.

▦ Cooling

Click in this multi-edit box to select a cooling system schedule from the Schedule Library.

Dwelling Units Tab

Use the Zone Element, Dwelling Units Tab to enter data about the dwelling unit size, the presence and fuel source of major appliances, the ventilation system for indoor air quality (IAQ) and the presence of a shower drain water heat recovery system within the residence.

Note that the mechanical ventilation requirements use the floor area, number of bedrooms per unit, and the number of identical units to calculate the minimum IAQ airflow requirements using Equation 4-1 from the Residential Manual. Ensure the Total Floor Area entered in this tab is equal to the Zone Floor Area, as shown at the bottom of the tab. If a multi-family project has individual IAQ ventilation systems for each dwelling unit, you must identify a new dwelling unit for each unit with a different number of bedrooms and/or conditioned floor area.

For high-rise residential projects, enter the number of units in this tab, but you need not enter the other information.

Refer to the discussion on entering single family , multifamily, or accessory dwelling unit data for additional information.

Unit Information

Unit Name

Enter a descriptive name to identify each dwelling unit.

Floor Area per Unit

Enter the floor area for each identical dwelling unit associated with each Unit Name. The total floor area here must match the total floor area entered in the Room Element(s).

Refer to the Dwelling Units topic for additional information.

Number of Units

Enter the number of identical residential dwelling units associated with each Unit Name. Note that this multiplier only impacts the individual unit indicated by the Unit ID. If you are modeling an addition alone, enter only the data for the Addition here. You must specify the project as an Addition project in the Building Element, at which time you may enter the existing floor area and number of bedrooms. EnergyPro automatically calculates the ratio of the addition area relative to the area of the entire house (existing plus addition).

Refer to the Dwelling Units topic for additional information.

Range & Units: 0.0 - 999.0

Bedrooms per Unit

Enter the number of bedrooms in each dwelling unit. The value is reported on the CF1R form. The number of bedrooms in a building is used to establish mechanical ventilation (IAQ) requirements.

Refer to the Dwelling Units topic for additional information.

Total Floor Area and Zone Floor Area

[Not a Program Input.] EnergyPro automatically calculates the total floor areas in the dwelling unit and in the zone. The total floor area here must match the total floor area entered in the Room Element(s).

IAQ Fans

THIS SECTION TO BE UPDATED

New single family residential buildings, multifamily dwelling units and additions greater than 1,000 square feet must have mechanical ventilation that complies with ASHRAE Standard 62.2 (with amendments) to provide acceptable indoor air quality. In addition, the systems must be field-verified.
The simplest IAQ fan system is an exhaust fan like a bathroom fan that meets the criteria in ASHRAE Standard 62.2 for air delivery and low noise. You may also use more advanced IAQ fan systems that have both supply and exhaust fans.

You must select the option to input non-default data regarding the IAQ fan in the Miscellaneous Tab of the Building Element to enter IAQ fan data here. If you don't select that option, EnergyPro will model a default IAQ fan. Default IAQ fans are compliance neutral as the standard design is set equal to the proposed design.

Multifamily Configuration

(Supply Air) Source

Enter a descriptive name to identify each dwelling unit.

(Supply Air) Airflow to Zone

Enter a descriptive name to identify each dwelling unit.

(Supply Air) System Fan Power

Enter a descriptive name to identify each dwelling unit.

(Exhaust Air) Source

Enter a descriptive name to identify each dwelling unit.

(Exhaust Air) Airflow to Zone

Enter a descriptive name to identify each dwelling unit.

(Exhaust Air) System Fan Power

Enter a descriptive name to identify each dwelling unit.

Range/Oven

Check the box if there is a Range/Oven located in the dwelling unit. This entry does not impact the compliance results.

Local IAQ Fan

|tag=Calcs_Res_All Fan Type

You must select the option to input non-default data regarding the IAQ fan in the Miscellaneous Tab of the Building Element to energy IAQ fan data here.

Select the IAQ Fan Type from the drop-down list. Choices include Exhaust, Supply or Balanced. A Balanced system includes both supply and exhaust fans that have airflows within 10 percent of each other.

Enter the total airflow rate for the IAQ fan, in cubic feet per minute.

Range & Units:

       Imperial (US): 0 - 99,999 cfm

       SI (Metric):   0.0 - 99,999.0 L/s

⊞ |tag=Calcs_Res_All Power

Enter the total Watts for the IAQ fans.

<u>Range & Units</u>: 0 - 99,999 W

⊞ |tag=Calcs_Res_All Heat Recovery

Enter the <u>Home Ventilating Institute</u> (HVI) Adjusted Sensible Recovery Efficiency (ASRE) rating for high-rise residential systems and the Sensible Recovery Efficiency (SRE) for low-rise systems.

Range & Units: 0 – 99%.

Appliances (ratings from EnergyStaf listings)

⊞ Range

Check the box if there is a Range located in the dwelling unit.

⊞ (Range) Fuel Type

Select the fuel type for the Range/Oven from the drop-down list. Choices include:

- Fossil
- Electric

⊞ Refrigerator

Check the box if there is a Refrigerator located in the dwelling unit. This entry does not impact the compliance results.

⊞ (Refrigerator) Specify Usage

Enter the estimated annual energy usage for the inside refrigerator. If the EnergyGuide data is available for the refrigerator manufacturer and model, use the EnergyGuide data. If the EnergyGuide data is not available, enter 775 kWh/year. The refrigerator in the HERS reference home uses 669 kWh/year.

If there are additional refrigerators in the dwelling unit, add 1,013 kWh/year for each additional refrigerator. For each standalone freezer, add 929 kWh/year.

In multi-family projects with multiple refrigerators, enter the average kWh of all the refrigerators.

⊞ Dishwasher

Check the box if there is a Dishwasher located in the dwelling unit. This entry does not impact the compliance results.

(Dishwasher) Specify Usage

Enter the Energy Factor (EF) for the dishwasher, if the actual EF is available. If the EF is not available, use 0.46. The HERS Technical Manual assumes each dwelling unit has a dishwasher. The dishwasher in the HERS reference home has an EF equal to 0.46.

NOTE: The energy usage related to the dishwasher is dependent on the number of occupants in the home. You must enter this data in the Occupant Tab of the Room Element.

Washer (in Dwelling)

Check the box if there is a Washer located in the dwelling unit.

Dryer (in Dwelling)

Check the box if there is a Dryer located in the dwelling unit.

(Dryer) Fuel Type

Select either Fossil or Electric from the drop-down list to indicate the dryer fuel source.

Shower Drain Water Heat Recovery

Enter the specifications of the shower drain water heat recovery system if one exists.

Heat Recovery Device

Select the type of drain water heat recovery devices used (or none if none exist). Choices include: No Heat Recovery Devices, Feeds to Shower and DHW, Feeds to DHW Return, and Feeds to Shower Cold Water.

Total Showers Served by DHW

Enter the total number of showers served by the hot water system.
Range & Units: 0 – 999

Showers with Drain Water Heat Recovery

Enter the number of showers with drain water heat recovery systems.
Range & Units: 0 – 999

CSA Rated Efficiency

Enter the CSA rated efficiency of the drain water heat recovery system.
Range & Units: 1 – 99%

Compact DHW Distribution

Distance to Kitchen

Enter the plan view, straight line distance from the water heater to the furthest fixture served by that water heater in the kitchen.

Range & Units:
      Imperial (US): 0 - 9,999 feet
      SI (Metric):   0 – 3,048 meters

▦ Distance to Master Bathroom

Enter the plan view, straight line distance from the water heater to the furthest fixture served by that water heater in the master bathroom.

Range & Units:

Imperial (US): 0 - 9,999 feet
SI (Metric): 0 – 3,048 meters

▦ Distance to Other

Enter the plan view, straight line distance from the water heater to the furthest fixture served by that water heater in the furthest room in the dwelling unit.

Range & Units:

Imperial (US): 0 - 9,999 feet

SI (Metric): 0 – 3,048 meters.

🏠 Room Element

General Tab

Use the Room element of the Building Tree to enter information that describes a particular room or group of rooms in the building. In some cases the entire building may be considered a Room. Double click on the Building Tree's Room element to bring up a tabbed dialog box. Use this dialog box to enter information on general room characteristics, infiltration rates, occupants, equipment and process loads, domestic hot water, and lighting.

▦ Name

Enter a descriptive name for the room or group of rooms. For example, for residential buildings you may use want to use "Whole House" or "First Floor" as your description. For nonresidential buildings you may want to use "Complete Building" or "Corridor/Support Areas", etc.

▦ Area

Enter the total area for the room or rooms. EnergyPro displays the conditioned floor area in the Building Tree, at the Building, Plant, System and Zone levels. Fly over the element to display the total conditioned floor area for that element.

Range & Units:

Imperial (US): 0.0 - 999,999 ft²

SI (Metric): 0.00 - 92,899.9 m²

▦ Winter Indoor Temperature

Enter the indoor temperature of the zone during the heating season. The value specified in the Title 24 Standards is 68ºF (20.0°C). If the occupancy is set to Unconditioned and has a non-zero floor area, the heat transfer from an adjacent zone in the NR Loads calculation is defined by this value. That is, instead of using the outside winter design temperature, the program will use the Desired Winter Temperature in calculating the design loads heat flow across the common wall, floor, or ceiling.

Range & Units:

Imperial (US):   0 - 120°F

SI (Metric):   -17.8 - 48.9°C

🏢 Summer Indoor Temperature

Enter the desired indoor temperature of the zone during the cooling season. The value specified in the Title 24 Standards is 75°F (23.9°C). If the occupancy is set to Unconditioned and has a non-zero floor area, the heat transfer to an adjacent zone in the NR Loads calculation is defined by this value. That is, instead of using the outside summer design temperature, the program will use the Desired Summer Temperature in calculating the design loads heat flow across the common wall, floor, or ceiling.

Range & Units:

Imperial (US):   0 - 120°F

SI (Metric):   -17.8 - 48.9°C

Installed LPD [Not A Program Input]

The program automatically calculates the Lighting Power Density for the room based on the lighting information entered. The Installed LPD shown here does **NOT** include control credits.

Infiltration Tab

🏢 Infiltration Rate

Enter the number of times the total volume of air in the room is replaced every hour. For nonresidential buildings, typical values may range from 0.2 to 0.5 air changes per hour. The value you specify here will be the maximum infiltration level used according to the infiltration schedule in the Non Res Loads calculation.

For residential projects, enter infiltration information in the Miscellaneous Tab of the Building Element.

<u>Range & Units</u>: 0.00 - 99.00 AC/Hr

Occupant Tab

🏢 Occupant Density

Enter the area per occupant in the room. The Occupant Density and Ventilation Rate specified here are used in the Occupancy Basis ventilation calculation in the <u>Mechanical Tab</u> of the Zone Element. To Use the Occupancy Basis for calculating ventilation requirements, you must use a combination of Occupant Density and Ventilation rate inputs consistent with the minimum ventilation requirements set forth in the Standards. Table 4-14: Required Minimum Ventilation Rate per Occupancy in the Nonresidential Compliance Manual contains both CBC occupancy loads and ventilation requirements. You may also view the CBC occupant densities in Table 4-2.

Range & Units:

Imperial (US): 1.0 - 99,999.0 ft²/occ

SI (Metric):   0.1 - 9,289.9 m²/occ

🏢 Occupant Sensible

Enter the sensible heat gain attributable to each occupant in the room.

Range & Units:

Imperial (US): 0.0 - 99,999.0 Btu/hr-occ

SI (Metric): 0.0 - 29,309.7 W/occ

Occupant Latent

Enter the latent heat gain attributable to each occupant in the room.

Range & Units:

Imperial (US): 0.0 - 99,999.0 Btu/hr-occ

SI (Metric): 0.0 - 29,309.7 W/occ

Ventilation

Enter the ventilation air per occupant. To use the Occupancy Basis for ventilation, you must use a combination of Occupant Density and Ventilation rate inputs consistent with the minimum mechanical ventilation requirements set forth in the Standards.

Range & Units:

Imperial (US): 0.0 - 99,999.0 cfm/occ

SI (Metric): 0.0 - 47,189.5 L/s/occ

Occupancy Fraction
Enter the Occupancy Fraction for the Room. You may set the fraction to 0.5 for spaces without fixed seating, or higher for spaces with higher ventilation requirements. Use the Occupancy Fraction input to adjust the design ventilation rate to accommodate transfer air requirements for makeup air for exhaust from other zones. The design ventilation rate may be up to 120 percent of the proposed design exhaust rate for all spaces and thermal zones on a building story without penalty. You must always meet the minimum required ventilation rate for each space.

Range & Units: 0.5 – 5

Fixed Seating at 15 cfm per occupant
Check the box if the Room has Fixed Seating. Enter the number of occupants for which the space is designed. If checked, this you may override the default occupancy with values that comply with the California Building Code. You must always meet the minimum required ventilation rate for each space.

Occupants
Enter the number of occupants for which the space is designed for Rooms with Fixed Seating. You may override the default occupancy with values that comply with the California Building Code. You must always meet the minimum required ventilation rate for each space.

Range & Units: 0 – 999,999

Receptacle / Process Tab

(Receptacle) Sensible Heat

Enter the sensible heat gain attributable to the receptacles in the room. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer. This value is only used for load calculations. Receptacle load for residential and nonresidential compliance

calculations (Single Family Title 24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Receptacle) Latent Heat

Enter the latent heat gain attributable to the receptacles in the room. Latent heat is the energy contained in the moisture (water) in the air. This affects the energy needed to cool the moisture in the air and/or dehumidify the air. This value is only used for load calculations. Receptacle load for residential and nonresidential compliance calculations (Single Family Title 24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Process Equipment) Sensible Heat

Enter the sensible heat generated by all process equipment in the room in addition to the allotted receptacle load. Process load must be documented on the building plans and detailed in the specifications. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer. This value is modeled in both the Standard and Proposed designs in the NR T24 Performance calculation.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

(Process Equipment) Latent Heat

Enter the latent heat generated by all process equipment in the room. Latent Heat is the energy contained in the moisture (water) in the air. This affects the energy use needed to cool the moisture in the air and/or dehumidify the air. This value is modeled in both the Standard and Proposed designs in the NR T24 Performance calculation. It must be documented to the satisfaction of the local enforcement agency.

Range & Units:

Imperial (US): 0.000 - 999.000 W/ft²

SI (Metric): 0.0 - 10,749.24 W/m²

Elevators

Enter the number of elevators in the zone. If you have activated the EnergyPro NR T24 Process module, you may enter the required information into the Forms Tab of the Building Element to complete Form NRCC-PRC-E Process Systems.

Escalators

Enter the number of escalators in the Room. If you have activated the EnergyPro NR T24 Process module, you may also enter the required information into the Forms Tab of the Building Element to complete Form PRC-13-E Process Systems. Specify if the escalator is in an airport, hotel or transportation facility. You may edit the form in pdf format if necessary.

(Process Lighting) Process LPD

Enter the Lighting Power Density (in watts per square foot) of the lighting fixtures dedicated to illuminating the process. You may use this entry to model the portable lighting load for load calculations.

Domestic Hot Water Tab

Use the entries on this tab to specify the loads associated with Domestic Hot Water.

DHW Consumption

GPH per Occupant

Enter the peak load attributable to domestic hot water, in gallons per hour per occupant, for nonresidential and high-rise residential projects. This value is multiplied by design occupancy density values and modified by service water heating schedules to obtain hourly load values which are used in the simulation

Range & Units:

Imperial (US): 0 - 999,999 GPH/occ

SI (Metric): 0 - 293,099 GPH/occ

Lighting Tab

Task Data

Task Height

Enter the height above the floor at which the task will be performed.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Mounting Height

Enter the height above the floor at which the fixtures will be mounted.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Daylighting

Sidelit Area

Enter the area of the portion of the room lit by sidelighting. If your project also has skylights, be careful not to double-count the daylit area. Refer to Nonresidential Compliance Modeling Topics for more details.

Range & Units:

Imperial (US): 0.0 – 9,999,999 ft²

SI (Metric): 0.00 - 929,030 m²

⊞ Skylit Area

Enter the area of the portion of the room lit by skylights. If your project is also sidelit, be careful not to double-count the daylit area. Refer to Nonresidential Compliance Modeling Topics for more details.

Range & Units:

Imperial (US): 0.0 – 9,999,999 ft²

SI (Metric): 0.00 - 929,030 m²

Room Dimensions

⊞ Room Dimensions

Enter the dimensions of the task area to calculate the Room Cavity Ratio (RCR). Enter the Length and Width **or** the Perimeter. If you enter a value in the Perimeter field, it will override the Length and Width entries.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric): 0.0 - 304.5 m

Exterior Wall Element

When inputting a proposed building for compliance, every exterior surface or partition of the proposed building must be modeled.

⊞ Name

Enter a descriptive name of the Wall, e.g., North Wall, Front Wall, etc.

⊞ Area

Enter the total gross wall area facing exterior conditions. This includes all glazing areas and door areas. EnergyPro will subtract the area of all openings to obtain the net wall area.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

NOTE: The range for exterior wall area is dynamic. The wall area can never be less than the total window and door area in that wall.

⊞ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Assembly (Existing and/or New)

Click in the appropriate multi-edit box to select a wall construction assembly from the Assembly Library. The wall construction determines the materials, U-factor, R-Value, absorptivity, roughness, weight and heat capacity of the wall.

Note: The prescriptive minimum U-factors shown in Table 150.1-A are used to set the Standard Design energy budget in the residential Title 24 performance calculations. The values shown onscreen reflect the U-Factors published in the tables taken from Joint Appendix 4. When doing performance modeling, the CEC's Compliance Manager calculates U-Factors independent of that table, so reported results on the CF1R may differ slightly from those shown onscreen and in the appendices.

Orientation

Enter the orientation of the wall; the value you enter will include all the exterior glazing and doors located on that wall. You may enter the actual orientation in degrees or select an orientation from the drop-down list.

Range & Units: 0 - 360°

See also: Working with the Rotation Input.

Tilt

Specify the angle of the wall relative to the horizontal. A typical vertical wall has a 90º tilt. However, The software will accept values between 60º and 135º. A surface with a tilt of less than 60º is considered a Roof.

Wall Exception

Check the box if the new wall is either an existing wall or an extension of an existing wall that meets the requirements specified in Section 150.2(a)1A or 150.2(a)1B. This checkbox is used only for single family projects complying as Addition-alone or E+A+A.

Surface Geometry for Shading Devices

Wall Width

Enter the width of the wall that contains the glass and exterior shading combination. If you specify exterior shading (overhangs or sidefins) for NR T24 Performance calculations, you must specify the wall width and height, as well as the window width, height, and the position of the window on the wall.

Note that this input field is only enabled AFTER you enter an overhang or sidefin in the Window Element.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

Wall Height

Enter the height of the wall that contains the glass and exterior shading combination. If you specify exterior shading (overhangs or sidefins) for NR T24 Performance calculations, you must specify the wall width and height, as well as the window width, height, and the position on the wall.

This input field is only enabled AFTER you enter an overhang or sidefin in the Window Element.

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

[Not a Program Input] Code Comparison

EnergyPro displays the 2022 Title 24 and 2019 ASHRAE 90.1 baseline requirements for all construction assemblies. These values are used in the Standard Design simulation to set the energy budget. In addition, the program also displays the proposed value for easy comparison.

Window Element

Use the Window element of the Building Tree to enter the building's glazing, overhand and sidefin information. If there are different glazing types at the same orientation, you may want to name the windows for a distinguishing feature, e.g., East Window, Wood and East Window, Metal, or French Door.

Name

Enter a descriptive name for the Window, if desired. If there are different types of glazing at the same orientation, you might want to name the windows for a distinguishing feature, e.g., East Window, Wood and East Windows, Metal, or French Door.

Area

Enter the total area (frame/rough opening) of glazing.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

NOTE: The range for window area is dynamic. The total window and door area in one wall can never be greater than the total exterior wall area.

▦ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

▦ (Existing and/or New) Fenestration

Click in the appropriate multi-edit box to select a window assembly from the Fenestration Library.

▦ Overhang

Click in this field to select an Overhang assembly from the Overhang Library.

▦ Sidefin

Click in this field to select a Sidefin assembly from the Sidefin Library.

Surface Geometry for Shading Devices

▦ Window Width

Enter the combined width of all windows with the specified glass and shading combination. For NR T24 Performance calculations, you must specify window width, height, and the position of the window on the wall for glazing which has overhangs or sidefins. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

▦ Window Height

Enter the height of all windows with the specified glass and shading combination. The height is measured from the window sill to its head. For NR T24 Performance calculations, you must specify window width, height, and the position of the window on the wall for glazing which has overhangs or sidefins. You must also specify the width and height of the wall (in the Wall Element of the Building Tree). You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

▦ X Position on Wall

When modeling exterior shading for NR Title 24 compliance, you must enter the horizontal and vertical position of the window on the wall. The horizontal (x) position is the distance, measured looking at the wall from the outside, from the lower left corner of the wall to the left edge of the window. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

▦ Y Position on Wall

When modeling exterior shading for NR Title 24 compliance, you must enter the horizontal and vertical position of the window on the wall. The vertical (y) position is the distance, measured looking at the wall from the outside, from the bottom of the wall to the bottom of the window. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

[Not a Program Input] Code Comparison

EnergyPro displays the 2022 Title 24 and 2019 ASHRAE 90.1 baseline requirements for all construction assemblies. These values are used in the Standard Design simulation to set the energy budget. In addition, the program also displays the proposed value for easy comparison.

▦ Door Element

▦ Name

Enter a descriptive name of the Door. The name is for your information only and does not appear on any program report.

▦ Area

Enter the total area of doors of the specified door type located in the wall.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

NOTE: The range for door area is dynamic. The total door and window area in one wall can never be greater than the total exterior wall area.

▦ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

(Existing and/or New) Door Assembly

Click in this multi-edit box to select a door assembly from the Assembly Library. The door assembly determines the materials and thermal characteristics of the door(s) in the wall.

NOTE: Doors of more than 25% glass are input as glazing. For a partial glass door ($\leq$ 25%), input only the wood or metal area; input the glazed area, plus a 2 inch border all around, in the Window Element; select "Door" for the Window Type.

Surface Geometry for Shading Devices

Door Width

Enter the combined width of all doors with the specified shading combination. For NR T24 Performance calculations, you must specify door width, height, and the position of the door on the wall when overhangs or sidefins are specified. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

Door Height

Enter the height of all doors with the specified shading combination. For NR T24 Performance calculations, you must specify door width, height, and the position of the door on the wall for when overhangs or sidefins are specified. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

Range & Units:

Imperial (US): 0.0 - 999.0 ft

SI (Metric):   0.0 – 304.5 m

X Position on Wall

When modeling exterior shading for NR Title 24 compliance, you must enter the horizontal and vertical position of the door on the wall. The horizontal (x) position is the distance, measured looking at the wall from the outside, from the lower left corner of the wall to the left edge of the door. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

Y Position on Wall

When modeling exterior shading for NR Title 24 compliance, you must enter the horizontal and vertical position of the door on the wall. The vertical (y) position is the distance, measured looking at the wall from the outside, from the bottom of the wall to the bottom of the door. You must also specify the width and height of the wall (in the Wall Element of the Building Tree).

[Not a Program Input] Code Comparison

EnergyPro displays the 2022 Title 24 and 2019 ASHRAE 90.1 baseline requirements for all construction assemblies. These values are used in the Standard Design simulation to set the energy budget. In addition, the program also displays the proposed value for easy comparison.

Interior Surface Element

Use the Interior Surface element to model ceilings, walls and floors which serve as demising partitions and other interior partitions. In some cases, modeling interior walls is optional, but it is recommended so that mechanical systems do not appear to the program to be oversized.

Under the nonresidential Standards, demising partitions may **not** be modeled as exterior partitions. Use the Interior Surface element to model demising partitions between conditioned and unconditioned (or indirectly conditioned) spaces. Also use the element to model interior partitions which are solid barriers that separate two adjacent conditioned zones.

In the residential Standards, if the demising wall separates the house from an attached unconditioned garage, it is modeled as an interior surface, adjacent to the unconditioned zone. You must create an unconditioned zone in the model, including the exterior walls (you may ignore the windows), floor, and ceiling/roof of the unconditioned zone or garage. The actual assemblies in the unconditioned zone do not affect compliance, but it does result in a more accurate simulation of the building performance. Note that for residential garages, you must create the Interior Surface in the conditioned zone with the garage adjacent. Do not create the interior surface in the garage; as it creates an error in the Residential calculation engine.

EnergyPro automatically creates an unconditioned attic zone, so there is no need to create a zone for the attic in your model. Walls adjacent to an attic are also modeled as interior walls, with the "Next to Residential Attic" box checked, but again, the attic itself is not created as a separate zone.

See Section 3.4 in the Residential Manual for additional details.

Name

Enter a descriptive name of the Interior Surface.

Area

Enter the total area of the Interior Surface.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

Status
Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

Existing / New Assembly

Click in this multi-edit box to select a construction assembly for the surface from the Assembly Library.

For zonal control credit using Single Family Title 24 Performance, you must model interior walls separating living and sleeping zones as Uninsulated Wood Frame Walls, and Nonclosable Openings between zones—no more than 40 ft² (3.7m²). See also Special Topics, Zonal Control or refer to Section 4.5.2 of the *Residential Manual* and Section 5.9 of the *Residential ACM.*

Floor Elevation

Enter the elevation of the floor in the room where the Interior Surface is located, if different from the floor elevation in the Zone Element. EnergyPro will use the data from the Building Story in the Zone Element if you leave the field set to zero here.

Range & Units: 0 – 999 ft.

Next to a Different Dwelling Unit

Check the box if the Interior Surface is adjacent to a different dwelling unit (e.g., a party wall in a multi-family building).

Next to Residential Attic

Check the box if the Interior Surface is adjacent to a residential attic. Your model may include multiple attics, for example, the attic in an addition may not be adjacent to the existing attic, it may have different insulation, or may have a radiant barrier that is not present in the existing attic space. When you check this entry, click on the "Adjacent To" button to select the attic for the Room element that is "Adjacent to" the Interior Surface. EnergyPro will place the Interior Surface next to the attic in the selected Room.

EnergyPro automatically creates the unconditioned attic for the simulation. You do not need to create the attic zone in your model.

Adjacent To

Click the Select button to display the list of rooms from which you may select the Room Element adjacent to the Interior Surface.

Raised Floor Element

Name

Enter a descriptive name of the floor.

Area

Enter the total area of the floor.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

(Existing and/or New) Floor

Click in this multi-edit box to select a construction for the floor from the Assembly Library. The floor assembly determines the materials, U-Factor, R-value, absorptivity, roughness, weight and heat capacity of the floor.

Slab Element

Name

Enter a descriptive name of the Slab-On-Grade. The name is for your information only and does not appear on any program report.

Area

Enter the total area of the Slab-On-Grade. The slab-on-grade area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

(Existing and/or New) Slab

Click in this multi-edit box to select a construction assembly for the Slab-On-Grade from the Assembly Library. For the nonresidential performance calculation, you must use a floor assembly that has 12" (305 mm) of soil (earth) on the outside. The slab-on-grade construction is modeled identically in both the proposed and standard buildings.

Exterior Perimeter

Enter the exterior perimeter of the conditioned Slab-On-Grade.

Range & Units:

Imperial (US): 0.0 - 99,999.0 feet

SI (Metric):   0.0 - 30,479.7 meters

Surface Condition

Select the appropriate condition for the slab. The choices include: Default, 20% Exposed, Covered, and Exposed. If the condition is anything other than "Default, 20% Exposed", the carpet and exposed slab conditions must be documented on the construction plans.

Underground Wall Element

See Special Topics: Underground Walls and Floors (Residential) and

Underground Walls and Floors (Nonresidential).

Name

Enter a descriptive name of the Underground Wall.

▦ Area

Enter the total area of the Underground Wall. The underground wall area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

▦ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

▦ (Existing and/or New) Underground Wall

Click in this field to select a construction assembly for the Underground Wall from the Assembly Library. Nonresidential T24 Performance calculations require the Underground Wall assembly to include 12" 305 mm) of soil (earth) on the outside. You must select the assembly from Reference Appendix JA4. The underground wall construction is modeled identically in both the proposed and standard buildings.

▦ Depth Below Grade

Enter the depth below grade the Underground Wall extends. This value is used to take into account the insulating effects of the earth.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric):   0.0 - 2,515 mm

🗀 Underground Floor Element

See Special Topics: Underground Walls and Floors (Residential) and

Underground Walls and Floors (Nonresidential).

▦ Name

Enter a descriptive name of the Underground Floor. The name is for your information only and does not appear on any program report.

▦ Area

Enter the total area of the Underground Floor. The underground floor area is modeled identically in both the proposed and standard buildings.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

▦ Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

▦ (Existing and/or New) Underground Floor

Click in this field to select a construction assembly for the Underground Floor from the Assembly Library. Nonresidential T24 Performance calculations require the Underground Wall assembly to include 12" (305 mm) of soil (earth) on the outside. The underground wall construction is modeled identically in both the proposed and standard buildings.

▦ Depth Below Grade

Enter the depth below grade for the Underground Floor. This value is used to take into account the insulating effects of the earth.

Range & Units:

Imperial (US): 0.000 - 99.000 inches

SI (Metric): 0.0 - 2,515 mm

▦ Surface Condition

Select the appropriate condition for the underground slab. The choices include: Default, 20% Exposed, Covered, and Exposed. If the condition is anything other than "Default, 20% Exposed", the carpet and exposed slab conditions must be documented on the construction plans.

Roof Element

Name

Enter a descriptive name of the Roof. The roof name is for your information only and does not appear on any program report.

Area

Enter the total gross roof area facing conditioned space.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

Status
Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

(Existing and/or New) Roof

Click in this multi-edit box to select a construction assembly for the roof from the Assembly Library. The roof assembly determines the materials, U-Factor, R-value, absorptivity, roughness, weight and heat capacity of the roof.

Orientation

Specify the orientation of the roof as well as all the skylights within it. You may enter the actual orientation in degrees or select the orientation from the drop-down list.

Range & Units: 0 - 360°

🖩 Slope

Enter the numerator of the fraction representing the roof slope. The numerator denotes the amount the roof rises vertically for every 12 units of horizontal run.

Range & Units: 0 – 20 ft

Replacing > 50% of the Roof Surface (or >2,000 sqft NonRes or 1,000 sqft Res)

Select this option when either more than 50% of the total roof surface area is being replaced (or for Nonresidential projects more than 2,000 sqft and Residential projects more than 1,000sqft), whichever is less.

[Not a Program Input] Code Comparison

EnergyPro displays the 2022 Title 24 and 2019 ASHRAE 90.1 baseline requirements for all construction assemblies. These values are used in the Standard Design simulation to set the energy budget. In addition, the program also displays the proposed value for easy comparison.

🖌 Skylight Element

Use the Skylight Element of the Building Tree to enter the building's skylight information.

General Tab

🖩 Name

Enter a descriptive name for the Skylight, if desired. If there are different types of skylights, you might want to name them for a distinguishing feature, e.g., Translucent Skylight or Transparent Skylight.

🖩 Area

Enter the total area (frame/rough opening) of skylight.

Range & Units:

Imperial (US):   0.0 - 99,999.0 ft²

SI (Metric):   0.0 - 9,289.9 m²

NOTE: The range for skylight area is dynamic. The total skylight area in one roof can never be greater than the total roof area.

🖩 Status

Select Existing, New, or Altered from the drop-down list to indicate the equipment or surface status.

- Existing

Existing equipment or surface that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- New

New equipment or surface for new construction or being added as part of an addition.

- Altered

Select Altered if the equipment or surface is being altered from existing conditions but is not part of an addition. By checking the Altered option the user will need to describe the Existing equipment or surface to

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illustrate the status prior to any changes or replacement as well as the New equipment or surface to describe the equipment or surface after the alteration.

For Single Family Title 24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater prior to the alteration. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Miscellaneous Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the "existing" field.

(Existing and/or New) Fenestration

Click in the appropriate multi-edit box to select a window assembly from the Fenestration Library.

[Not a Program Input] Code Comparison

EnergyPro displays the 2022 Title 24 and 2019 ASHRAE 90.1 baseline requirements for all construction assemblies. These values are used in the Standard Design simulation to set the energy budget. In addition, the program also displays the proposed value for easy comparison.

Lighting Element

Name

Enter a descriptive name of the fixture(s).

Status

Select the status of the luminaire from the drop-down list. Options include Existing, New, and Altered.

Luminaire

Click in this multi-edit box to select a lamp/fixture combination from the Lighting Library. The name and wattage of the selected light fixture will appear on the Certificate of Compliance, Form LTG-1 (Part 2 of 2). The program calculates the installed LPD based on the Fixture Types, the number of fixtures and the floor area of the room.

It is important that you either select specific light fixtures for all zones under consideration or that you do not specify any light fixtures, but instead select the Override with Modeled LPD input from the Zone Element, Lighting Tab.

Multiplier

Enter the number of identical fixtures of the selected type. If the fixture selected is a track light, use this input to specify the number of linear feet in the track light rather than the number of fixtures.

Range & Units: 0 - 99,999 (units N/A)

Reference Code

Enter a code that identifies each light fixture type on the Certificate of Compliance, Lighting Forms. The reference code usually corresponds to the codes specified on the building light fixture schedule from the plans or specifications.

Controls for Credit

Select a Lighting Control option from the drop-down list for varying levels of compliance credit. The lighting credit is applied only to the selected fixtures. For more information on control requirements and options (Lighting Power Adjustment Factors), refer to Table 140.6-A in the Standards and Sections 5.4, 5.6 and 5.9 of the *Nonresidential Manual*. Controls selected must be installed on all fixtures specified in this element. You must provide supporting documentation for lighting control credits.

Additional Allowance

If the luminaires meet the requirements to qualify for additional lighting power allowances, select the appropriate credit from the list. Choices include:

No Additional Allowance

Detailed Task Work

Specialized Task Work

Decorative/Display

Precision Work

White board or chalk board

Videoconferencing Studio

Tuneable White or Dim-to-Warm

Transitional Lighting Off at Night

Refer to Table 140.6-C and Section 5.7.2 of the *Nonresidential Compliance Manual* for additional details.

Whiteboard Length

Check the box if the luminaires are exempt from the code, such as lighting for special effects in theme parks.

Exempt from Code

Check the box if the luminaires are exempt from the code, such as lighting for special effects in theme parks.

(Lighting) Task Element

Name

Enter a descriptive name of the Task.

Type

Use the Type drop down list to either select the "Task" type (Wall Display, Floor Display, Decorative, Very Valuable Merchandise or Tailored Task) lighting category. Refer to the Nonresidential Manual for additional details.

Area

Enter the area of the task for floor displays and very valuable merchandise.

Range & Units:

Imperial (US): 0.0 - 99,999.0 ft²

SI (Metric): 0.0 - 9,289.9 m²

▦ Wall Length

Enter the wall length associated with wall displays.

Range & Units:

Imperial (US): 0.0 - 999,999.0 feet

SI (Metric): 0.0 - 30,479.7 meters

▦ Mounting Height

Enter the height above the floor at which the fixtures will be mounted.

Range & Units:

Imperial (US): 0.0 - 999.0 feet

SI (Metric): 0.0 - 304.5 meters

[Not a Program Input] Proposed Lighting

EnergyPro displays the total watts for the proposed lighting fixtures entered in the Task Lighting Element.

NOTE: Insert light fixtures specifically associated with each task by right-clicking on the Task Element and selecting Add Lighting to create a new (Task) Lighting Element.

Libraries

Common Library Commands

EnergyPro uses a system of libraries as building blocks to create and/or modify a building description. The program structure can be extremely powerful and efficient in developing an input file. Some of the advantages of the library system are:

- You can create and maintain a custom library of equipment and building characteristics that can easily be applied to many different projects.

- When editing an input file, one whole group of values associated with a specific feature, piece of equipment, or design assumption can be instantly substituted for another group. The results of the switch can then be quickly tested.

- The libraries, as a building-block approach, create an input structure that enables you to easily keep track of a complex building description.

EnergyPro includes the following libraries, which feed directly into the Building Tree include:

- Assembly. Construction assemblies of Walls, Roofs/Ceilings, Floors and Doors.

- Fenestration. Contains a list of windows rated by the National Fenestration Rating Council (NFRC).

- Overhang. Contains a list of typical overhang dimensions.

- Sidefin. Contains a list of typical sidefin dimensions.

- Central. Contains Packaged and Split HVAC systems.

- Zonal. Contains VAV and baseboard heating components.

- Chiller. Contains condensing units used for cooling.

- Tower. Contains a list of variable-speed-fan towers.

- Boiler. Shows a list of electric and gas fired heating devices (domestic hot water and heating boilers).

- Schedule. Contains annual schedules that you may build from hourly, daily, and weekly schedules for lights, equipment, occupants, utility rates, and other operations information.

- Luminaire. Contains a list of luminaires and wattages.

Each building description file has its own unique set of libraries which are saved, along with the overall input, to the active job file. A second set of libraries, the Default Libraries, is accessible from every job file. The Default libraries can include assemblies, glazing, equipment or other entries which you want to have available for many different projects.

Predefined Project and Default Libraries come with the program. The entries contained in them may be used when appropriate or modified as needed to create your own when the project demands. You will probably not need to alter certain libraries such as the Schedule Library very often. On the other hand, Central System entries are likely to be created or modified often.

NOTE: Equipment and Glazing manufacturers' product lines change frequently. Thus, some entries in the different libraries may contain information for products which are no longer available. Be sure to check manufacturers' data for current product lines before selecting equipment or glazing types. Glazing information can be checked against the latest NFRC Certified Products Directory for accurate U-Factors (http://search.nfrc.org/).

Here are a few tips to remember when using the libraries:

- Only items in the project libraries are accessible from within the Building Tree or from the left pane of the tri-pane window. You may access the Default libraries from the Tools menu. When you revise the Project Defaults, your changes will only apply to new projects; they will not apply to an open project.

- You may sort all libraries by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort. For example, you may wish to sort all the furnaces in the library by the heating capacity. Click on the Heat Output column heading for a first sort. All items in the list will be sorted and displayed in order of the capacity, beginning with the smallest unit. A second click on the column heading will reverse the sort, displaying the largest unit first.

- If you edit or create new HVAC and DHW systems, be sure to use values that are documented by the manufacturer or appropriate CEC publication.

- You will not find the listing "Undefined" in libraries—this is simply the default setting for many library items until they have been defined. Should you wish to change a selection back to Undefined, e.g., you decided not to model overhangs after you had already input 6-foot (1.8 meter) overhangs, simply click the "X: to the right of the entry box. This will set the entry to undefined but will not change any items in the library.

Common Library Window Commands

Most of the library commands are located at the top of the Right-Top window pane. The commands on the right of the entry tab vary depending on whether which set of libraries you are using (default or project), and for the project libraries, the way you accessed the library.

NOTE: Changes to EnergyPro libraries are saved automatically. If you access the Libraries through the Library Option in the Left Window Pane, any changes you make are automatically saved to the Library item as soon as you click or tab in any other entry field. If you access the Libraries through an element in the Building Tree, changes will be saved to the library when you close the Edit window (whether you click the OK button or use the X in the corner of the window).

Move to First: Use this command to move from anywhere in the library to the first entry.

Move to Previous: Select this command to select the previous entry in the library.

Current Position: Enter the line number to move the selection to a specific line item in the library.

Total Number of Items: EnergyPro displays the total number of items in each library.

Move to Next: Use this command to select the next entry in the library.

Move to End: Use this command to move from anywhere in the library to the final entry.

Add New: Click on the "+" sign to add a new entry to the library. The software will copy the selected entry to provide a starting point from which you may modify the new entry.

Delete: Click the "X" after highlighting the item you want removed from the library. Use caution--there is no Undo feature to recover items you delete; you must re-create them.

Move Item Up: Use the up arrow "" to move the selected entry up on line. You may re-arrange the order of the library entries at any time.

Move Item Down: Use the down arrow "" to move the selected entry down one line.
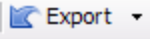
Export: Click *Export* to copy an entry from the current file to another file. You may copy the entry to the default libraries or to any project library provided the destination file is open.

Assembly Library

The Assembly Library is used to define Wall, Roof/Ceiling, Floor, and Door construction types. Specific assemblies are selected from within the Building Tree under the Wall, Roof, Raised Floor, Slab-On-Grade, Interior Surface, Underground-Wall and Underground-Floor room elements.

A predefined library of standard construction types is included with the program per the descriptions in the Title 24 Building Energy Efficiency Standards Joint Appendices. The values in the CEC Joint Appendix 4 (JA4) must be used for all residential and nonresidential prescriptive Title 24 compliance calculations. Certain limited adjustments may be made to the assemblies when using CEC-approved compliance software such as EnergyPro. For example, the user may choose a construction by entering the cavity insulation (insulation penetrated by framing); continuous exterior and interior insulation; and other factors such as framing dimensions and spacing.

In **Libraries**, located on the lower left window pane, select the assembly type you wish to use. Common assembly types are normally defined in the Assembly Library before entering the Building Tree. Then, as you work through the Building Tree, the assemblies you need to include will be readily available. Of course, you can access the Assembly Library from the various Room Surface Elements to define new assemblies or modify existing ones as you go. Simply click on the "New/Existing Assembly" box while in the Room Surface Element (e.g., Wall or Floor) and select the assembly you want to use or edit.

You may also create a set of Project Defaults, default construction assemblies that will be included in each new file. You may customize the Project Defaults by selecting the Project Defaults option in the left window pane. Select assemblies you use most often to automatically populate specific Building Tree elements in each new project file. Changes to Project Defaults will be applied in the next new project file. They will not change the data in an open project.

Explanation of Assembly Library Window

The Assembly Library window displays a List of library items on the left and four tabs containing the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Use the General Tab to select the assembly from the library and indicate some of the primary assembly characteristics. Use the JA4 tab to specify interior and exterior insulation values for Residential and Nonresidential Prescriptive compliance calculations and Residential Performance calculations EXCEPT Residential T24 Performance. For Residential Title 24 performance calculations, use the Res T24 Performance tab to specify insulation and framing details and surface characteristics for exterior walls. Use the "Layers" tab to edit the attributes of the assembly for nonresidential performance (CBECC-Com NR Title 24, NR Performance, and ASHRAE 90.1 Performance) calculations. Any changes made on the Layers tab will only be used in the NR performance calculations. No other calculations will be impacted by changes made in this tab.

Sort **EnergyPro** library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Assembly Inputs

The Assembly Library contains four tabs: General, JA4, Res T24 Performance, and Layers. EnergyPro requires the same general information for most assembly types, but different calculations use the information differently.

Use the General tab to name the assembly, and to specify particular features.

Use the JA4 tab to create the assembly for Residential and Nonresidential Prescriptive calculations, Residential Performance calculations EXCEPT Res T24 Performance, and for Loads calculations. Import (or select an existing) assembly type from the JA4 database, add interior or exterior insulation, and specify framing characteristics, as required.

The Res T24 Performance tab is used only for Residential Title 24 compliance calculations. Specify details regarding interior and exterior insulation levels, and for Roofs, specify characteristics of the attic (radiant barrier, insulation, ventilated/unventilated).

The Layers tab is used to create an assembly for all NR Performance (NR T24 Performance, NR Performance and ASHRAE 90.1) calculations.

General Tab

Component Description

Assembly Name

Enter a user-defined name identifying each assembly. It should clearly describe insulation and construction type associated with Wall, Roof/Ceiling, and Floor assemblies.

[Not a Program Input] Assembly Type

This reference information is automatically generated by EnergyPro after an assembly is selected from Joint Appendix 4 (JA4) of the Reference Appendices.

Roof

Radiant Barrier

Check the box if a radiant barrier will be installed. The radiant barrier is a reflective material that reduces radiant heat transfer caused by solar heat gain in the roof in a vented attic. Under Section 150.1(c)1A - Insulation, Option B (insulation at ceiling and below roof deck) radiant barriers are required prescriptively in climate zones 2, 3, and 5-7. If using Option C (insulation at ceiling only, ducts in conditioned), radiant barriers are required prescriptively in climate zones 2-15.

The radiant barrier is to be installed with the shiny side facing down toward the attic space. The radiant barrier is a reflective material that reduces radiant heat transfer caused by solar heat gain in the roof. For the radiant barrier to work properly it must not have insulation abutting to the shiny side. Refer to Section 3.4.4 of the Single Family Residential Compliance Manual and 11.3.3.2 of the Nonresidential/Multifamily Compliance Manual for additional details regarding radiant barrier installation requirements in single and multifamily buildings.

CRRC-1 Certified Roofing (Checkbox)

Once a roof construction type has been selected, you may check the box labeled "CRRC-1 Certified Roofing" for a roof which meets the requirements for a certified Cool Roof. Checking the box enables the reflectance and emittance fields. The values are ignored if the CRRC 1 Certified Roofing field is unchecked. Compliance credit may be taken when a certified cool roof that exceeds the prescriptive requirements is installed when using the performance approach.

Residential default values for uncertified roofing materials are equal to 0.10 for aged solar reflectance and 0.85 for emittance. For nonresidential projects, default values for uncertified asphalt shingle roofs are equal to 0.08 and 0.10 for all other roof types, and 0.85 for emittance. Refer to Standards Sections 110.8 for mandatory requirements, and 140.3(a)1A and 150.1(c)11 and 170.2(a)1A for additional prescriptive requirements for new nonresidential, single family and multifamily roofs respectively, and to Sections 141.0 and 150.2 and 180.2 for alterations and additions.

Roofing Type
Select the roofing type that best describes the project roof. Choices include:
- Lightweight (<5 lbs/sqft)
- Normal Gravel (5 lbs/sqft)
- Concrete Tile (10lbs/sqft)
- Heavy (15 lbs/sqft)
- Very Heavy (25 lbs/sqft)
- Metal Tile

Aged Solar Reflectance
Enter the CRRC-certified aged solar reflectance for the roofing material.
Range: 0 - 1

Thermal Emittance
Enter the CRRC-certified thermal emittance for the roofing material.
Range: 0 – 1

Door Has Automatic Closer
Check the checkbox if the door has an automatic closer. Standards Section 140.4(n) and 170.2(c) require all directly conditioned nonresidential and multifamily common area spaces with manually operable openings to have interlock controls to disable or reset the temperature in the space if the opening is open for more than five minutes. The controls are not required if the door has an automatic closing device.

JA4 Tab

Specify assembly details to be used in the following calculation modules:

Res and NR T24 Prescriptive and Res Performance (non-compliance).

[Not a Program Input] Description

This reference information is automatically generated by EnergyPro after an assembly is selected from Joint Appendix 4 (JA4) of the Reference Appendices. The U-Factor values shown on-screen are calculated based

upon the U-Factor tables contained in Joint Appendix 4. When doing performance modeling, the CEC's Compliance Manager calculates U-Factors based on the assembly description independent of the tables.

Added Interior Insulation

To model added interior insulation fill in any one or all of the inputs depicting the furring (none, wood, metal) the insulation R-Value and/or the thickness.

Framing
Select the option that best describes the framing material that penetrates the interior insulation. Choices include:
- None (default)
- Wood
- Metal

Insulation
Enter the R-value of the insulation being added to the interior of the assembly.
Range & Units:
> **Imperial (US):** 0.0-99.0 (hr)(ft²)(°F)/Btu
> **SI (Metric):** 0.00 - 17.42 (m²)(°C)/W

Thickness
Enter the thickness of the framing being added to the interior of the assembly.
Range & Units:
> **Imperial (US):** 0.00 - 5.50 inches
> **SI (Metric):** 0 - 140 mm

Added Exterior Insulation

To model added exterior insulation fill in any one or all of the inputs depicting the furring (none, wood, metal) the insulation R-Value and/or the thickness.

Framing
Select the option that best describes the framing material that penetrates the exterior insulation. Choices are:
> None (default)
> Wood
> Metal

Insulation
Enter the R-value of the insulation being added to the exterior of the assembly.
Range & Units:
> **Imperial (US):** 0.0-99.0 (hr)(ft²)(°F)/Btu
>
> **SI (Metric):** 0.00 - 17.42 (m²)(°C)/W

Thickness
Enter the thickness of the framing being added to the exterior of the assembly.
Range & Units:
> **Imperial (US):** 0.00 - 5.50 inches
> **SI (Metric):** 0 - 140 mm

JA4 Properties

[Heat Capacity]

This value shows the total heat capacity (amount of heat required to change a substance's temperature by 1 degree) of each assembly; it is calculated by the program automatically. It is the sum of the heat capacities of all the materials in the assembly, including the effects of framing.

Range & Units: (This is a calculated value. Range is dependent on inputs.)

[U-Factor]

This value shows the total winter U-Factor for the entire assembly. The program calculates this automatically weighting U-Factors through the assembly and through the framing, including air film resistance at both surfaces. (The U-Factor of a building section is the reciprocal of its total R-value.)

The CEC Compliance Manager does not use the assembly U-factors from the *Reference Appendices*, Joint Appendix 4. Instead, assemblies are created inside the program. As you build an assembly, EnergyPro displays the calculated U-factor and R-value on the screen to help determine how the assembly compares to the standard design assembly (Section 150.1(c), Table 150.1-A, Package A).

Range & Units: (This is a calculated value. Range is dependent on inputs.)

Imperial (US): Btu/(hr)(ft²)(°F)

SI (Metric):   W/m²(°C)

[R-Value]

This value shows the total winter R-value for the entire assembly. The program calculates this automatically by adding up the R-values of all the materials in the assembly, including air film resistance at both surfaces and the effect of framing. The R-value is a measure of thermal resistance.

Range & Units: (This is a calculated value. Range is dependent on inputs.)

Imperial (US): Btu/(ft²)(°F)

SI (Metric):   kJ/m²(°C)

Res T24 Performance Tab

Assembly details entered on this tab will only be used in the Res T24 Performance calculation module.

Attic

Unventilated

Check the box if the attic is unventilated. When spray foam insulation is applied to a roof that will not be vented, it is modeled as a "conditioned" attic (rather than a ventilated attic) and the volume of the attic is included in the conditioned space.

Truss Heel Height

If the trusses have raised heels, enter the height of the raised heel, in inches. Raised-heel trusses allow one to install insulation on the attic floor to the outside walls without compression.
Range & Units:

Imperial (US): 3.5- 20.0 inches
SI (Metric): 8.9 – 50.8 cm

Insulation Covers Framing at Underside of Roof Deck

Check the box if the insulation installed within the framing cavity at the underside of the roof deck covers the framing (versus being entirely within the cavity).

Insulation

Complete the insulation fields to specify the location, framing, R-value, and thickness of the insulation in the assembly. Enter the data describing the assembly cavity, interior, and exterior conditions.

Insulation

Select the R-value of the insulation installed in the cavity/interior/exterior of wall and floor assemblies. If the assembly is a roof, select the R-value of the insulation at the ceiling level and enter the R-Value of the insulation installed below/above the roof deck.
Range & Units:
Imperial (US): 0.0-99.0 (hr)(ft²)(°F)/Btu
SI (Metric): 0.00 - 17.42 (m²)(°C)/W

Framing

Select the option that best describes the framing material that penetrates the cavity/interior/exterior insulation. Choices include:
- None (default)
- Wood
- Metal

Thickness

Enter the thickness of the framing being added to the cavity/interior/exterior of the assembly.
Range & Units:
Imperial (US): 0.00 - 5.50 inches
SI (Metric): 0 - 140 mm

Other

Exterior Wall Finish

Select the exterior wall finish from the drop-down list. Choices include: Stucco, Synthetic Stucco, Wood Siding and All Other Siding.

Non-standard Spray Foam Insulation Requiring QII Inspection

Check the box if the R-value of the spray foam insulation used in the assembly is higher than the default values of R5.8 per inch for closed-cell, and R3.6 per inch for open-cell spray foam insulation. Any value other than the default requires HERS verification. Refer to Joint Reference Appendices JA4.1.7 and RA3.5.6 for additional details regarding the verification requirements. Residential Manual Section 3.5.1.3 describes the types of spray foam insulation (SPF) and lists the thickness required to achieve various default R-values.

Layers Tab

Use the table to edit the attributes of the assembly for the Loads calculations and nonresidential performance simulations (NR Title 24 Performance, NR Performance, and ASHRAE 90.1).

- **Edit Existing Layer:** Double click on an existing material in the table to open the Edit Layer dialog box. Select the material, specify the thickness, and indicate the Framing Type, if any. Select OK.

- **Add New Layer:** Click on the plus sign at the top of the table and EnergyPro will add a new layer at the bottom of the list. Double click on the blank new layer and select the material from the Edit Layer list.

- **Delete Layer:** Delete layers by selecting the layer, then clicking on the red "x" to delete it.

- **Change Order:** Use the up and down keys to change the order of the individual layers within the assembly.

Fenestration Library

Use the Fenestration Library to define various glazing products. Click on **Libraries**, located at the bottom-left of the left window pane, select the library you wish to use or edit. Common fenestration types are normally defined in the Fenestration Library before entering the Building Tree. If you define the fenestration in advance, as you work through the Building Tree, the fenestration type you need will be readily available. Of course, you can access the Fenestration Library from either the Window or Skylight Element of the Building Tree to define new fenestration components or modify existing ones as you go. Simply click on the "New/Existing Fenestration" box while in the Window or Skylight Element and select the fenestration you want to use or edit.

NOTE: The Fenestration Library included with the program may contain information on fenestration types which are no longer available. Check manufacturer's data for the current product lines before selecting glazing types from the library. Glazing information can be checked against the latest NFRC Certified Products Directory for accurate U-Factors.

Explanation of Fenestration Library Window

The Fenestration Library window displays a list of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort **EnergyPro** library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Name

Enter a user-defined name identifying each type of glazing.

Product Type

In the **Product Type** drop down list select the type of product that relates to the fenestration being installed.

- Manufactured – The fenestration product typically assembled before delivery to a job site.

- Site-Built – Fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units that are manufactured with the intention of being assembled at the construction site. Refer to Nonresidential Fenestration for additional details regarding Title 24 modeling and labeling requirements for site-built fenestration.

- Field-Fabricated – The frame is made at the construction site of standard dimension lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door.

Visible Transmittance

Enter the visible transmittance (VT) of the fenestration. This value is also referred to as the Visible Light Transmittance. VT refers to the percentage of visible light transmitted by a window or skylight compared to the light striking the glazing. The visible light transmittance is used in the Title 24 calculation of the effective aperture of daylighting systems and daylighting control power adjustment factors. The default value is 0.5 for most glazing types, and can be changed to values between 0 and 1.0, as determined by NFRC.

This value is not used in residential Title 24 calculations. For ASHRAE 90.1 calculations, refer to Table A8.1B or A8.2 for a list of default values based on the glazing type.

U-Factor

The U-Factor is a measure of heat flow through a material (in this case a window assembly) and is the inverse of the R-Value (1/R). Depending on the Product Type chosen, select or input the U-Factor that identifies the proposed fenestration. Depending on the Product Type, your options for defining the U-Factor will change. Choices include:

- **Default**: When NFRC certified U-Factors are unavailable for Manufactured products, Site-Built products or Field Fabricated applications. EnergyPro will select the appropriate U-Factor from Table 110.6-A for the glazing product based on the fenestration properties.

- **Center of Glass**: Enter the center of glass U-Factor from the manufacturer's literature. This value must be determined using methods consistent with NFRC 100 procedures. EnergyPro will automatically calculate the product total U-Factor. You may not use the center of glass value for residential T24 Performance calculations.

- **NFRC Labeled**: Enter the NFRC-certified glazing U-Factor for each window type; a standard, rated value which represents the total amount of heat that flows through a glazing product (window, clerestory, glass door or skylight) at a given difference in temperature between the interior and exterior surfaces, including the frame, edge of glass and dividers.

Obtain glazing (fenestration) U-Factor from either:
- National Fenestration Rating Council (NFRC) Procedure for Determining Fenestration Product Thermal Properties; or,
- Title 24 Default Fenestration Product U-Factors Table 110.6-A
- Alternative default calculations in Reference Appendix NA6. Availale for for site-built skylights up to 200 square, and in feet site-built fenestration in nonresidential projects with less than 200 square feet of skylight and alterations to vertical fenestration. For low-rise residential projects, the alternate method is available for up to 250 square feet or 5% of the conditioned floor area, whichever is greater.
- ASHRAE 90.1 projects: Refer to Section 5.8.2 for exceptions for products that do not have a NFRC rating.

Range & Units :

Imperial (US): 0.000 - 1.300 Btu/hr-ft²(°F)

SI (Metric): 0.000 - 17.034 W/m²(°C)

▦ Solar Heat Gain Coefficient (SHGC)

Enter the Solar Heat Gain Coefficient (SHGC), the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then re-radiated, conducted, or convected into the space. For example, a SHGC of 0.25 lets in only one-quarter the heat per square foot as glazing with an SHGC of 1.00.

Depending on the Product Type chosen, select or input the SHGC that identifies the proposed fenestration.

- **Default**: Use the default values when NFRC certified SHGC values are unavailable. Selecting Default SHGC enables the Fenestration Properties fields. EnergyPro will select the appropriate SHGC from Table 110.6-B for the glazing product.

- **Center of Glass**: Select Center of Glass if the SHGC for the whole product is unavailable (some manufacturers only list a center of glass value). EnergyPro will automatically calculate the whole product SHGC. The center of glass value must be determined using methods consistent with NFRC 200 procedures. You may not use the center of glass value for residential T24 Performance calculations.

- **NFRC Labeled**: Enter the NFRC-certified SHGC for each window type. Depending on the Product Type, your options for defining the SHGC will change.
    - ASHRAE 90.1 projects: Refer to Section 5.8.2 for exceptions for products that do not have a NFRC rating.

Fenestration Properties

The options contained in the Fenestration Properties section define the characteristics of a glazing product when using the default values from Table 110.6-A Default Fenestration Product U-Factors and/or Table 110.6-B Default Solar Heat Gain Coefficient (SHGC).

For example: Selecting Window for the Fenestration Type, 2 for the number of panes, selecting Metal for the Frame Type, and leaving the Operable checkbox blank (window is Fixed) will automatically yield a Table 110.6-A Default U-Factor of 0.710 and a Table 110.6-B Default SHGC of 0.730.

▦ Fenestration Type

Select the fenestration type from the drop-down list. Choices include:

- Window
- Greenhouse/Garden
- Glass Block
- Door
- Skylight with Curb - Glass
- Skylight with Curb - Plastic
- Skylight without Curb
- Curtainwall / Storefront
- NAFS AW Rated (North American Fenestration Standard)
    - Performance Class (R, LC, CW, AW)
    - R – Single-family residential buildings
    - LC- Low and mid-rise multi-family residential and light commercial buildings
    - CW – Mid-rise multi-family residential and commercial office buildings

       o   AW- High-rise multi-family residential and commercial buildings

Number of Panes

Select the number of panes in the fenestration product.

Frame Type

The options contained in the Default Fenestration Properties section define the characteristics of a glazing product when using the 110.6-A Default U-factor and/or the 110.6-B Default SHGC.

Select the frame type that most closely matches the glazing product to be modeled.
The options are:
- **Metal** - Select for any metal framed (aluminum, steel, etc...) glazing product.
- **Metal, Thermal Break** - Select for any thermally broken metal framed (aluminum, steel, etc...) glazing product.
- **Non-metal** - Select for any glazing product using a framing material other than metal (vinyl, fiberglass, etc...)

Tinted

Select if the glazing product has a tint.

Operable

Check the Operable checkbox if the fenestration is operable (as opposed to fixed).

Door Has Automatic Closer

Check the checkbox if the door has an automatic closer. Standards Section 140.4(n) and 170.2(c) require all directly conditioned nonresidential and multifamily common area spaces with manually operable openings to have interlock controls to disable or reset the temperature in the space if the opening is open for more than five minutes. The controls are not required if the door has an automatic closing device.

Pane Dividers

Select if the glazing product has pane dividers.

Overhang Library

Use the Overhang Library to define any horizontal shading devices located above glazing.

Overhang Library Window

Click on **Libraries**, located at the bottom-left of the left window pane, and select the Overhang Library. Then either select an entry, or create your own Overhang by modifying one of the existing entries. Simply click on the "New/Existing Overhang" box while in the Window Element and select the overhang you want to use or edit. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Name

Enter a user-defined name identifying the overhang, or use the default name, if desired. Usually the name will include the overhang length and distance above the glazing (e.g., 2' Overhang/0.1' Above indicates a length of 2' over the glazing and 1" above the glazing).

Horizontal Projection

Enter the Horizontal Projection (overhang length). This value is the distance from the glazing to the outside edge of the overhang in front of the window.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

Distance Above Window

Enter the distance from the top of the window to the bottom tip of the overhang. If the overhang is curved or tilted, the distance above the glazing should be measured from the top of the glazing to the imaginary horizontal plane connecting the outside edge of the overhang and the window wall. (The value cannot be less than 0.)

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

Left Extension Past Window

Enter the extension of the overhang past the left edge of the glazing, as viewed from the exterior.

Range & Units:

Imperial (US): 0 - 9,999 feet

SI (Metric): 0 - 3,048 meters

Right Extension Past Window

Enter the the extension of the overhang past the right edge of the glazing, as viewed from the exterior.

Range & Units:

Imperial (US): 0 - 9,999 feet

SI (Metric): 0 - 3,048 meters

Flap Extension Down

Enter the height of the flap, in feet, if the overhang has a flap that extends lower than the bottom of the overhang.

Range & Units:

Imperial (US): 0 - 9,999 feet

SI (Metric): 0 - 3,048 meters

Sidefin Library

Explanation of Sidefin Input

Use the Sidefin Library to define any vertical shading devices or fins located on either side or both sides of the glazing.

The program always assumes that the top edge of every Sidefin is level with the top edge of the glazing.

Sidefin Library Window

Click on **Libraries**, located at the bottom-left of the left window pane, and select the Sidefin Library. Then either select an existing entry, or create your own Sidefin by modifying one of the entries. Simply click on the "New/Existing Sidefin" box while in the Window Element and select the sidefin you want to use or edit. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Name

Enter a user-defined name identifying each type of Sidefin, or use the default name, if desired. Usually the name will include the Sidefin depth and distance from the glazing (e.g., 2' Left Fin/0.1' Away).

Left Sidefin Depth

Enter the left Sidefin depth. This value is the distance from the left edge of the glazing to the outermost edge of the left Sidefin.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

(Left Sidefin) Distance From Window

Enter the distance from the left edge of the glazing to the left Sidefin. If the fin is curved or tilted, the distance from the glazing should be measured from the side of the window along the imaginary vertical plane connecting the outermost edge of the Sidefin and the wall.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

Right Sidefin Depth

Enter the right Sidefin depth. This value is the distance from the right edge of the glazing to the outermost edge of the right Sidefin.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric): 0.0 - 3,047.7 meters

(Right Sidefin) Distance From Window

Enter the distance from the right edge of the glazing to the right Sidefin. If the fin is curved or tilted, the distance from the glazing should be measured from the side of the window along the imaginary vertical plane connecting the outermost edge of the Sidefin and the wall.

Range & Units:

Imperial (US): 0.0 - 9,999.0 feet

SI (Metric):   0.0 - 3,047.7 meters

Central System Library

Heating System   Cooling System   Controls   Outdoor Air   Fans   Evaporative Cooling   Practice

The Central System Library is used to define a library of HVAC equipment types which are selected from within the Building Tree. The Central System Library includes all the packaged and built-up system types that may be used by the appropriate compliance and load calculations.

In **Libraries**, located on the lower left hand side of the window, select the Central library. If you enter the equipment types in the Central System Library before entering the Building Tree, then the system you need will be readily available as you work through the Building Tree. Of course, you can access the Central System Library from within the Building Tree, System Element to define new equipment or modify existing equipment as you go. Simply click on the "New/Existing System" box while in the System Element and select the equipment you want to use or edit. You will probably want to develop your own Central System Library from manufacturers' specification catalogs, and from the CEC-certified HVAC equipment directories that come with the program.

The Central System Library included with the program may contain information on equipment which is no longer available. Be sure to check manufacturers' data for the current product lines before selecting systems from the library.

Explanation of Central System Library Window

The Central System Library window displays a List of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort EnergyPro library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Central System Inputs

The Central System is the designation applied to the portion of the heating, air conditioning and ventilating (HVAC) system excluding any zonal components. Use the Central System Library to describe the characteristics of the system's general, heating, cooling, economizer, supply and return fans, evaporative cooling, condenser, and reheat and preheat coil components.

Compliance calculations assume that both heating and cooling equipment are installed, even when a heating-only or a cooling-only system is specified. The equipment performance curves contained in the DOE-2 Reference Manual (Version 2.1E) Supplement are used to describe the performance characteristics of both the proposed and reference designs. Performance curve data is fixed for compliance calculations, except for chiller performance curves, which can be customized for compliance purposes.

Use a System Multiplier to describe more than one identical piece of equipment serving the same HVAC Zone.

Central System Inputs By System Type

Heating Tab

▦ Name

Enter a user-defined name identifying the system. The central system name appears on the CF1R and MECH-3 forms. In the case of an existing system in an Existing-plus-Addition calculation, you may wish to use a generic name such as "Existing System".

NOTE: If there is no cooling system installed, create a system such as No Cooling or Default Cooling System. When defining the system, leave Cooling Output and Sensible Output set to zero (0), and the software will automatically use all correct default assumptions for the compliance analysis (residential or nonresidential).

NOTE: If there is no heating system installed, when defining the system, leave Heating Output set to zero (0), and the software will automatically use all correct default assumptions for the compliance analysis (residential or nonresidential).

▦ System Type

Choose a System Type from the drop-down list. **EnergyPro** automatically enables the applicable inputs based upon your selection. The choices are:

- Split (DX) Constant Volume Single Zone

- Packaged (DX) Constant Volume Single Zone

- Packaged (DX) Vertical Unit

- Room Air Conditioner/Heat Pump

- Packaged (DX) Terminal AC/Heat Pump

- Variable Refrigerant Flow

- Packaged (DX) VAV Single Zone

- Packaged (DX) VAV with Terminal Boxes

- Chilled Water Constant Volume Single Zone

- Chilled Water VAV Single Zone

- Chilled Water VAV with Terminal Boxes

- Four Pipe Fan Coil System

- Chilled Water Chilled Beam

- Hydronic Heat Pump

- Evaporative Cooling System

▦ Using New HSPF2/SEER2/EER2 Ratings

Check the box if you will be entering the efficiency ratings using the new system effective January 1, 2023. The Department of Energy (DOE) has changed the way it rates HVAC equipment to better reflect installed field conditions. The new ratings are designated by the number 2 following the rating metric, e.g., EER2.

If you leave the box unchecked and enter the rating data using the EER/SEER/HSPF ratings, EnergyPro will automatically calculate the EER2/SEER2/HSPF2 rating. A conversion factor is used to convert EER to EER2 ratings for modeling. For all air conditioners the conversion factor is 0.96 to convert EER to EER2. A conversion factor is used to convert SEER to SEER2 ratings for modeling. For split-system equipment, the conversion factor is 0.95; for single-package equipment, the conversion factor is 0.96; for small-duct high-velocity equipment the conversion factor is 1.00; and for space-constrained equipment the conversion factor is 0.99 to convert SEER to SEER2.

Computer Room Unit

Check the box if the system is a computer room unit.

Single Phase

Check the box if the system is a single-phase unit to set the appropriate baseline for the equipment in the Standard Design.

<u>Heating Coil</u>   Heating Type

Choose the Heating Type from the sources listed on the drop-down list:

- No Heating Provided
- Gas Central Furnace
- Gas Wall Furnace
- Gas Floor Furnace
- Gas Room Furnace
- Fireplace or Stove
- Electric Heat Pump
- Electric Resistance
- Hot Water Hydronic
- Dual Fuel Heat Pump

The heating type in some system types is pre-determined and cannot be altered. For example, an Electric Heat Pump, by definition, has heat pump heating. The input is grayed, but displays the appropriate selection when you have selected one of those system types.

Coil Control

Choose a Coil Control for central air heating systems from one of the four controls in the drop-down list. The Standard Design supply air temperature control method is fixed (constant temp) for all occupancies except for healthcare facilities which are modeled identically to the proposed design. This input defines how the heating coil exit air temperature is controlled. The choices are:

- Constant Temperature
- Warmest Zone
- Coldest Zone
- OA (outside air) Reset

If the system samples thermostat signals from a representative number of zones (i.e., drawings must show zone control wiring or pneumatic tubing connecting back to air handler unit control panel), reset may be coldest zone (the zone with a temperature value furthest from the setpoint).

For simple control systems, heating supply setpoint will more likely be constant temperature.

Total Output

Enter the Total Output Capacity of the heating equipment in Btu/hr. This is the nominal output or bonnet capacity listed by the manufacturer.

Heat pump output capacity is the value taken at the 47ºF (8.3ºC) outdoor dry bulb temperature. For electric resistance heaters, convert watts to Btu/hr (1 watt = 3.413 Btu/hr) if you are working in Imperial (US) units.

Range & Units:

Imperial (US): 0 - 9,999,999 Btu/hr

SI (Metric):   0.0 - 29,310 kW

Output at 17⁰F

If the system is a heat pump, enter the rated heating capacity at 17°F for the heat pump compressor to be installed. The capacity is used to determine the effect of backup electric resistance heat in the simulation.

Range & Units:

Imperial (US): 0 - 9,999,999 Btu/hr

SI (Metric):   0.0 - 29,310 kW

Supplemental Elec.

For electric heat pump systems, enter the amount of auxiliary electric resistance heating (strip heat), in kW.

Range & Units: 0.0 - 9,999.0 kW

Supply Temperature

Enter the temperature to which air is heated before being distributed through a building.

Range & Units:

Imperial (US):   65 – 140°F

SI (Metric):   18.3 - 60.0°C

Efficiency

Enter the appropriate energy efficiency rating for the heating system. Most gas-fired and oil-fired furnaces use the AGA-rated Annual Fuel Utilization Efficiency (AFUE); very large gas furnaces greater than 225,000 Btu/hr use Thermal Efficiency (TE). The heating efficiency of air-source heat pumps is measured using the Heating Seasonal Performance Factor (HSPF) rating; water-source heat pumps and gas fired heat pumps use the Coefficient of Performance (COP). EnergyPro automatically displays the appropriate metric for the selected heating system type.

The rating is normally listed in the latest CEC *Modernized Appliance Efficiency Database System (MAEDBS)*. You may also call the Commission Hotline, (800) 772-3300, and ask for the rating for a specific piece of equipment.

If you do not know what system will be installed, use an AFUE default value of 0.80 for non-weatherized gas or oil-fired systems.

If no heating system is installed in the building or zone, use the AFUE default value.

If modeling a Gas Heat Pump system, enter the Coefficient of Performance for the system, which is the heating output divided by the gas input rate at ARI conditions.

Range & Units: 0.400 - 10.000 AFUE, HSPF, TE or COP (depending on equipment type)

Heat Pump (HP) AFUE

For Dual Fuel heat pumps, enter the AFUE for the gas supplemental heating.

Range: 0.0 – 0.99

 Preheat Coils

Preheat Coils   Choose a preheat source to define the type of preheat coil (if present). Preheat coil fields are enabled for Packaged (DX) VAV Single Zone, and all Chilled Water systems (Constant Volume SZ, VAV SZ, VAV w/Terminal Boxes, and Chilled Beam). The choices are: None, Electric, and Hot Water.

 Temperature Setpoint

Enter the temperature setpoint below which the coil runs. This input is required only for Central Systems with preheat coils on the outside air intake (unusual for most of California). To disable the preheat coil, input zero (0) for this value.

Range & Units:

Imperial (US):   0 - 65°F

SI (Metric):   -17.8 - 18.3°C

Reheat Coils   **Reheat Coils**

Choose a reheat source from the drop-down list to define the type of coils used in systems with zonal level reheating of air. The choices are: None, Electric, and Hot Water. Reheat coil fields are enabled for all system types except: Room Air Conditioner/Heat Pump, Packaged (DX) Terminal AC/HP, Variable Refrigerant Flow, Four Pipe Fan Coil, and Hydronic Heat Pump systems.

 Delta T

Enter the maximum temperature rise across a zone reheat coil. This value is a required input for systems with zonal reheat such as VAV reheat systems and fan-powered VAV systems. The value is not significant as long as it is large enough to handle the heating load.

Range & Units:

Imperial (US):   0 – 55°F

SI (Metric):   0.0 - 30.6°C

Baseboard Heat   **Baseboard Heat Source**

Choose the baseboard heat source to define the type of coils used in systems with zonal level baseboard heat. The choices are: None, Electric, and Hot Water.

Cooling Tab

Cooling Coil   **Coil Control**

Choose a Coil Control for central air systems from the drop-down list. This input defines the strategy for controlling the cooling coil exit air temperature. The choices are:

- Constant Temperature
- Warmest Zone
- Coldest Zone
- OA (outside air) Reset

If the system samples thermostat signals from a representative number of zones (i.e., drawings must show zone control wiring or pneumatic tubing connecting back to air handler unit control panel), reset may be warmest zone (the zone with a temperature value furthest from the setpoint).

For simple control systems, cooling supply setpoint may be constant temperature.

Total Output

Enter the Total Cooling Output capacity of the cooling equipment at ARI conditions. This is the ARI total or nominal output, taking fan heat gain into account.

If this value is set to zero (0), the program uses all the appropriate defaults for a minimum efficiency cooling system as explained in the note under Cooling Name.

Range & Units:

Imperial (US): 0 - 9,999,999 Btu/hr

SI (Metric):   0.0 - 29,310.0 kW

Sensible Output

Enter the Sensible Cooling Output capacity of the cooling equipment at ARI conditions, not adjusted for fan heat. This value is typically 70-75% of the total Cooling Output (see manufacturers' specifications). You must enter the sensible capacity to correctly calculate loads and ventilation requirements.

If no cooling equipment is specified, the software assumes a Sensible Cooling Output equal to the peak sensible cooling load for NR T24 Performance calculations.

Range & Units:

Imperial (US): 0 - 9,999,999 Btu/hr

SI (Metric):   0.0 - 29,310.0 kW

Supply Temperature

Enter the temperature to which air is cooled before being distributed through a building.

Range & Units:

Imperial (US):   40 – 70°F

SI (Metric):   4.4 - 21.1°C

Reset High

Enter the maximum value for the supply air reset temperature.

Range & Units:

Imperial (US):   40 – 72°F

SI (Metric):   4.4 - 22.2°C

Reset Low

Enter the minimum value for the supply air reset temperature.

Range & Units:

Imperial (US):   40 – 72°F

SI (Metric):   4.4 - 22.2°C

Efficiency

EnergyPro automatically enables the appropriate efficiency rating metric based on the System Type entered on the Heating tab. If you are unsure of the exact equipment to be installed, or if no cooling equipment is being installed, use the minimum efficiency value for the type and size of the anticipated equipment.

SEER/SEER2

For packaged equipment with cooling capacity less than 65,000 Btu/h, specify the EER/EER2 along with the SEER/SEER2 when available from manufacturer's literature or AHRI certificate. For equipment with capacity above 65,000 Btu/h that are required to have a EER/EER2 rating, the EER/EER2 must be specified.

Energy Efficiency Ratio (EER/EER2)

Enter the ARI-rated Energy Efficiency Ratio of the air conditioning or heat pump system.

EER/EER2 includes both the compressor and condenser energy use (including condenser fan) and the supply fan energy use at ARI testing conditions. When running NR T24 Performance, the software automatically extracts the ARI supply fan data from the EER rating and replaces it with the fan data at design conditions as input on the Fans tab.

IEER (Integrated Energy Efficiency Ratio)
The IEER is a composite rating for a range of part-load conditions and different ambient conditions. The rating is determined according to AHRI procedures, and equipment with this rating is subject to mandatory minimum requirements.
Enter the IEER for packaged DX equipment with capacity greater than 65,000 Btu/hr. This input is currently used only to confirm mandatory equipment efficiency.

If you are not sure of the exact equipment to be installed, use the minimum value for the type and size of the anticipated equipment. The information is available in Section 110.2 of the Standards or the CEC Appliance Efficiency Database. You may also call the Commission Hotline, (800) 772-3300, and ask for the rating for a specific piece of equipment.

Fan Heat Included in Output

Check this box if the specifications for the unit you are modeling include fan heat. Some cooling systems (e.g., Packaged Systems) are delivered from the manufacturer ready to be installed. Often these units have capacity specifications which account for the heat given off by the fan.

If no cooling system is being installed in the building or zone, use the default value.

Range & Units: 6.0 - 20.0 EER

Number of Compressor Stages

Enter the number of compressor stages in the design.

Condenser   The condenser is part of the refrigeration cycle of the outdoor air conditioning unit. It is where the heat originally removed from the conditioned space, plus the heat equivalent of the compressor work, are rejected to the condenser coolant (water or air). Smaller condensers (i.e., less than or equal to 20 tons) typically are air-cooled; larger units (i.e., greater than 20 tons) are often water-cooled.

Condenser Type

Select the condenser type from the drop-down list. Choices include:
- Air-Cooled
- Water-cooled
- Evaporative pre-cooled (both Residential and Nonresidential)

If the condenser is water-cooled, and is a central water-cooled condenser (one condenser/tower connected to all systems in the building) enter the pump energy in the Plant element, Hydronic Tab.

If the condenser is water-cooled, and is part of the individual system, include pump energy in the Performance at ARI Conditions input (Compressor / Condenser Power).

If the condenser is evaporatively pre-cooled it is an air-cooled unit which uses a direct evaporative cooling process to cool outdoor air before it enters the refrigeration cycle:

For Nonresidential: Enter the effectiveness of the pre-cooling cycle as well as the condenser pump energy consumption at <u>design conditions</u> in the inputs provided on the Cooling tab.

For Residential: Enter the Energy Efficiency Ratio (EERa) of the system at 95° F. Drybulb and 75° F. Wetbulb into the Evap PC Efficiency field. Enter the EER of the system at 82°F Drybulb and 65°F Wetbulb in the Performance at ARI Conditions section of the Cooling Tab. **Using the evaporative pre-cooling option triggers the mandatory use of Duct Sealing.**

Evap Pre-cooled Condenser (PC) Effectiveness

Enter a fractional value to define evaporative effectiveness if the condensing unit has an evaporative pre-cooler. A typical value is 0.80.

<u>Range & Units</u>: 0.00 - 1.00 (units N/A)

Pump Motor (Evap PC Pump Motor) Design Power

Enter the power output of the condenser pump listed by the manufacturer <u>at design conditions</u>.

Range & Units:

Imperial (US): 0 - 99,999 hp (brake horsepower)

SI (Metric): 0 - 74,599 kW

Controls Tab

Fan Operation

Indicate whether the fan operates continuously or intermittently, in the drop-down list.

Cycle System on at Night to Meet Loads

Check the checkbox if the system will cycle on during unoccupied hours to meet heating and/or cooling loads, usually to maintain a setback temperature.

Maximum Humidity

Enter the maximum humidity level, as a percent, allowed to meet specific humidity condition requirements. In some systems, this may affect supply water temperature reset.

Outdoor Air Tab

🖩 Economizer Type

Choose an Economizer Type, if any, from the drop-down list. The choices are:

- No Economizer
- Fixed Temperature (Non-Integrated)
- Fixed Temperature (Integrated)
- Fixed Enthalpy (Non-Integrated)
- Fixed Enthalpy (Integrated)
- Differential Temperature (Non-Integrated)
- Differential Temperature (Integrated)
- Differential Enthalpy (Non-Integrated)
- Differential Enthalpy (Integrated)
- 100% Outside Air

An integrated economizer works in conjunction with mechanical cooling to meet the cooling load if it cannot meet the entire load by itself. A non-integrated economizer operates only when it can meet the entire cooling load, otherwise the mechanical cooling takes over. When an economizer is included in the nonresidential Standard Design, the software assumes a fixed temperature integrated economizer for the default type.

When modeling a system that has 100% Outside Air, you may choose this option, in which case the software will model all supply air as coming from the outdoors.

🖩 Limit Temperature

Enter the outside air dry bulb setpoint above which the air economizer will be turned off. The limit temperature is set according to the values in Standards, Table 140.4-G.

Range & Units:

Imperial (US):   55 – 80°F

SI (Metric):   12.8 - 26.7°C

🖩 Water Side Economizer

Check this box if a water cooled condenser is specified, and a water side economizer option is available that allows the condenser water to be diverted through a water side economizer coil that cools the entering air if the water temperature is more than a predetermined number of degrees below the air temperature. After leaving the water side economizer coil the water then enters the unit condenser.

Exhaust Air Heat Recovery

ASHRAE 90.1-2013 prescriptive path for compliance requires exhaust air heat recovery systems for fan systems of a certain size and characteristics. Refer to Section 6.5.6 of the ASHRAE 90.1-2013 Standards for additional details regarding the conditions under which energy recovery systems are required.

Title 24 allows heat recovery systems when modeled with balanced ventilation systems in specific situations.

🖩 Energy Recovered

Select the heat recovery method used. Choices include: None, Sensible, and Total. Sensible heat systems are also known as dry bulb only systems. Total heat recovery systems are also called wet bulb systems, and recover both sensible and latent heat.

HVI Adjusted Sensible Heat Recovery Rating

Enter the HVI adjusted sensible recovery rating (ASRE) of the exhaust air heat recovery equipment associated with this HVAC System.

Range & Units: 0 -99%

Minimum Delta T Required for Heat Recovery

Enter the minimum temperature difference between the exhaust air and outside air, below which the heat recovery system will not operate.

Electrical Energy Usage

Enter the electrical demand (in kW) for the exhaust air heat recovery system.

Pump/Motor Runs Only When Heat Recovery is Active

Check the checkbox if the pump or motor runs only when heat recovery is active.

Fan Savings When Heat Recovery is in Bypass Mode

Enter the fan energy savings, in percent, when the heat recovery system is bypassed.

Exhaust Air Stream Evaporative Cooling Effectiveness

Enter the effectiveness for the exhaust air evaporative cooling equipment used in the heat recovery system.

Fans Tab

Induction Ratio

Enter the Induction Ratio for the unit. The induction ratio is the ratio of induction-side airflow of a fan-powered box at design heating conditions to the primary airflow and is only used for chilled beam systems.

Range: 0 - 10

Supply Fan   Fan Control

Choose the type of fan volume control, if any, for the supply fan, from the drop-down list. The choices for fan control are:

- Constant Volume
- Variable Speed Drive
- Discharge Dampers
- Inlet Vanes
- Two Speed

The fan control method for the standard design varies depending on the HVAC system type, as listed in Table 2: HVAC System Map of the Nonresidential and Multifamily ACM Reference Manual.

Fan Type

Choose a Fan Type from the drop-down list. The choices are:

- Centrifugal Air Foil
- Centrifugal Backward Inclined
- Centrifugal Forward Curved
- Axial

▦ Configuration

Choose a Fan Configuration from the drop-down list. The choices are:
- Blow-Through
- Draw-Through
- Outside Airflow

▦ Design Airflow

Enter the total air circulation rate of the supply fan at design conditions. This information is obtained from manufacturers' literature.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

▦ Minimum Airflow

Enter the minimum air circulation rate at which the supply fan is designed to operate.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

▦ (Supply Fan) Design Power

Enter the power output of the supply fan listed by the manufacturer <u>at design conditions</u>. The program uses this value along with the Motor Efficiency and Drive Efficiency to calculate input fan power.

It is sometimes difficult to obtain an accurate value since the design static pressure is not always known precisely at the correct cfm. You may use the nominal (nameplate) power output value.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

▦ (Supply Fan) Drive Efficiency

Enter the drive efficiency of the supply fan, expressed as a percentage (%). By definition, this value is 100% if the supply fan is direct drive. Indirect drive fans (with fan belts) will be characterized by drive efficiencies less than 100%, usually around 97%.

<u>Range & Units</u>: 0.0 - 100.0%

▦ (Supply Fan) Input as Watts

You may enter the fan motor data as watts as an alternative to entering the design power (bhp) and efficiency (%).

Range & Units: 0 – 9,999,999 watts

Return Fan 🔢 **Fan Control**

Choose a fan volume control, if any, for the return fan from the drop-down list. The choices for fan control are:

- Constant Volume
- Variable Speed Drive
- Discharge Dampers
- Inlet Vanes
- Two Speed

The fan control method for the reference design varies depending on the HVAC system type, as listed in Table 2: HVAC System Map of the Nonresidential and Multifamily ACM Reference Manual.

🔢 **Fan Type**

Choose a Return Fan Type from the drop-down list. The choices are:

- Centrifugal Air Foil
- Centrifugal Backward Inclined
- Centrifugal Forward Curved
- Axial

🔢 **Configuration**

Choose a Return Fan Configuration from the drop-down list. The choices are:

- Blow-Through
- Draw-Through
- Outside Airflow

🔢 **(Return Fan) Design Airflow**

Enter the total air circulation rate of the return fan at design conditions, in cubic feet per minute (cfm). This information is obtained from manufacturers' literature.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

🔢 **(Return Fan) Minimum Airflow**

Enter the minimum air circulation rate at which the return fan operates, in cubic feet per minute (cfm).

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

🔢 **(Return Fan) Design Power**

Enter the power output of the return fan listed by the manufacturer at design conditions. The program uses this value along with the Motor Efficiency and Drive Efficiency to calculate input fan power.

It is sometimes difficult to obtain an accurate value since the design static pressure is not always known precisely at the correct airflow. You may use the nominal (nameplate) power output value.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

(Return Fan) Drive Efficiency

Enter the Drive Efficiency of the return fan, expressed as a percentage (%). By definition, this value is 100% if the return fan is direct drive. Indirect drive fans (with fan belts) will be characterized by drive efficiencies less than 100%, usually around 97%.

Range & Units: 0.0 - 100.0%

(Return Fan) Input as Watts

You may enter the fan motor data as watts as an alternative to entering the design power (bhp) and efficiency (%).

Range & Units: 0 – 9,999,999 watts

Evaporative Cooling Tab

An evaporative cooling cycle utilizes the difference between a high dry bulb temperature and a low wet bulb temperature to cool air while humidifying it. In a direct evaporative cooling cycle, the conditioned air is humidified. In an indirect evaporative cooling cycle, a secondary air stream is humidified; and cooling of the conditioned air through a heat exchanger leaves the total humidity of the conditioned air unchanged. According to the definition of mechanical cooling in the Standards, in nonresidential, multifamily buildings, and hotel/motel buildings, cooling of a space by direct or indirect evaporation of water alone is not considered mechanical cooling.

The adiabatic efficiency of the evaporative cooler (see Direct Effectiveness and Indirect Effectiveness below) is defined as the drop in dry bulb temperature produced in the air passing through the cooler divided by the wet bulb depression of the entering air. Stated in different words, the effectiveness or adiabatic efficiency is the percent reduction of the initial wet bulb depression. Mathematically, this is expressed as:

% Adiabatic Efficiency $= (DB_{entering} - DB_{leaving}) / (DB_{entering} - WB_{entering})$

The evaporative cooler defined here cools the supply air stream.

Evaporative Cooling Type

Choose the Evaporative Cooling Unit Type from the drop-down list. The choices are:

- None
- Indirect
- Indirect/Direct
- Direct

In an indirect system, there is only an indirect evaporative cooling cycle in which no additional moisture is introduced into the supply air. In an indirect/direct system, there are two cycles, indirect and direct. In the direct cycle, moisture is added to the supply air.

Air Flow

Enter the volume of the design supply air flow that passes through the evaporative cooler.

If this value is greater than the (Minimum Airflow Ratio in the Zonal System Library) x (Supply airflow), all of the outside air plus some of the return air will flow through the evaporative cooler.

Range & Units:

Imperial (US):   0 - 99,999 cfm

SI (Metric):   0.0 - 47,189.5 L/s

Direct Effectiveness

Enter the effectiveness or adiabatic efficiency of the direct evaporative cooling cycle, a fractional value between 0.0 and 1.0 (if applicable). A typical value is 0.80.

Range & Units: 0.00 - 1.00 (units N/A)

Indirect Effectiveness

Enter the effectiveness or adiabatic efficiency of the indirect evaporative cooling cycle, a fractional value between 0.0 and 1.0. A typical value is 0.80.

Range & Units: 0.00 - 1.00 (units N/A)

Integrated Operation

Check this box if the evaporative cooler does as much cooling as possible, and the mechanical cooling system concurrently handles the remaining load. Leave this box unchecked if the evaporative cooler operates only when it meets the entire cooling load.

Return Air Heat Recovery

Check this box if return air is used for the secondary airstream of the indirect cooler. Leave this box unchecked if outside air is used for the secondary airstream of the indirect cooler.

Supplemental Fan   (Fan Motor) Design Power

Enter the power output of the evaporative cooler fan listed by the manufacturer at design conditions. The program uses this value along with the Motor Efficiency and Drive Efficiency to calculate input fan power.

It is sometimes difficult to obtain an accurate value since the design static pressure is not always known precisely at the correct airflow. You may use the nominal (nameplate) power output value.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

(Fan Motor) Drive Efficiency

Enter the Drive Efficiency of the evaporative cooler fan, expressed as a percentage (%). By definition, this value is 100% if the condenser fan is direct drive. Indirect drive fans (with fan belts) will be characterized by drive efficiencies less than 100%, usually around 97%.

Range & Units: 0.0 - 100.0%

(Fan Motor) Input as Watts

You may enter the fan motor data as watts as an alternative to entering the design power (bhp) and efficiency (%).

Range & Units:　　　0 – 9,999,999 watts

Pump Motor　🔳 **(Pump Motor) Design Power**

Enter the power output of the evaporative cooler pump listed by the manufacturer at design conditions. The program uses this value along with the Motor Efficiency and Drive Efficiency to calculate input pump power.

If pump energy is expressed in kilowatts (kW), divide the kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

Zonal Library

General Tab　Fan Tab　Outside Air Tab　Practice

The Zonal Library is used to define a library of zonal boxes and fans including entries for Minimum Airflow Ratio, Reheat Coil, Zone Heating Output, Cooling Output, Sensible Cooling Output, Zonal Fan Data and Outside Air.

In **Libraries,** located on the lower-left hand side of the window, select the Zonal Library. Zonal systems are typically defined in the Zonal Library before entering the Building Tree. Then, as you work through the Building Tree, the zonal system type you need will be readily available. Of course, you can access the Zonal Library from the Building Tree Zone Element to define new systems or modify existing ones as you go. In the Mechanical tab, click on the "Zonal System" box, and select the zonal system you wish to use or edit.

Explanation of Zonal Library Window

The Zonal Library window displays a List of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Zonal System Inputs

General Tab

🔳 **Name**

Enter a user-defined name identifying the zonal system. The system name appears on the NRCC-PRF-01-E form.

🔳 **Type**

Select one of the following system types from the drop-down list:

- VAV Box
- VAV/Series Fan
- VAV/Parallel Fan

- Variable Ref. Flow
- Active Chilled Beam
- Passive Chilled Beam

Thermostat Type

Select the type of thermostat control for the zone from the drop-down list. Choices include: Proportional, Reverse Action, and Two Position. Reverse action thermostats allow variable volume heating as well as cooling. The Standards assume systems with reverse action thermostats set the maximum airflow to 50% of the total volume when in heating mode.

Minimum Airflow Ratio

Enter the minimum airflow at which reheat occurs. This value is the lowest fraction at which the fan system can operate in a stable manner. For packaged and built-up VAV systems, the Standard Design assumes a minimum fan speed ratio equal to 0.2; for single-zone VAV systems, 0.5. The minimum position must be no smaller than the minimum ventilation quantity.

Range & Units: 0.00 - 1.00 (units N/A)

Heating Output

Enter the total heating output capacity of the zone level terminal unit (e.g., VAV box). The heating output is printed on the Zonal System and Terminal Units Summary of the NRCC-PRF-01 form.

Range & Units:

Imperial (US): 0 - 9,999,999 Btu/hr

SI (Metric): 0.00 - 2,931.00 kW

Cooling Output

Enter the total cooling output capacity of the Variable Refrigerant Flow (VRF) zonal system.

Sensible Output

Enter the sensible cooling output capacity of the Variable Refrigerant Flow (VRF) zonal system.

Fan Tab

Fan Cycles with Load

Indicate whether the supply fan operates continuously during occupied hours or cycles on with load (when heating or cooling is required). This input applies only to residential units of high-rise residential buildings and hotel/motel guest rooms. EnergyPro models the fan operation as continuous during occupied hours for all other occupancy types. Fan operation is identical in both the standard and proposed buildings.

Fan Control

Choose a fan volume control, if any, for the supply fan, from the drop-down list. The choices for fan control are:
- Constant Volume
- Variable Speed Drive
- Discharge Dampers
- Inlet Vanes

- Two Speed

The fan control method for the reference design varies depending on the HVAC system type, as listed in Table 2: HVAC System Map of the Nonresidential and Multifamily ACM Reference Manual.

Fan Type

Choose a Fan Type from the drop-down list. The choices are:
- Centrifugal Air Foil
- Centrifugal Backward Inclined
- Centrifugal Forward Curved
- Axial

Configuration

Choose a Fan Configuration from the drop-down list. The choices are:
- Blow-Through
- Draw-Through
- Outside Airflow

Design Airflow

Enter the total air circulation rate of the zonal fan (or fan coil fan). This information is obtained from manufacturer's literature.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric): 0 - 999,999 L/s

Minimum Airflow

Enter the minimum air circulation rate at which the supply fan is designed to operate.

Range & Units:

Imperial (US): 0 - 999,999 cfm

SI (Metric): 0 - 999,999 L/s

(Fan Motor) Design Power

Enter the power output of the zonal fan listed by the manufacturer <u>at design conditions</u>. The program uses this value along with the Motor Efficiency and Drive Efficiency to calculate input fan power.

If fan energy is expressed in kilowatts (kW), divide the kilowatts by 0.746 to convert to brake horsepower.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric): 0.00 - 74,599.25 kW

(Fan Motor) Drive Efficiency

Enter the drive efficiency of the zonal fan, expressed as a percentage (%). This value is 100% if the supply fan is direct drive. Indirect drive fans (with fan belts) will be characterized by drive efficiencies less than 100%, usually around 97%.

<u>Range & Units</u>: 0.0 - 100.0%

(Fan Motor) Input as Watts

You may enter the fan motor data as watts as an alternative to entering the design power (bhp) and efficiency (%).

Range & Units: 0 – 9,999,999 watts

Outside Air Tab

Use this tab to specify the characteristics of the outside air controls for the Variable Refrigerant Flow zonal system.

Outside Air

Select the type of economizer or energy recovery system from the drop-down list. Choices include:

- No Economizer
- Temperature
- Enthalpy
- Energy Recovery

Energy Recovery Ventilator

Describe the energy recovery system features. These inputs are enabled for VRF Zonal Systems only. ASHRAE Standard 62.2 recommends heat recovery systems for systems that provide increased ventilation to enhance indoor air quality. You may also be able to obtain LEED, Environmental Quality points for installing an energy recovery system.

Power

Enter the electrical demand (in Watts) of the energy recovery ventilator system.

Sensible Effectiveness

Enter the effectiveness of the system (as a percent) at recovering sensible heat.

Latent Effectiveness

Enter the effectiveness of the system (as a percent) at recovering latent heat.

Minimum Delta T

Enter the minimum temperature difference between the exhaust and outdoor air below which the system will not operate.

Preheat Setpoint

Enter the preheat setpoint temperature for the energy recovery ventilator.

Chiller Library

Select Libraries from the menu at the lower left hand side of the window, and then the Chiller Library. If you enter the chiller data in the Chiller Library before entering the Building Tree, the chiller you need will be readily available as you work through the Building Tree. Of course, you can also access the Chiller Library from the Building Tree Plant Element to define new Chillers or modify existing ones as you go. Simply click on the Chilled Water tab while in the Plant element, add a chiller, and click the Chiller graphic to display the chiller data entry information. Click in the "Chiller" box and select the chiller you want to use or edit.

Explanation of Chiller Library Window

The Chiller Library window displays a List of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Explanation of Chiller Equipment Inputs General Tab

Name

Enter a user-defined name identifying the Chiller equipment. The Chiller Name appears on the MECH-3 form of the report.

Equipment Type

Select one of the types listed:

- Centrifugal
- Reciprocating
- Screw
- Scroll
- Single Stage Absorption
- Dual Stage Absorption
- Gas Absorption
- Gas Engine Driven
- Heat Recovery

The standard design chiller(s), as defined in the Nonresidentia/Multifamilyl ACM Manual Section 5.8.2, is selected based upon the cooling load, as shown below.

Table 15: Type and Number of Chillers

Building Peak Cooling Load	Number and Type of Chillers
< 300 tons	One water-cooled screw chiller
> 300 LOAD < 600 tons	Two water-cooled screw chillers, sized equally

≥ 600 tons	A minimum of two water-cooled centrifugal chillers, sized to keep the unit size below 800 tons

Full Load Efficiency

Enter the full-load efficiency of the Chiller. If you are not using a Custom Curve, this value must be at ARI conditions. This input typically includes both the compressor and the condenser for air-cooled Chillers. The software automatically converts kW/ton to EIR for use in NR Performance calculations.

Range & Units:

Imperial (US): 0.000 - 5.000 kW/ton

SI (Metric): 0.00 - 1.42 kW/kW

IPLV Rating

Enter the IPLV rating for the chiller. The IPLV is the Integrated Part Load Value. As chillers often operate at less than full capacity, the IPLV is calculated at 100%, 75%, 50%, and 25% capacity to better represent typical equipment operating conditions than the rating calculated at full load only.

Range & Units:

Imperial (US): 0.000 - 5.000 kW/ton

SI (Metric): 0.00 - 1.42 kW/kW

Capacity

Enter the chiller capacity. If you are not using a Custom Curve, this value must be at ARI conditions. conditions.

Range & Units:

Imperial (US): 0 - 9,999 tons

SI (Metric): 0.0 - 35,166.5 kW

Air Cooled

Check Air Cooled if the system is an air-cooled or evaporatively cooled chiller that does not rely on a cooling tower for heat rejection.

Rating Conditions

Enter the Rating Conditions for chillers designed to operate at conditions other than the ARI Standard 550 test conditions.

Leaving Chilled Water Temperature

Enter the temperature of the water leaving the chiller. The standard ARI rating condition for leaving chilled water temperature is 44°F.

▦ Entering Condenser Water Temperature

Enter the temperature of the condenser water entering the tower. The standard ARI rating condition for Entering Condenser Water Temperature is 85°F.

▦ Outside Air Drybulb Temperature

Enter the outside air temperature for air-cooled equipment for use in the chiller efficiency adjustment curve calculation.

Gas Chiller Tab

▦ <u>Efficiency</u>

Enter the efficiency of the gas chiller at ARI conditions.

<u>Range & Units</u>:   0.50 - 10.00 COP (Coefficient of Performance) units N/A

▦ <u>Burner Efficiency</u>

Enter the burner efficiency for the gas absorption chiller.

<u>Range & Units</u>: 0.000 - 1.000 (units N/A)

▦ <u>Idle Ratio</u>

Enter the idle ratio for the gas engine driven chiller.

<u>Range & Units</u>: 0.000 - 1.000 (units N/A)

▦ <u>Jacket Heat Recovery Efficiency</u>

Enter the jacket heat recovery efficiency for the gas engine driven chiller.

<u>Range & Units</u>: 0.000 - 1.000 (units N/A)

▦ <u>Exhaust Heat Recovery Efficiency</u>

Enter the exhaust heat recovery efficiency for the gas engine driven chiller.

<u>Range & Units</u>: 0.000 - 1.000 (units N/A)

TES Chiller Tab

For use with chillers designed for Ice-On-Coil Storage thermal energy storage systems only.

▦ Efficiency at Beginning of Ice Making

Enter the efficiency, in kW per ton, of the chiller at the start of the TES charging process, e.g., when the chiller starts building ice.

Range & Units:

Imperial (US): 0.000 - 10.000 kW/ton

SI (Metric): 0.00 - 2.84 kW/kW

▦ Efficiency at End of Ice Making

Enter the efficiency, in kW per ton, of the chiller at the end of the TES charging process, e.g., when the chiller has completed building ice.

Range & Units:

Imperial (US): 0.000 - 10.000 kW/ton

SI (Metric): 0.00 - 2.84 kW/kW

▦ Capacity Reduction

Enter the percent of capacity reduction that occurs for each degree (F) drop in suction temperature.

Range & Units:

Imperial (US): 0.000 - 100.000 (units N/A)

SI (Metric): 0.00 - 100.000 (units N/A)

Heat Recovery Chiller Tab

Heat Recovery Ratio

Enter the Heat Recovery Ratio of the chiller heat recovery system. You must select "Heat Recovery" as the Equipment Type in the General tab to enable this field.

Curves Tab

Use this tab to enter custom chiller performance curve coefficients. You may obtain this information from the manufacturer or from a software tool designed to calculate these numbers. The curves define the performance characteristics of a chiller depending on the ambient conditions, and whether the chiller is operating at full capacity or part-load conditions. The curve type varies depending on the independent variables from which the equation is derived. Chiller curves are typically functions of either the part-load ratio (PLR), or the chilled water temperature (T_{OUT}) and the entering condensing water temperature (T_{IN}). Air-cooled chiller curves are functions of the chilled water supply temperature (T_{OUT}) and the outdoor dry-bulb air temperature (OAT).

The standard energy budget is calculated using the chiller electrical efficiency and default performance curves at ARI conditions. One typically uses custom curves to model a chiller that performs better at part load than one that follows the default curves. The software uses default curves for both the standard and proposed designs if you do not specify custom performance curves here.

▦ Use Custom Curve Coefficients

Check the box if you wish to enter custom curve coefficients to calculate the proposed design chiller performance at various operating conditions. The software notes that custom curves were specified in the analysis on Form PERF-1. Title 24 requires you to provide supporting documentation for all custom curves.

The standard energy budget is calculated using the chiller electrical efficiency and default performance curves at user specified conditions. When using custom curves enter the chiller efficiency (kW/ton) at the design conditions.

The Equipment Performance data entry fields will not appear unless you enter at least one chiller in the Plant Element of the Building Tree. You do not need to fully define the chiller characteristics, but the entry field "Number of Chiller Types" must be at least 1.

Equipment Performance

In order to use the custom curve feature, the chiller technical breakdown documenting the part load performance will have to be requested from the chiller manufacturer. The technical breakdown should include ten data points reporting correlating Leaving Chilled Water temperature, Entering Condenser Water temperature, Cooling Capacity, and Input Energy kW.

The initial display will show only one data entry row. When you enter the new Leaving Chilled Water Temperature in the first row, the next data entry row will appear.

Minimum Operating Ratio

Enter the minimum operating ratio, below which the chiller must cycle or employ false loading.

▦ Leaving Chilled Water Temperature

Input the Leaving Chilled Water Temperature used to rate the Capacity and kW/ton for each of the ten data points.

Range & Units:

Imperial (US):   36 - 48ºF

SI (Metric):   2.2 - 8.9ºC

▦ Entering Condenser Water Temperature

Input the Entering Condenser Water Temperature used to rate the Capacity and kW/ton for each of the ten data points.

Range & Units:

Imperial (US):   65 - 105ºF

SI (Metric):   18.3 - 40.5ºC

▦ Cooling Capacity

Input the Cooling Capacity in tons for each of the ten data points.

Range & Units:

Imperial (US):   0 - 9,999 tons

SI (Metric):   0.0 - 35,166.5 kW

▦ Input kW

Enter the Input Energy in kW for each of the ten data points.

<u>Range & Units</u>: 0 - 999,999.0 kW

Tower Library

 General Tab   Tower Fan Tab   Practice

In the Libraries menu on lower left hand side of the window, select the Tower Library. If you enter the data for the Cooling Tower in the Cooling Tower Library before entering the Building Tree, the equipment you need will be readily available as you work through the Building Tree. Of course, you can also access the Tower Library from the Building Tree Plant Element to define new Towers or modify existing ones as you go. Simply click on the Hydronic Tabin the Plant Element, then in the "Cooling Tower" box and select the Tower you want to edit or use.

Explanation of Cooling Tower Library Window

The Tower Library window displays a List Box from which you can sort, edit, or select existing entries. In addition, the Library Commands allow you to add new, delete existing and re-arrange entries in the library.

Sort **EnergyPro** library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Explanation of Cooling Tower Equipment Inputs

General Tab

▦ Name

Enter a user-defined name identifying the Cooling Tower equipment. The Tower Name appears on the MECH-3 form of the report.

▦ Type

Select the cooling tower type from the drop-down list. Choices include: Open Circuit, Closed Circuit, and Closed Circuit Evap. Open cooling towers collect the cooled water from the tower and pump it directly back to the cooling system. Closed towers circulate the evaporated water over a heat exchanger to indirectly cool the system fluid.

▦ Capacity Control

Choose a type of capacity control to specify the control method which regulates the Tower exit temperature. The choices are:

- Variable-Speed Fan
- Two-Speed Fan
- One-Speed Fan
- Fluid Bypass

A Variable-Speed Fan modulates the airflow so that Tower capacity exactly matches the load at the desired set-point. This option simulates both variable speed drives as well as variable pitch fans.

A Two-Speed Fan causes the fan to cycle between off, low, and high speeds to maintain the Tower set-point. The reference design cooling tower contains a two-speed fan.

A One-Speed Fan cycles as often as required to maintain the Tower set-point. (In actual practice, fan cycling is usually limited to no more than 4-8 cycles per hour to protect the motor against burnout.)

Fluid Bypass utilizes a three-way valve to bypass water around the Cooling Tower. The valve modulates to maintain the Tower set-point, while the Tower fan runs continuously during all hours that a heat rejection load exists.

Output

Enter the Tower capacity in tons.

Range & Units:

Imperial (US):   0 - 9,999 tons

SI (Metric):   0.0 - 35,166.5 kW

Condenser Water Reset

Check the checkbox if the tower has a control to reset the exiting fluid temperature set-point in response to the wet-bulb temperature.

Wet Bulb-Reset causes the set-point to drop as the wet bulb drops. This approach recognizes that, as the wet bulb drops, the exiting Tower temperature can also drop without any increase in Tower energy consumption (although Tower energy might otherwise be saved). For a given Cooling Tower load, the Tower cannot achieve the same approach temperature as the wet bulb drops (i.e., the approach temperature will increase).

Approach Temperature

Enter the temperature difference between the wet bulb temperature of the building location and the temperature of the water leaving the Cooling Tower. The Title 24 reference design cooling tower approach temperature is equal to 10°F (5.6°C).

Range & Units:

Imperial (US):   1 - 20°F

SI (Metric):   0.6 - 11.1°C

Setpoint Temperature

Enter the cooling tower leaving water temperature set-point when the tower set-point control is fixed.

Range & Units:

Imperial (US):   32 - 100ºF

SI (Metric):   0.0 - 37.8ºC

Minimum Water Temperature

Enter the minimum tower leaving water temperature when the tower set-point control is wet bulb-reset.

Range & Units:

Imperial (US):   32 - 100°F

SI (Metric):   0.0 - 37.8°C

Tower Fan Tab

▦ Centrifugal Fan

Check the box if the tower has a centrifugal fan. The Standard Design system is modeled with an axial fan.

▦ (Fan Motor) Flowrate

Enter the total air flow rate of the tower fan at design conditions. This information is obtained from manufacturers' literature.

Range & Units:

Imperial (US):   0 - 999,999 cfm

SI (Metric):   0 - 999,999 L/s

▦ (Fan Motor) Design Power

Enter the power output of the tower fan motor at design conditions.

Range & Units:

Imperial (US): 0.000 - 99,999.000 hp (brake horsepower)

SI (Metric):   0.00 - 74,599.25 kW

▦ (Fan Motor) Drive Efficiency

Enter a value between zero and one hundred (%) to indicate the fan motor drive efficiency reflecting the losses associated with non-direct drive motors. A typical value for a belt-driven fan is 97%.

Range & Units: 0.0 - 100.0%

▦ (Tower Fan) Input as Watts

You may enter the fan motor data as watts as an alternative to entering the design power (bhp) and efficiency (%).

Range & Units: 0 – 9,999,999 watts

Boiler Library

The Boiler Library is used to define a library of hot water systems and boilers from which specific equipment is selected from within the Building Tree. The Boiler Library includes all the service water heaters and boilers used in the program calculations.

Typically, Water Heater or Boiler types are defined in the Boiler Library before entering the Building Tree. Then, as you work through the Building Tree, the Water Heaters or Boilers you need will be readily available. Of course, you can access the Boiler Library from the Plant Element in the Building Tree to define new Water

Heaters or Boilers or modify existing ones as you go. Simply click on the "New/Existing Boiler" entry box from the Heating Hot Water or Domestic Hot Water Tab, as appropriate, and select the Water Heater or Boiler you want to edit or create a new entry. You may want to develop your own DHW Library from the CEC Modernized Appliance Efficiency Database System (MAEDbS).

The Boiler Library included with the program may contain information on equipment which is no longer available. Be sure to check manufacturer's data for the current product lines before selecting systems from the library.

Explanation of Boiler Library Window

The Boiler Library window, displays a list of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Explanation of Boiler Inputs

Name

Enter a user-defined name identifying each Water Heater (DHW) or Boiler System.

Type

Choose the Water Heater or Boiler proposed for the building or space. The choices are:

- Gas Fired
- Electric Resistance
- Heat Pump
- Indirect Gas

Heat Pump Type

This field is enabled when the water heating type is set to Heat Pump. The choices are:

- Residential (NEEA-rated) Product
- Commercial Product
- UEF Rated
- Non-UEF Rated

Select NEEA HP

Click on this button to select a NEEA-rated water heater from the list of rated models. Per the Single Family ACM Reference Manual, Section 5.2.2.2, "The Northwest Energy Efficiency Alliance (NEEA) Advanced Water Heater Specification was developed to address critical performance and comfort issues of HPWH in colder climates. Tiers are incorporated into this specification recognizing variations in product performance and configuration. An HPWH that meets the NEEA Advanced Water Heater Specification performs significantly better in real world conditions, and an HPWH that meets the NEEA Tier 3 or higher can be used to meet the prescriptive requirement for newly constructed buildings, addition, and alteration."

The list of qualified NEEA HPWH products can be found at https://neea.org/img/documents/qualified-products-list.pdf.

Volume

Enter the volume of the system tank as listed in the CEC *Directory of Certified Water Heaters.* Tank volume must be set to zero 0 for instantaneous (tankless/on-demand) water heaters (e.g. Takagi T-K2 as listed in the default library). Click on the Import button, as explained below, to import data from the CEC directory.

Range & Units:

Imperial (US): 0.0 - 99,999.0 gallons

SI (Metric):   0.0 - 378,536.2 Liters

Input Rating

Enter the rated input of the system as listed in the CEC *Directory of Certified Water Heaters.* Click on the Import button, as explained below, to import data from the CEC directory.

Range & Units:

Imperial (US): 0 - 100,000,000 Btu/hr

SI (Metric):   0.0 - 29,310.0 kW

Uniform Energy Factor

The Uniform Energy Factor (UEF) is the federal efficiency metric for water heaters, effective June 12, 2017. The UEF allows a direct comparison across equipment as it uses the same efficiency descriptor for all residential (and some commercial) water heaters. In addition, the UEF test method includes updated draw patterns and outlet water temperature requirements to better reflect actual usage.

If the equipment is UEF-rated, enter the Uniform Energy Factor of the water heater as a decimal value (e.g., 2.5), and check the UEF-rated checkbox. This value is found in the CEC Appliance Efficiency Database. EnergyPro will convert the UEF into EF for compliance calculations.

The Energy Commission's Appliance Efficiency Regulations list the federal minimum efficiency requirements for various types of water heating equipment.

Range & Units: 0.00 - 10.00 (units N/A)

First Hour Rating

Enter the First Hour Rating for the water heater. The First Hour Rating is the amount of hot water a fully heated water heater can deliver in the first hour.

Flow Rating

When modeling a tankless water heater, enter the Flow Rating of the unit. The flow rating is the maximum hot water flow when all fixtures are running. When selecting the water heater size, the flow rating is an important consideration. Add up all the flow rates of all the hot-water fixtures and appliances to ensure the unit is able to adequately supply hot water during peak demand periods.

Range & Units: 0 – 99,999 gpm

Recovery Efficiency

Recovery Efficiency is a measure of the total amount of heat produced by the water heater that is then transferred to the water. Enter the recovery efficiency of the water heating system expressed as a fractional value (e.g., 0.78 instead of 78%). This value is found in the CEC *Directory of Certified Water Heaters* and in the CEC *Directory of Certified Boilers.* Note that in the case of certain types of boilers, this may be listed as a Thermal Efficiency or Combustion Efficiency.

Range & Units: 0.000 - 1.000 (units N/A)

▦ Electric Mini-Tank Standby

Enter the standby loss for the mini-tank, in watts, from the CEC's appliance directory.

Range & Units: 0.0 – 99,999 watts

▦ Standby Loss

Standby losses occur when heat is lost due to storage (e.g. hot water stored in a water tank). Enter the standby loss of the water heating system expressed as a fractional value (e.g., 0.038 instead of 3.8%/hr). This value is found in the CEC *Directory of Certified Water Heaters*.

Range & Units: 0.0000 - 9.0000 (units N/A)

▦ Pilot Energy

Enter the energy used by the standing pilot light (in Btu/hr) for boilers, large instantaneous and indirect water heaters.

▦ External Insulation

Enter the R-value (RSI) of the external tank insulation. This input is used only for indirect gas units and boilers.

Range & Units:

Imperial (US): 0.0 - 99.0 R-value

SI (Metric):   0.00 - 17.42 RSI

▦ Internal Insulation

Enter the R-value of the internal tank insulation. This input is used only for indirect gas units and boilers.

Range & Units:

Imperial (US): 0.0 - 99.0 R-value

SI (Metric):   0.00 - 17.42 RSI

Luminaire Library

Practice

The Luminaire Library is used to define a library of Light Fixture types and wattages from which specific Light Fixtures are selected within the Building Tree. This information is used in showing compliance with the Nonresidential Standards (see the *Residential Manual* Section 6.1 for lighting requirements).

In the Library Menu, select the library type you wish to use. For example, select *Default* or *Job-Name* and choose Light Fixture. You may either define the fixture types in the Lighting Library before entering the Building Tree or access the Lighting Library from the Lighting element to define new fixtures or modify existing ones as you go. Simply click on Fixture Type while in the Lighting element. Then double click the Light Fixture you want to edit or click the *New* button. The Lighting element may be a part of the Room element or the Task element (for Tailored Lighting Calculations).

NOTE: If you create or modify this Library through the Building Tree element, the first two buttons (on-screen options) will be different from those listed here. Instead of *Close* you will find *Select*; and the *Cancel* button will be active.

Explanation of Luminaire Library Window

The Luminaire Library window, displays a List of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

Sort library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Explanation of Lighting Inputs

All inputs (excluding the Light Fixture Name) regarding Indoor, Outdoor, and Sign Lighting elements are described further in the *Nonresidential/Multifamily Compliance Manual* in Chapters 5, 6 and 7 respectively. The values input here are listed on the Lighting Compliance forms.

Name

Enter a user-defined name identifying each Light Fixture. (e.g. if on the electrical plans there is a fixture named "A", label the fixture as "Fixture A"). This name appears on the LTG-1C form (Certificate of Compliance), so it should clearly describe the type, wattage and number of lamps in the fixture.

Type

Select the fixture type from the drop-down list. Choices include: General, Track, Portable, Small Aperture/Color Changing.

Total Watts

Enter total watts for the fixture, including lamp and ballast energy use. This value may be obtained from Appendix NA-8 of the CEC Reference Appendices, or from lighting manufacturers' literature.

Range & Units: 0.0 - 999,999.9 watts

Track Lighting   (Track Lighting) Type

Select the track lighting type from the drop-down list. Choices include: Standard Track 30w/ft, Current Limiter Track, Driver/Transformer, and Overcurrent Panel.

The wattage of these systems shall be determined as follows:

• The wattage shall be the greater of 30 watts per linear foot of track or plug-in busway or the rated wattage of all of the luminaires in the system (where the luminaire wattage is as specified by UL 1574, 1598, 2108, or 8750).

• For line-voltage track lighting and plug-in busway served by a track lighting current limiter, the wattage shall be the volt-ampere rating of the current limiter as specified by UL 1077.

• For line-voltage track lighting and plug-in busway served by a track lighting protection panel, the wattage shall be the sum of the ampere ratings of all the overcurrent protection devices times the branch circuit voltage for the track lighting protection panel.

• For other modular systems with power supplied by a driver, power supply, or transformer, including low-voltage lighting systems, the wattage shall be the maximum rated input wattage of the driver, power supply, or transformer as specified by UL 2108 or 8750.

Total Amps

For Overcurrent Panel track lighting, enter the total amps for the fixture.

Range & Units: 0 - 99,999 amps

Track Length

For Standard Track lighting, enter the length of the fixture, in linear feet.

Range & Units: 0 - 99,999 feet

Track Head Watts

For Standard Track lighting, enter the wattage for each head.

Range & Units: 0 - 99,999 watts

Number of Heads

For Standard Track lighting, enter the number of heads on the fixture.

Driver/Transformer Wattage

Enter the maximum rated input wattage of the driver, power supply, or transformer as specified by UL 2108 or 8750.

Overcurrent Panel Voltage

Enter the branch circuit voltage for the track lighting protection panel.

Ext. Lighting Cutoff Rating Required

Check the box if the luminaire is an exterior luminaire that must meet the luminaire cutoff requirements in Section 130.2(b). Complete the Exterior Backlight, Uplight, and Glare (BUG) ratings data fields.

Exterior BUG Ratings   All outdoor luminaires that emit 6,200 lumens or greater must comply with Backlight, Uplight, and Glare ("BUG") requirements contained in Section 5.106.8 of the CalGreen Code (Title 24, Part 11).

Backlight Mounting

Maximum allowable backlight rating is dependent on the lighting zone and the distance from property lines. Select the location of the back hemisphere of the luminaire from the drop-down list. Choices include:

> 2 Mounting Heights (MH) from property line

Back hemisphere 1-2 MH from property line

Back hemisphere 0.5-1 MH from property line

Back hemisphere < 0.5 MH from property line

🔢 Backlight Rating

Enter the luminaire backlight rating. This information is typically available from the manufacturer.

🔢 Uplight Rating

Enter the luminaire uplight rating. This information is typically available from the manufacturer.

🔢 Area Lighting

Enter the luminaire uplight rating. This information is typically available from the manufacturer.

🔢 Glare Mounting

Maximum allowable glare rating is dependent on the lighting zone and the distance from property lines. Select the location of the front hemisphere from the drop-down list. Choices include:

> 2 Mounting Heights (MH) from property line

Front hemisphere 1-2 MH from property line

Front hemisphere 0.5-1 MH from property line

Front hemisphere < 0.5 MH from property line

🔢 Glare Rating

Enter the luminaire glare rating. This information is typically available from the manufacturer.

Schedule Library

The Schedule Library contains three schedule types; fraction, temperature, and utility rate. Fractional (occupancy, lights, equipment, etc.) and temperature (heating and cooling setpoints) schedules are fixed within the program for compliance calculations and cannot be altered. Utility Rate schedules are optional inputs and can be used in residential and nonresidential performance projects.

In the Libraries Menu, select the library type you wish to use. For example, select Schedules. All Schedule types are normally defined in the Schedules Libraries before entering the Building Tree.

NOTE: Even if you are using the schedules only for load calculations, you always designate a Yearly Schedule. Therefore, you must create both a Weekly and a Yearly Schedule for the program to use the designated hourly data.

Explanation of Schedule Library Window

The Schedule Library window displays a List of library items on the left and the detailed data for the selected item on the right. The Library Commands at the top of the list allow you to add new, delete existing and re-arrange entries in the library.

EnergyPro contains an external database of gas and electric utility rates from utilities throughout the country. Select the Import button at the top of the Schedule Libraray window, then select the rate you wish to use, and Import.

Sort the software library items by any column heading. Simply click on the heading to activate the Sort feature. Click on the heading a second time and you will activate a reverse sort.

Explanation of Schedule Inputs

▦ Name

Enter a user-defined name identifying each Schedule.

▦ (Schedule) Type

Set the Schedule Type to Fraction, Temperature, or Utility Rate. On/Off Schedule types are a new feature in DOE-2.2.

- Choose Fraction for schedules covering occupancy, lights, equipment, infiltration, DHW, process and fans. Fraction schedules specify the fraction of the maximum number of occupants, etc., on an hourly basis.

- Choose Temperature for heating and cooling schedules. Temperature schedules specify heating and cooling setpoints on an hourly basis.

- Choose Utility Rate for utility rate schedules. Utility rate schedules specify rates on an hourly basis for fuels purchased from the local utility and used in your project.

- Choose On/Off for those schedule types which were previously modeled as fraction schedules, but do not actually have a fractional component. For example, fan schedules were previously modeled as fraction schedules using 100% to indicate the FANS ON condition, and 0% to indicate FANS OFF. On/Off Schedule types are a new feature in DOE-2.2.

Week Periods

Use this tool to create an annual schedule. Click the Add button ✛ to add a blank schedule and define the schedule characteristics as indicated below. Add weekly schedules to Select the weekly schedule and the date through which the schedule will be in effect. You may also re-arrange the order of the individual weekly schedules using the Library Commands buttons at the top of the list box.

▦ Period Name

Enter a user-defined name identifying the schedule for each period.

▦ Period Ending

Select the day from the calendar through which you want the Weekly Schedule in operation for the annual NR Performance simulation.

▦ Daily Schedule (Monday, Tuesday, etc.)

Choose one of eight daily boxes, *Monday* through *Sunday,* or *Holiday* to modify the hourly data defining each daily schedule. You may copy any daily schedule to any other day in the current schedule or to a different schedule (as long as the schedule types are the same). Right-click on any daily schedule, select **Copy** from the pop-up menu. To paste the schedule to another day, right-click on the target daily schedule and select **Paste** from the pop-up menu.

The software ignores all schedules (sets all hourly data to 100%) for Nonresidential Loads calculations, unless you choose a specific design day schedule for the program to use. Select **Calculations** from the list in the lower left window pane, then select Loads, and the relevant simulation options. There will be a drop-down

All schedules are used as defined in the NR Performance non-compliance energy analysis. Operating schedules are fixed for Title 24 compliance calculations.

Hourly Data (12:00 - 1:00 am, etc.)

Fraction Schedules (Under Type Select Fraction)

Select the day you wish to alter by clicking on the day of the week. A graphical function will appear. You may then specify the fraction of the maximum number of occupants, equipment load, etc. for each of 24 hourly values. Drag the mouse up or down in the column to adjust the number, or use the keyboard to enter the value in the edit box at the bottom of the column.

Range & Units: 0 to 100 (% of maximum).

Temperature Schedules

Specify the heating or cooling setpoint for each of 24 hourly values. Drag the mouse up or down in the column to adjust the number, or use the keyboard to enter the value in the edit box at the bottom of the column.

Range & Units: 0 to 100°

Utility Rate Schedules

Select the rate from the choices, which include: Summer Peak, Summer Part Peak, Summer off Peak, Winter Part Peak, and Winter off Peak, or Summer/Winter, at which projected energy use will be charged for each of 24 hourly values. The energy and demand charge for each rate selected is specified in the Yearly Schedule.

On/Off Schedules

Choose On/Off (0% or 100% only) for those schedule types which were previously modeled as fraction schedules, but do not actually have a fractional component. For example, fan schedules were previously modeled as fraction schedules using 100% to indicate the FANS ON condition, and 0% to indicate FANS OFF. On/Off Schedule types are a new feature in DOE-2.2.

Utility Rates…

Click the Utility Rates… button to access the Rate dialog box to enter the various costs which, together, constitute the utility rate. The button is only enabled when the Schedule Type is set to Utility Rate.

You may also import a utility rate from an external database of electric and gas utility rates from all the major utilities throughout California. Select the Import button at the top of the Schedule Library window, then select the rate, and finally, select Import.

Edit Utility Rate Dialog

Within the Schedule Library select the *Type* Utility Rate and click on the Utility Rates button. A **dialog** box will appear named Edit Utility Rates.

Utility Rate ID

Enter a reference or descriptive text to identify the Utility Rate.

Monthly Charges   **Meter Charge ($)**

Enter the base monthly charge, sometimes referred to as a meter charge or customer charge. If there is more than one monthly charge, add all monthly charges together and enter the total. This charge is not associated with or dependent on the amount of energy use or demand.

Range & Units: $0.00 - $99,999.00

Min. (Minimum) Total Charge ($)

Enter the minimum monthly charge the customer must pay in the event there is no energy use during the billing period. Note that the minimum charge is often implemented on a per day basis. You will have to convert the charge to a monthly number (by multipying the charge per day, by the number of days in the month).

Range & Units: $0.00 - $99,999.00

Demand Charge ($)

Enter the monthly maximum demand charge (per unit), if applicable. Demand charges may not apply to your project, depending on the fuel type (availability) and rate structure.

Range & Units: $0.00 - $99,999.00

Min. (Minimum) Demand Charge ($)

Enter the minimum demand charge, if applicable.

Range & Units: $0.00 - $99,999.00

Tax (%)

Enter the applicable tax rate (as a percentage), if any.

CO_2

Enter the number of pounds of CO_2 emissions per unit of energy use for the specific utility and rate.

Rate Schedules

Enter a descriptive name for each Rate Schedule. Use the Rate Schedule to enter the cost for each component of the utility rate. You can create flat rates, block rates, and time-of-use rates for each fuel used in your project. The table enables you to enter energy and demand charges and the ranges independently.

Energy Tiers

Enter the number of energy use tiers in the utility rate structure. Many rates, often called block rates, contain different charges for each successive amount, or block, of energy use. For example, consider a two-tier winter natural gas rate. The customer is charged $0.50/therm up to 500 therms. All energy use exceeding 500 therms is charged at a rate of $0.75/therm. First, type in a value ($) for the charge and a second row will appear where you may enter the amount of the second tier, and so on . Enter $0.50 for the first tier energy charge and 500 for the first tier (energy) limit. Then enter $0.75 as the second tier energy charge.

If the charge per unit of energy use remains constant regardless of the amount of energy use, enter the charge per unit in the first row, and no limit.

Charge ($)

Enter the cost (in dollars) per unit of energy used for each tier in the rate. For example, if you are creating an electricity rate, enter the cost per kWh (kilowatt-hour); if it is a natural gas rate, enter the cost per therm.

Range & Units: $0.00 - $1.00

(Energy) Limit

Enter the maximum number of energy units in each tier, or block. If the number is unlimited, do not enter anything in this input.

Range & Units: 0 - 9,999,999 (units N/A)

Demand Tiers

Enter the number of demand tiers in the utility rate structure. Many rates, often called block rates, contain different charges for each successive amount, or block, of energy demand. For example, consider a two-tier summer electricity rate. The customer is charged $5.00/kW (kilowatt) of demand up to 50 kW. For every unit of demand exceeding 50, the rate is $10.00/kW. Enter $5.00 for the first tier demand charge and 50 for the first tier demand limit. Then enter $10.00 as the second tier demand charge.

If the charge per unit of demand remains constant regardless of the amount, enter the Charge per unit in the first row and no limit.

Charge ($)

Enter the cost (in dollars) per unit of demand for each tier in the rate. For example, if you are creating an electricity rate, enter the cost per kW (kilowatt).

Range & Units: $0.00 - $100.00

(Demand) Limit

Enter the maximum number of demand units in each tier, or block. If the number is unlimited, do not enter anything in this input.

Range & Units: 0 - 999,999 (units N/A)

Edit Location Dialog Box

Practice

The Edit Location Dialog Box opens when you check the "User Defined" checkbox and select "Edit" from the Project Design Data Tab of the Building Element. To customize an existing location or create a new (user-defined) location, you must complete the data in the Geographical Data, and Seasonal Data tabs. The Dialog Box also includes Temperature Profile and Solar Gain Profile tabs that provide graphical displays of the weather characteristics.

To create a new location, select a city which is close in proximity to the city you want to identify by clicking *Select* under Location. A list of United States and Canadian cities will appear. Click on the city and click OK.

Then check the box named *User Defined* and select *Edit* to open the Edit Location Dialog Box. Enter the new location data where required, and select *OK* to save the changes or *Cancel* to close the dialog box without saving any changes. The location data is not a library, and your entry will not be shown in the location list in future projects.

The Location data includes all 821 California ASHRAE locations and design data contained in the *Climatic Data For Region X - *** Arizona, California, Hawaii and Nevada* by the Golden Gate and Southern California Chapters of the American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE): Fifth Edition, May 1982. The publication is cited as the official source for location data for design load calculation in the *Standards*. The Location Library that comes with the program also contains the correct California climate zone associated with each ASHRAE location and additional data that was published as a supplement to the above listed ASHRAE publication.

The *Climatic Data For Region X* publication may be ordered from:

Order Desk
Building News
3055 Overland Avenue
Los Angeles, CA 90034

(800) 873-6397 or (213) 202-7775

Geographical Data Tab Country

Enter the name of the country in which the city is located.

State

Enter the name of the state in which the city is located.

City

Enter the name of the city.

Location

Latitude

Enter the north latitude of the location.

Range & Units: -90.0 - 90.0°

Longitude

Enter the longitude of the location.

Range & Units: -180.0 - 180.0°

Elevation

Enter the altitude above sea level of the location. You may need to convert between meters and feet (1 meter = 3.28 feet).

Range & Units:

    Imperial (US):   -999.0 - 99,999.0 feet

    SI (Metric):   -304.5 - 30,479.7 meters

🖩 Time Zone

Enter the number of hours ahead or behind (positive or negative) the location is with respect to Greenwich Mean Time (or the Coordinated Universal Time, UTC) reference. This value is not used for calculations, it is included for reference only.

Compliance Data

🖩 CA Climate Zone

Enter the California climate zone of the location. Look up climate zones for several thousand specific California cities, towns and other locations are listed on the California Energy Commission web site at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/climate-zone-tool-maps-and.

🖩 DOE Climate Zone

Enter the DOE Climate Zone designation of the location. ASHRAE publishes a list of major United States cities and their respective Climate Zone designations as well as a map depicting the zone definitions. ASHRAE also publishes a list of Canadian and other international cities, and a methodology for determining the climate zone for any international location based primarily on the number of heating and/or cooling degree days.

Weather File

🖩 Filename

For Title 24 compliance calculations, EnergyPro uses the CEC weather files and design conditions as documented in the Reference Appendices, Joint Appendix JA2.

For non-compliance calculations, you may use alternative weather files or add locations that aren't in the EnergyPro database. Browse your computer to locate and select the weather file which the program will use for a NR Performance simulation. *Note that this does not affect the weather data that the program uses for the NR Title 24 Performance Compliance run.* Refer to the DOE-2 user's manual for instructions on how to pack source files for use with DOE-2.1E.

You may add locations that aren't included in the EnergyPro location database. Download the BIN file for the location from the following web site http://www.doe2.com. Place the files in the EnergyPro weather folder, usually located at the following path if installed locally-- C:\Program Files (x86)\EnergySoft\EnergyPro 9\Weather.

Return to the Project Design Data tab of the Building Element, check the User Defined Location box, and select Edit. Browse to the Weather File list and select your file. Note that the BIN files do not replace the Design Data on the Seasonal Data tab; you must input the ASHRAE design conditions for the location, from the Handbook of Fundamentals.

🖩 NOAA Station ID

Enter the name of the NOAA Station ID from which the weather data was collected. This information is not used for calculations, it is included for reference only.

▦ Utility - Electric

Select the Utility that provides electricity to this location.

▦ Utility – Natural Gas

Select the Utility that provides natural gas to this location.

Seasonal Data Tab **Summer Conditions**

Three boxes require input for Summer Conditions: 0.5%/0.4%, 1.0%, and 2.0%.
Enter for each, the Design Dry Bulb, Mean Coincident Wet Bulb and Design Wet
Bulb temperatures. The Standards recommend the 0.5%/0.4% temperature value for residential cooling
calculations; and a value no greater than the 0.5% temperature for nonresidential cooling calculations. The
default value used by the program is the 0.5%/0.4% temperature.

▦ (Summer Conditions) Design Dry Bulb

Enter the design summer dry bulb temperature (temperature of air) of the location.

Range & Units:

Imperial (US):   40 - 150ºF

SI (Metric):   4.4 - 55.6ºC

▦ (Summer Conditions) Mean Coincident Wet Bulb

The wet bulb temperature is a function of the ambient air and humidity. The mean coincident wet bulb
temperature describes average values that occur to cooresponding design wet and dry bulb temperatures.

Enter the summer mean coincident wet bulb temperature of the location.

Range & Units:

Imperial (US):   40 - 90ºF

SI (Metric):   4.4 - 32.2ºC

▦ (Summer Conditions) Design Wet Bulb

Enter the summer design wet bulb temperature of the location.

Range & Units:

Imperial (US):   40 - 90ºF

SI (Metric):   4.4 - 32.2ºC

▦ Summer Daily Temperature Range

The outdoor daily range of summer dry bulb temperatures of the location.

Range & Units:

Imperial (US):   0 - 99ºF

SI (Metric):   0.0 - 55.0ºC

▦ Winter Conditions

One box requires input for Winter Conditions: Enter the temperature for Median/Mean of Extremes, Dry Bulb (0.2%) and Dry Bulb (0.6%) temperatures. Heating design temperatures should be no lower than the median of extremes, according to the Standards.

▦ (Winter Conditions) Median/Mean of Extremes

Enter the winter median of extremes of the location. This is the default value used by the program.

Range & Units:

Imperial (US):   -99 - 90⁰F

SI (Metric):   -72.8 - 32.2⁰C

▦ (Winter Conditions) Design (0.2%/0.4%)

Enter the design winter dry bulb temperature of the location.

Range & Units:

Imperial (US):   -99 - 90⁰F

SI (Metric):   -72.8 - 32.2⁰C

▦ (Winter Conditions) Design (0.6%/1.0%)

Enter the design winter dry bulb temperature of the location.

Range & Units:

Imperial (US):   -99 - 90⁰F

SI (Metric):   -72.8 - 32.2⁰C

▦ Ground Temperature

Enter the effective ground temperature for the peak heating load calculations for the location.

Range & Units:

Imperial (US):   -99 - 90⁰F

SI (Metric):   -72.8 - 32.2⁰C

Temperature Profile Tab   ▦ Summer Design Conditions

Select a Summer Design Condition to graph in the Chart. Choices include: ASHRAE 0.5%, 1.0%, and 2.0% Summer Design Conditions.

▦ Use Design Wetbulb

Check the checkbox to show the design wetbulb temperature in the graph instead of the Mean Coincident Wetbulb temperature.

🏛 Month

Select the month to display in the hourly temperature graph for the location.

Solar Gain Profile Tab

🏛 Orientation

Select the orientation to display in the hourly solar gain graph for the location.

🏛 Month

Select the month to display in the hourly solar gain graph for the location.

Calculations

Depending on the modules you have installed and the building type, you may perform any of the residential or nonresidential calculations for a building description file. EnergyPro allows you to perform multiple calculations at one time and view the results for each in the bottom right window pane. Select Calculations from the list in the lower left window pane to display the list of calculations. Check the checkbox adjacent to each calculation you wish to perform and choose the calculation options displayed in the upper right window pane.

Calculations modules include three basic functions: selecting which calculations to run (Options), running the calculations (Calculate), displaying results and diagnostic messages (Results).

To access the Calculations functions, select Calculations from the list in the lower left window pane.

Note that all Title 24 calculations require access to the internet.

Modules

Single Family Modules

- Single Family Title 24 Prescriptive
- Single Family Title 24 Performance
- Single Family Loads
- Single Family GreenPoint Rated (GPR) Performance
- Single Family Performance

Nonresidential/Hotel Motel (and Multifamily) Modules

- NR Title 24 Mandatory
- NR Title 24 Envelope
- NR Title 24 Indoor Lighting
- NR Title 24 Mechanical and Load Calculations
- NR Title 24 Prescriptive Outdoor Lighting
- NR Title 24 Process Loads
- NR Title 24 Performance
- NR ASHRAE 90.1 Performance
- NR Performance (non-T24 compliance)

Compliance and Report Managers

The **Single Family Title 24 Performance** and **NR T24 Performance** modules are state-approved computer software for the Performance method, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 10-109(c), Compliance Software…. All Title 24 performance compliance calculations

use the CEC 2022 Compliance Manager, the simulation and compliance rule implementation software required by the Commission. This Compliance Manager includes many advanced modeling capabilities including the modeling of solar gains, thermal mass and airflows. The Single Family Title 24 Performance module uses the CBECC-Res compliance manager, and the NR Title 24 Performance module uses the CBECC compliance manager.

As part of the compliance software requirements, all programs must access electronic versions of the compliance forms from an Energy Commission web server. Energy analysts using the software for Title 24 compliance will need internet access to generate a Title 24 compliance report for submittal to the building department. You may find additional detail regarding the CEC compliance software on the CEC's website on the 2022 Energy Code Compliance Software page.

In addition, EnergyPro 9 NR Prescriptive modules produce the 2022 Prescriptive Title 24 forms generated by the CEC's online reporting webservice. You MUST have full access to the Internet to generate the forms. Should EnergyPro fail to generate these forms, you may need to contact your IT department to request that they disable ALL security blocking to allow for the generation of the forms. Access to the following site is required: https://nonresdocs.com

Options

Each calculation module allows you to select specific calculation **Options** that identify which calculations to run, the scope of each project, and several other options.

Calculation Options

Single Family Calculations:

Single Family Title 24 Performance

Single Family GreenPoint Rated

Single Family Performance

Loads

Single Family calculations are only performed on zones which are designated as single family residential occupancies. The software ignores any nonresidential, hotel/motel and multifamily residential occupancies when you select a single family residential calculation.

Nonresidential Calculations:

NR Title 24 Prescriptive

NR/MF Title 24 Performance

NR ASHRAE 90.1 Performance

NR Performance

NR Loads

Calculate

You may run selected calculations by clicking on the Calculate button in the toolbar. EnergyPro runs all the calculations (for the project occupancy type) that have been selected in the Calculations list. When the calculations are complete, all results are displayed in tabbed format in the bottom-right window pane. Each results tab is labeled with the calculation type (e.g., NR T24 Performance).

You must re-calculate each time you make changes to your file to update Results. If you try to view or print reports after changes were made to the file but you did not recalculate, EnergyPro displays a message reminding you to update your results. You may view and print the reports, but the results will not reflect the changes.

Results

EnergyPro displays the <u>most recent</u> calculation results in tabbed format in the lower-right window pane. Each results tab is labeled with the calculation type (e.g., NR T24 Performance). Click on any tab to display the results. In addition, EnergyPro displays the Input Diagnostic messages on a separate tab in the results pane. Input Diagnostics provide guidance at five different levels, ranging from Information to Errors. Double-click on any message in the Diagnostic Tab, Location List Box, and EnergyPro will take you to the source of the message.

Note that for residential projects, EnergyPro displays the results for all end-use categories in the simulation, including the non-regulated components. The total TDV energy use includes all components (regulated and non-regulated). However, the "Savings" category includes only the regulated components, and displays the percentage above or below the Standard Design compliance budget.

You may adjust the results display size on the screen by dragging the upper bar of the Results pane up to enlarge the display or down to show only the tabs at the bottom of the screen.

View Results Details

Single Family Calculations:

Single Family Title 24 Prescriptive

Single Family Title 24 Performance

Single Family GreenPoint Rated

Single Family Performance

Single Family Loads

Nonresidential and Multifamily Calculations:

NR Title 24 Prescriptive

NR/MF Title 24 Performance

NR ASHRAE 90.1 Performance Results

NR Performance Results

NR Loads

Single Family Title 24 Prescriptive Calculation

The **Single Family Title 24 Prescriptive** module is a computerized version of the Single Family Prescriptive method for additions and alterations (modeled as Addition Only or Existing + Addition + Alteration). The prescriptive calculation is only valid for Additions and Alterations since new construction projects require HERS registration.

The results document whether the project meets the prescriptive requirements and EnergyPro completes the forms required for registration and building department submittal. Because there are no tradeoffs or substitutions in the Prescriptive Approach, and each element of the project must meet the minimum requirement, the module doesn't perform a simulation, or provide any calculation options. The software does

perform some calculations, such as calculating the maximum allowed window area, and weighted average U-factors.

Information about the prescriptive requirements is contained throughout the Single Family Residential Compliance Manual, depending on the scope of the specific project. Single Family additions and alterations are covered in Chapter 9.

Single Family Title 24 Prescriptive Results

As noted above, the Single Family Title 24 Prescriptive module does not perform a simulation of the building so the results pane for this module is very simple. If the project complies, EnergyPro reports only that fact on-screen. If the project does not comply, EnergyPro displays the results in two tabs. The first tab displays a notification of compliance status, and the second tab lists each component of the project that doesn't meet the minimum prescriptive requirement. In addition to listing the feature, EnergyPro indicates the proposed value and the minimum requirement for prescriptive compliance.

Single Family Title 24 Prescriptive Reports

EnergyPro's Single Family Title 24 Prescriptive module creates the forms required for HERS registration (if necessary) and for submittal to the building department.

You may create a Single Family Title 24 Prescriptive report irrespective of the calculation results, but EnergyPro will print a watermark indicating that the project does not comply if any of the project features fail to meet the minimum prescriptive requirement. The Single Family Title 24 Prescriptive report contains one of the following compliance forms, depending on the project scope:

CF1R-ADD-02-E – Additions 1,000 ft^2 or less, or Additions that do not require HERS verification

CF1R-ALT-05-E – Alterations that do not require HERS verification

EnergyPro will also create the files required to register addition or alteration projects that do require HERS verification. EnergySoft has created detailed instructions on registering projects with a HERS Provider to help you through the process.

In addition to the official compliance forms, you may also wish to include some of the supporting documentation EnergyPro can provide, such as the Mandatory Measures form, as a convenient reference, or the RMS Summary form for a one-page project summary.

Single Family Title 24 Performance Calculation

EnergyPro is a state-approved residential computer Performance method, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 10-109(c), Compliance Software. The Residential Title 24 calculations use the CEC 2022 Compliance Manager, the simulation and compliance rule implementation software required by the Commission. This Compliance Manager includes many advanced modeling capabilities including the modeling of solar gains, thermal mass and airflows.

As part of the compliance software requirements, all programs must access electronic versions of the compliance forms from an Energy Commission web server. Energy analysts using the software for Single Family Title 24 compliance will need internet access to generate the final Title 24 reports for building department submittal.

The following excerpt from Section 1.3 of the 2022 Single Family Residential ACM Reference Manual summarizes the single family compliance calculation process:

> *Compliance for newly constructed buildings requires calculating the proposed design energy use, the standard design energy budget, and the reference design energy use. There may also be additional internal calculations to establish the standard design photovoltaics (PV) requirement and the proposed design PV scaling and when target energy design ratings (EDR) ratings are specified. There are two EDRs that are considered in the energy budget that are described in more detail in this chapter and Section 1.5 Energy Design Rating.*

The proposed building shall separately comply with the source energy design rating (EDR1), efficiency energy design rating (Efficiency EDR2), and total energy design rating (Total EDR2). No tradeoffs are allowed between EDR1 and EDR2. Compliance with EDR2 requires meeting two criteria. First, the proposed design Efficiency EDR2 must be equal to or less than the standard design Efficiency EDR2. Second, the proposed design Total EDR2 must be equal to or less than the standard design Total EDR2.

Single Family Title 24 Performance Calculation Options

The **Single Family Title 24 Performance** calculation is a state-approved alternative compliance method (performance simulation), as described in [Chapter 8 of the Single Family Residential Compliance Manual](). The 2022 Standards introduced a third energy metric, Hourly Source Energy (EDR1) in addition to the two EDR metrics (efficiency and total). ***The building complies when the Proposed Efficiency EDR2 Score is less than or equal to the Standard Efficiency EDR, the Proposed Total EDR2 is equal to or less than the Standard Total EDR2, and the Proposed Source Energy EDR1 is equal to or less than the Standard Source Energy EDR1.***

Compliance Calculations

Run Standard: Runs the Standard Design which sets the energy budget for the single family building as explained in Chapter 8 of the *Single Family Residential Compliance Manual*.

Run Proposed: Runs the Proposed Design whose energy use is compared to the Standard energy budget as explained in Chapter 8 of the *Single Family Residential Manual*.

Scope

Run Four Orientations: Runs the building in all four cardinal orientations. Select this option only when you are showing compliance for a residential project that will be built multiple times within a subdivision. If the design complies in all four cardinal orientations, it may be built facing any orientation within the subdivision.

Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

Generate CSV Output File Containing Detailed Results: Check this box to create and save a CSV file that includes detailed simulation results. EnergyPro saves the file in the Results folder under the project name with a .csv extension.

Run Quick Analysis (Not for Compliance): Check this box to run an analysis that produces results approximately 40 percent faster than a full compliance simulation. Results are typically within 5% of the more detailed and lengthy compliance simulation. You must run the full compliance simulation to obtain a CF1R that can be registered.

View CBECC Log File: Click this button to view the log file created by the CBECC-Res engine. The file is a text file that lists each of the CBECC engine actions. It can be quite long and repetitive but can also provide clues regarding the source of an error. Start at the bottom of the file to find errors more easily.

View CSE Error File: Click this button to view the detailed error log file created by the California Simulation Engine (CSE).

Do Not Generate CF1R at End of Calculation (allows offline calcs): Check the box if you do not want to generate a compliance report for the calculation. This option allows you to perform calculations without an internet connection (the report requires connection to the CBECC site).

Single Family Title 24 Performance Results

Note that for single family projects, EnergyPro displays the results for all end-use categories in the simulation, including the non-regulated components. The Total TDV (EDRt) energy use column includes all components (regulated and non-regulated).

The performance calculation includes the following components: Space Heating, Space Cooling, IAQ Ventilation, Water Heating, Self Utilization/Flexibility Credit, Photovoltaic System, Battery Storage, Flexibility, Indoor and Outdoor Lighting, Appliances and Cooking and Plug Loads. The energy use for the lighting, appliances and cooking, and plug loads is included in the simulation but held constant and is not part of the compliance calculation.

See Chapter 8 in the Single Family Residential Compliance Manual for a detailed discussion of the Performance Method.

<u>**Components of the Single Family Title 24 Performance Calculation Results**</u>

    Calculation: Lists Standard and/or Proposed, depending on your selection(s) in Options. Lists the results for the proposed building facing North, East, South, and West when "Run Four Orientations" is selected.

    Heating: Lists the annual space heating Time Dependent Valuation (TDV) energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Cooling: Lists the annual space cooling TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Interior Lighting: Lists the annual interior lighting TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Exterior Lighting: Lists the exterior lighting TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Appliances: Lists the annual appliances TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Receptacle: Lists the annual receptacle TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    PV: Lists the annual renewable TDV energy generated (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    Battery: Lists the annual TDV energy used via battery storage (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    IAQ: Lists the annual TDV energy (in TDV kBtu/sf-yr) used to maintain indoor air quality for the Standard and/or Proposed designs.

    DHW: Lists the annual domestic hot water system TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

    EDR2: The Source Energy EDR1 score for the standard and/or proposed building.

    EDRe: The Efficiency EDR2 score for the standard and/or proposed building.

    EDRt: The Total EDR2 score for the standard and/or proposed building.

Single Family Title 24 Performance Reports

EnergyPro creates reports documenting the project's energy features, estimated energy usage, and energy costs. The CEC requires that all software use the CEC Report Manager, which requires an internet connection. See Printing Reports for basic instructions on how to create a report. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

The forms and documentation needed for compliance submittal include an electronic version of the CF1R form. If the project includes features that require HERS field verification, the forms must be registered with a HERS provider. Supporting documentation that may also be required includes equipment manufacturer specification sheets, roofing material rating from the Cool Roof Rating Council, solar water heating documentation to support a modeled solar fraction, AHRI certified efficiency of cooling, heating and/or water heating equipment, NFRC certified U-factor and Solar Heat Gain Coefficient for windows and skylights.

EnergyPro Single Family Title 24 Performance reports typically include the following forms:

- Cover Page
- Table of Contents
- Form CF1R – Certificate of Compliance
- Form RMS-1 Residential Measures Summary
- Form MF-1R – Mandatory Measures Summary
- HVAC System Heating and Cooling Loads Summary

EnergyPro provides additional forms for your convenience should you wish to include them in the report, as listed below:

- HVAC Zone Load Summary
- Room Load Summary
- Room Heating Peak Loads
- Room Cooling Peak Loads
- Form ECON-1 Energy Use and Cost Summary
- Form ECON-2 Energy Upgrade Recommendations
- Project Summary
- Energy Use Summary

NOTE: All pages of the performance report show the date and time the report was produced. For all single family buildings for which compliance requires HERS field verification, all compliance documentation (Certificates of Compliance, Installation, and Verification) required for the dwelling unit must be submitted for registration and retention to a HERS Provider data registry. Once registered, each page will show the Registration Number, Registration Date/Time, and the HERS Provider Name.

Basis and Capabilities of the Single Family Title 24 Performance Calculation

Single Family Title 24 Performance is a state-approved residential computer Performance method, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 10-109(c), Compliance Software. The Single Family Title 24 calculations use the CEC 2022 Compliance Manager, the simulation and compliance rule implementation software required by the Commission. This Compliance

Manager includes many advanced modeling capabilities including the modeling of solar gains, thermal mass and airflows.

As part of the compliance software requirements, all programs must access electronic versions of the compliance forms from a California Energy Commission web server. Energy analysts using the software for Single Family Title 24 compliance need internet access to generate the final Title 24 reports for registration and building department submittal.

[The following text explaining computer performance methods is contained in Section 8.1 of the *Single Family Compliance Manual.*]

> *The performance method provides maximum flexibility to trade off the energy performance of different building components to achieve compliance. For new construction, the energy budget is expressed in terms of the Energy Design Ratings (EDR), which are based on source energy and time-dependent valuation (TDV) energy. The EDR is a score from 0 to 100, where 0 represents a building that has zero net energy consumption based on the TDV energy consumption and 100 represents a building that meets the 2006 International Energy Conservation Code. This is the same criteria for a score of 100 for the National Home Energy Rating System. Energy Commission-approved compliance software programs calculate an EDR for the building (proposed efficiency) and compare it to the energy budget (standard efficiency). Approved compliance programs also calculate an EDR for proposed photovoltaic (PV)/demand flexibility and compare it to the standard PV/flexibility budget.*

> *Energy Design Rating 1 (EDR1) is based on hourly source energy. Energy Design Rating 2 (EDR2) is based on TDV energy and has two components, the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The Total Energy Design Rating accounts for both the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The proposed building must separately comply with the Source Energy Design Rating (EDR1), Energy Efficiency Design Rating (Efficiency EDR2) and the Total Energy Design Rating (Total EDR2).*

> *The standard efficiency includes water heating, space heating, space cooling, indoor air quality (IAQ) fan energy, and solar generation. Energy use from lighting and appliances is not eligible to be traded off.*

> *The Energy Commission-approved compliance software programs calculate space-conditioning and water-heating energy use in accordance with a set of rules. Modeling capabilities are in the Residential Alternative Calculation Method (ACM) Reference Manual. All approved software programs use the California simulation engine to simulate the energy use, and the same report generator to create the certificate of compliance (CF1R), as the public domain program, California Building Energy Code Compliance - Residential (CBECC-Res).*

A computer method can perform a significant number of calculations to project the interactive thermal effects of many different building components in conjunction with specific outdoor weather conditions. The calculations include:

- Heat gain and heat loss through walls, roof/ceilings, floors, fenestration and doors
- Solar gain through fenestration as affected by orientation, fixed shading or operable shading devices
- Natural ventilation by operable windows and infiltration through cracks and porous surfaces in the building envelope
- Heat storage effects of different types of thermal mass in buildings with large amounts of mass (e.g., passive solar buildings)
- Efficiencies of mechanical heating and cooling equipment and duct systems
- PV system production and impacts of location, tilt, and other system components on capacity.

Computer simulations are generally the most detailed and flexible compliance path. The energy performance of a proposed building design can be calculated according to actual building geometry and site placement. Also, credit for certain conservation and decarbonization features, such as improved equipment efficiency or reduced building envelope leakage, cannot be taken in the prescriptive packages, but can be evaluated with an approved computer method.

NOTE: Use of a computer method may require special documentation associated with particular features such as radiant barriers or solar thermal systems. Refer to the relevant sections in the Single Family Manual for additional information. Similarly, compliance credit for features, such as improved duct efficiency or reduced building envelope air leakage, that require diagnostic testing and field verification also require special documentation and processing. See Section 2.5 of the Residential Manual, and Sections RA2 and RA3 of the Reference Appendices for HERS Field Verification and Diagnostic Testing requirements.

The Commission approves the alternative calculation method according to the procedures outlined in Standards Sections 10-109 and 10-110. The procedures are detailed in the *Single Family Residential Alternative Calculation Method (ACM) Approval Manual.*

The Commission maintains a listing of approved computer programs. This list may be obtained from the Commission's Publications Office, by calling the Energy Hotline at (800) 772-3300, or online at https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-1

Excerpt from Standards, Section 150.1(b)

> **Performance Standards**. *A building complies with the performance standards if the energy consumption calculated for the Proposed Design Building is no greater than the energy budget calculated for the Standard Design Building using Commission-certified compliance software as specified by the Alternative Calculation Methods Approval Manual.*
>
> 1. **Newly Constructed Buildings.** *The Energy Budget for newly constructed buildings is expressed in terms of the Energy Design Ratings, which are based on source energy and time-dependent valuation (TDV) energy. The Energy Design Rating 1 (EDR1) is based on source energy. The Energy Design Rating 2 (EDR2) is based on TDV energy and has two components, the Energy Efficiency Design Rating, and the Solar Electric Generation and Demand Flexibility Design Rating. The Total Energy Design Rating shall account for both the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The Proposed Building shall separately comply with the Source Energy Design Rating, Energy Efficiency Design Rating and the Total Energy Design Rating.*
>
>   **EXCEPTION to Section 150.1(b)1.** *A community shared solar electric generation system, or other renewable electric generation system, or community shared battery storage system, which provides dedicated power, utility energy reduction credits, or payments for energy bill reductions, to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system and demand flexibility Energy Design Rating required to comply with the Standards, as calculated according to methods established by the Commission in the Residential ACM Reference Manual.*
>
> 2. **Additions and Alterations to Existing Buildings.** *The Energy Budget for additions and alterations is expressed in terms of TDV energy.*
>
> 3. **Compliance Demonstration Requirements for Performance Standards**.
>
>   A. **Certificate of Compliance and Application for a Building Permit.** *The application for a building permit shall include documentation pursuant to Sections 10-103(a)1 and 10-103(a)2 which demonstrates, using an approved calculation method, that the building has been designed so that its Energy Efficiency Design Rating and the total EDR meets or exceeds the Standard design EDR for the applicable Climate Zone.*

> *EXCEPTION to Section 150.1(b)3A: Multiple Orientation: A permit applicant may demonstrate compliance with the energy budget requirements of Section 150.1(a)3 and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.*

B. **Field Verification**. *When performance of installed features, materials, components, manufactured devices or systems above the minimum specified in Section 150.1(c) is necessary for the building to comply with Section 150.1(b), or is necessary to achieve a more stringent local ordinance, field verification shall be performed in accordance with the applicable requirements in the following subsections, and the results of the verification(s) shall be documented on applicable Certificates of Installation pursuant to Section 10-103(a)3 and applicable Certificates of Verification pursuant to Section 10-103(a)5.*

i. **EER/EER2/SEER/SEER2/CEER/HSPF/HSPF2 Rating.** *When performance compliance requires installation of a space conditioning system with a rating that is greater than the minimum rating required by TABLE 150.1-A or specified for the standard design, the installed system shall be field verified in accordance with the procedures specified in the applicable sections of Reference Residential Appendix RA3.4.*

ii. **Variable Capacity Heat Pump (VCHP) Compliance Option.** *When performance compliance requires installation of a heat pump system that meets all the requirements of the VCHP compliance option specified in the ACM Reference Manual, the system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.4.3.*

iii. **Low Leakage Air Handler.** *When performance compliance requires installation of a low leakage air-handling unit, the installed air-handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.*

iv. *RESERVED*

v. **Heat Pump - Rated Heating Capacity.** *When performance compliance requires installation of a heat pump system, the heating capacity values at 47° F and 17° F shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.*

vi. **Whole-house fan**. *When performance compliance requires installation of a whole-house fan, the whole-house fan ventilation airflow rate and fan efficacy shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.9.*

vii. **Central Fan Ventilation Cooling System**. *When performance compliance requires installation of a central fan ventilation cooling system, the installed system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.3.4.*

viii. **Building Enclosure Air Leakage**. *When performance compliance requires a building enclosure leakage rate that is lower than the standard design, the building enclosure shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.8.*

ix. **Quality Insulation Installation (QII).** *When performance compliance requires field verification of QII, the building insulation system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.5.*

Combined Energy Budget: Space Conditioning and Water Heating Energy Use

Each approved computer method uses the Compliance Manager to automatically generate the Standard Design EDR Score (effectively, the **energy budget)** by calculating the annual TDV energy use of the **standard design**, a version of the proposed building incorporating all the conservation features of prescriptive Package in the Standards, Table 150.1-A, and converting the TDV energy use to the EDR Score.

Since the standard design is derived by assuming equal distribution of fenestration area in all four cardinal orientations, the energy budget remains the same regardless of how the actual building is oriented.

Variables which affect the energy budget (Standard Design) are:

- Conditioned floor area

- Gross roof/ceiling area

- Gross wall area

- Window area

- Slab edge length

- Conditioned Slab-on-grade area

- Raised floor area over crawl space

- Raised floor area over open space

- Heating system type

- Cooling system type

- Space conditioning distribution system type

- Climate zone

Other building-related inputs such as type of fenestration products, ventilation, HVAC efficiencies and duct efficiencies are automatically fixed in the standard design building according to the prescriptive requirements and are not accessible for modification by program users.

NOTE: You should always have copies of the Standards and Single Family Compliance Manual at hand for reference when using the Single Family Title 24 Performance calculation.

Building Features Modeled by Single Family Title 24 Performance

Single Family Title 24 Performance can model the following building features associated with energy use:

- Roof/ceiling assemblies

- Wall assemblies

- Raised floor assemblies

- Slab-on-grade floor and slab edge insulation

- Fenestration area, U-Factor, solar heat gain coefficient, overhangs, sidefins

- Heating and cooling equipment and distribution system

- Heating and cooling zonal controls

- Mechanical IAQ ventilation

- Evaporative cooling

- Water heaters

- Water heating distribution system

- Drain Water Heat Recovery

- Solar thermal collectors

- Ventilation Cooling: Whole House Fans

- Photovoltaic systems

- Battery Storage systems

- Unconditioned zones

GreenPoint Rated Module

EnergyPro offers a Single Family GreenPoint Rated module that enables you to calculate the number of energy points using the GreenPoint Rated residential green building rating system, developed by Build It Green. The GreenPoint Rated system can be used for single family and multifamily new construction projects, as well as existing homes. The homes must meet specific requirements in five categories (Resource Conservation, Indoor Air Quality, Water Conservation, Energy, and Community) and meet all other requirements to earn the GreenPoint Rated label. The GreenPoint Rated label also provides a numerical score to allow one to compare the environmental performance of different homes.

The GPR calculation produces three sets of results that allow you to compare the energy performance of the rated project to the GreenPoint Rated reference home.

EnergyPro's GreenPoint Rated module also produces a GreenPoint Rated report that includes an HVAC system and loads summary, an energy use and cost summary, and the GPR-1 Form (similar to Title 24 CF1R Form). Form GPR-1 documents the detailed energy features of the home as well as the number of energy points the project is eligible to earn through the GPR rating system.

GreenPoint Rated Results

Components of the Res GreenPoint Rated Calculation Results

Calculation: Lists GPR Reference and Vintage Homes, Rated Home, and possibly Alternative Energy Measures, depending on your selections in the Options Tab.

Heating: Lists the annual space heating Time Dependent Valuation (TDV) energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

Cooling: Lists the annual space cooling TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

Interior Lights: Lists the annual interior lighting TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Rated Home designs.

Exterior Lights: Lists the annual exterior lighting TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Rated Home designs.

Appliances: Lists the annual appliances TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Rated Home designs.

Receptacle: Lists the annual receptacle TDV energy usage (in TDV kBtu/sf-yr) for each design.

PV: Lists the annual TDV energy (in TDV kBtu/sf-yr) generated by the renewable system for the Reference and/or Rated Home designs (subtracted from the total TDV energy use).

Fans: Lists the annual space cooling TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

Heat Rejection: Lists the annual heat rejection TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

Pumps: Lists the annual space cooling TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

    Exterior: Lists the annual outdoor equipment (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

    DHW: Lists the annual domestic hot water system TDV energy (in TDV kBtu/sf-yr) for the Reference and/or Proposed designs.

    Total: The total predicted (TDV) energy use of the GPR Reference design, the Rated Home, and each Alternative Measure design, in TDV kBtu/sqft-yr. A new home must exceed 2019 Title 24 by a specified margin (and meet ALL other requirements) to be eligible for GreenPoint Rated certification.

    GPR Index: The GPR Index Score for the Reference Home (always 100), and the Rated Home.

GreenPoint Rated Calculation Options

    Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

    Generate CSV Output File Containing Detailed Results: Check this box to create and save a CSV file that includes detailed simulation results. EnergyPro saves the file in the Results folder under the project name with a .csv extension.

    Run Quick Analysis (Not for Compliance): Check this box to run an analysis that produces approximately 40 percent faster than a full compliance simulation. Results are typically within 5% of the more detailed and lengthy compliance simulation. You must run the full compliance simulation to obtain a CF1R that can be registered.

Single Family Performance Calculation Module

Use the Single Family Performance Module to simulate the energy performance of a project that doesn't involve a particular Standard. Single Family Performance performs an hourly simulation on the building to calculate annual energy consumption and energy cost.

The Single Family Performance simulation includes additional energy end-uses beyond those considered in Title 24, including: interior and exterior lights, appliances, and receptacle (plug) loads. You may use the default assumption for interior lighting or enter the interior lighting power density manually in the Lighting Tab of the Zone Element.

Single Family Performance Calculation Options

    Delete Temporary Files after Simulation is Complete: Check this box to delete all temporary files generated during the simulation. The default setting is to delete the files.

    Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each end use in Microsoft Excel. The CSV files will be saved in the EnergyPro 6\Results folder under the project name with a .csv extension.

Alternative Energy Measures

No Alternative Energy Measure Runs: Select this option to instruct EnergyPro to simulate only the Reference and Proposed homes without analyzing any alternative energy features.

Run Individual Measures: Select this option to instruct EnergyPro to conduct iterative simulations that test the impact of adding one individual energy-saving measure to the project at a time. The Individual Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the base case project in each iterative simulation.

Run Measures Combined Together: conduct iterative simulations, to allow you to test the cumulative impact of adding new energy-saving measures to the project. The Combined Alternatives process begins by modeling the project as defined, then adds an additional energy-savings measure to the previous simulation in each iteration, thus building an increasingly efficient model. Selected measures (from the Alternatives Tab) are added in the order listed on that tab.

Run Test out Home with Final Measures: Select this option to simulate the final, as-built and verified home.

Note that if you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Measure Financing

The financial data fields are not used in the Residential Performance simulations. These fields are used for CA Home Energy Rating System (HERS) ratings and reports.

Interest Rate: Enter the interest rate if the project will be financed. The default value is the most recent monthly average commitment rate published by Freddie Mac.

Number of Years Financed: Enter the number of years that the measure(s) is(are) financed. The default value is 30 years, or the measure life, if less than 30 years.

Income Tax Bracket: Enter the customer's income tax bracket. The default value is 30%, which is the combined federal and state marginal tax rate.

Single Family Performance Results

Components of the Res Performance Calculation Results

Calculation: Lists the modeled (Proposed) home and/or Alternatives, depending on your selection(s) in Options.

Heating: Lists the annual space heating energy (in kBtu/sf-yr of site energy use) for the Proposed design and/or Alternatives.

Cooling: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Interior Lights: Lists the annual interior lighting energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Exterior Lights: Lists the annual exterior lighting energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Appliances: Lists the annual appliances energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Receptacle: Lists the annual receptacle (plug loads) energy usage (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

PV: Lists the annual energy (in kBtu/sf-yr) generated by the PV system for the Proposed design (subtracted from the total energy use) and/or Alternatives.

Fans: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Pumps: Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

DHW: Lists the annual domestic hot water system energy (in kBtu/sf-yr) for the Proposed design and/or Alternatives.

Total: The total predicted energy use of the home, and each Alternative Measure design, in kBtu/sqft-yr.

Single Family Loads Calculation

Section 150.0 of the *Standards* describes mandatory features and devices for single family buildings, including the calculation methodology for sizing of heating and cooling equipment.

The sizing of residential heating is regulated by the *Uniform Building Code (UBC)* and the *Standards*. The *UBC* requires that the heating system be capable of maintaining a temperature of 70°F (21.1°C) three feet (0.91 meters) above the floor throughout the conditioned space of the building.

Section 150.0(h)1 of the *Standards* states that the building design heat loss rate and design heat gain rate shall be determined using a method based on ASHRAE, SMACNA or ACCA Manual J: For the purpose of sizing the space conditioning (HVAC) system, the indoor design temperatures shall be 68°F (20°C) for heating and 75°F (23.9°C) for cooling. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values." The software uses the Median of Extremes as the default value.

While documentation of residential load calculations is not a permit requirement, it is recommended. In addition, documentation must be submitted at the request of the local enforcement agency.

Refer directly to ASHRAE publications for further information, including the **ASHRAE *Cooling and Heating Load Calculation Manual*,** which is an especially well-organized explanation of the topic, particularly Chapter 7, "Residential Heating and Cooling Loads." The manual may be obtained by contacting:

> **ASHRAE**
> **1791 Tullie Circle, N.E.**
> **Atlanta, GA 30329-2305**
> **Customer Service 1-800-527-4723**

The Residential Loads calculation is based on the **ASHRAE *Cooling and Heating Load Calculation Manual*** as applied to each HVAC System specified within the program. There is no hourly analysis of cooling loads (as there is in the Nonresidential Loads calculation), only the use of the listed average hourly solar gain factor (SGF) values based on glazing orientation and cooling load temperature difference (CLTD) values which are not sensitive to the opaque surface being modeled.

For Further Information

For additional details on the Single Family Loads method, refer directly to the ASHRAE publications mentioned above. Also see Sections 4.2 and 4.3 in the Single Family Compliance Manual for discussions of Heating and Cooling Equipment requirements.

View ASHRAE Policy Statement

(Res) Loads Options

Winter Design Conditions: Select the winter design conditions to use for the load calculations from the drop-down list. Choices include: Median of Extremes, 2.0% Design Data, and 6.0% Design Data. Median of Extremes is the default value for compliance purposes. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982*.

Summer Design Conditions: Select the summer design conditions to use for the load calculations from the drop-down list. Choices include: 0.5%/0.4% Design Data, 1.0% Design Data, and 2.0% Design Data. 1.0% is the default value for compliance purposes. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982.*

Use Design Wet Bulb (not Mean Coincident): Check the checkbox to use the Design Wet Bulb rather than the Mean Coincident value in the load calculations.

Ignore Exterior Shades in Load Calculations: Check the checkbox if you wish to calculate loads without the effects of any exterior shades.

Design Day for Schedules: Select a day of the week to use as the Design Day for Schedules, or select Ignore to set all to 100%. The program will use the weekly schedules you have selected throughout the building description, using the day of the week you have selected. When the variable is set to Ignore Schedules (use 100%), the program automatically overrides the schedules selected and runs maximum (100% on, 24 hours per day) schedules in all load calculations.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 7\Results folder under the project name with a .csv extension.

The **Single Family Loads** calculation is a computerized version of the residential ASHRAE heating and cooling loads methodology.

Single Family Loads Results

Components of the Single Family Loads Calculation Results

System: The name of the Mechanical System serving the Zone(s) selected.

Heating Load: The design block heating load of all the Zones served by the System, in Btu/hr.

Heating Output: The heating output of the mechanical system, in Btu/hr.

Sensible Load: The design block sensible cooling load of all the Zones served by the System, in Btu/hr.

(tons): The design block sensible cooling load of all the Zones served by the System, in tons.

Sensible Output: The cooling output of the mechanical system, in Btu/hr.

(tons): The cooling output of the mechanical system, in tons.

Latent Load: The design block latent cooling load of all Zones served by the System, in Btu/hr.

Latent Output: The design block latent cooling output of all Zones served by the System, in Btu/hr.

NR T24 Mandatory Measures

The **NR T24 Mandatory Measures** module allows you to complete the forms required to document the mandatory project characteristics. Use the Mandatory Measures module to complete the following forms:

NRCC-CXR-E: Nonresidential Building Commissioning

NRCC-ELC-E: Electrical Power Distribution

NRCC-SAB-E: Solar and Battery

You must complete the forms manually; they are not auto-populated by EnergyPro based on the project data.

NR T24 Prescriptive Calculations

The **NR Prescriptive** calculation modules are computerized versions of the Nonresidential Prescriptive Envelope, Indoor Lighting, Mechanical, Outdoor Lighting, Covered Processes, and PV and Battery Storage requirements. EnergyPro 9 produces the new 2022 Prescriptive forms for each regulated end use. Refer to Chapters 3-10 (depending on the topic) of the Nonresidential Manual for additional details about the Prescriptive approach.

EnergyPro 9 offers the following NR Prescriptive calculation modules:

Envelope

EnergyPro calculates Prescriptive Envelope compliance using the Prescriptive Component Envelope Approach. Prescriptive Envelope compliance is met when each feature in the proposed envelope design meets or exceeds the prescriptive requirement, as listed in Tables 140.3-B, 140.3-C and 140.3-D.

See the Standards, Section 140.3 and the Nonresidential/Multifamily Compliance Manual, Chapter 3 for additional details.

Indoor Lighting

To comply with the Prescriptive Indoor Lighting requirements, the Proposed installed lighting power density (watts/square foot) must be equal to or less than the Standard.

The program adds up installed wattage, applies any credits for controls and compares it to the Complete Building, Area Category or Tailored allowed values selected according to the occupancy type of each zone. Refer to the Standards, Section 140.6 and to Chapter 5 in the Nonresidential/Multifamily Compliance Manual for additional information and a list of occupancy types and allowed LPD.

Outdoor Lighting

To comply with the Prescriptive Outdoor Lighting requirements, the proposed lighting power must be equal to or less than the Standard lighting power. he program sums installed wattage for all outdoor luminaires, applies credits for controls, and compares it to the Outdoor Lighting power allowance based on the outdoor activity selected in the Exterior Application Element of the Building Tree. Refer to the Standards, Section 140.7 and to Chapter 6 of the Nonresidential/Multifamily Manual for additional details.

Mechanical (HVAC)

To comply with the Prescriptive Mechanical requirements:

- Proposed Heating output must be equal to or less than the Standard output for each Mechanical System, and the Proposed Cooling output must be equal to or less than the Standard output for each Mechanical System; or,

- You must demonstrate the equipment selected has the smallest output capacities that can meet the load "within the available options of the desired equipment line" as stated in Section 140.4(a) of the *Standards.*

- Air conditioning equipment with cooling capacity greater than 33,000 Btuh (9.7 kW) may require an integrated economizer (see Standards, Section 140.4(e) and *Nonresidential/Multifamily Manual,* Section 4.6.2.2).

- Fan systems over 5 horsepower (3.7 kW) at design conditions may need to meet specific fan power (watts/cfm requirements (see Standards Section 140.4 (c) and the *Nonresidential Manual*, Chapter 4.6.2).

Heating (Btuh): The Standard value is the design heating load times 1.43, which is the oversizing factor (10% safety, 30% other loads) for heating systems generally.

Cooling (Btuh): The Standard value is the design cooling load times 1.21, which is the oversizing factor (10% safety, 10% other loads) for cooling systems generally.

NOTE: There are several special equipment and/or control requirements, as well as exceptions to those requirements, which apply to the Prescriptive Mechanical standards. Carefully review Section 140.4 of the Standards and Chapter 4 of the Nonresidential/Multifamily Manual to make sure the project meets all applicable Prescriptive Mechanical requirements.

Covered Processes

The scope of the prescriptive 2022 Standards (Section 140.9) includes several nonresidential processes, including Computer Rooms, Commercial Kitchens, and Laboratory and Factory Exhaust Systems.

Computer Rooms: The Standards require HVAC systems serving computer rooms with power density greater than 20 W/ft^2 to meet six requirements with respect to: economizers, reheating, humidification, fan power and control, and containment.

Commercial Kitchens: The Standards include requirements for commercial kitchen exhaust and ventilation systems and controls.

Laboratory and Factory Exhaust Systems: The Standards include requirements for reducing exhaust airflow, fan power, and automatic fume hood controls.

NR T24 Prescriptive Calculation Options

Scope

Envelope — Runs the nonresidential Prescriptive Envelope calculations.

Indoor Lighting — Runs the nonresidential Prescriptive Indoor Lighting calculations using the selected Lighting Method. You may override occupancy designations within the Zone Element of the Building Tree by selecting the Complete Building checkbox and specifying the building type here.

Outdoor Lighting — Runs the Outdoor Lighting Calculations as explained in Chapter 6 of the *Nonresidential Manual*

Mechanical — Runs the nonresidential Prescriptive Mechanical calculations.

The **NR T24 Prescriptive** calculation is a computerized version of the Nonresidential Prescriptive Envelope, Lighting, Mechanical, Outdoor Lighting, and Covered Process requirements. Refer to Chapters 3-10 (depending on the topic) of the Nonresidential Manual for a detailed discussion of the Prescriptive approach.

NR T24 Prescriptive Reports

The program can print either prescriptive or performance reports, or both. See Printing Reports for basic printing instructions. Use the Report Wizard feature to easily select the appropriate forms to include in your report. Appendix A in the Nonresidential Manual contains a list of all nonresidential compliance forms.

Submit only those forms which are appropriate for the project scope (envelope, lighting, HVAC, and/or Covered Processes). Within each category print *all* forms except as noted below. Depending on the specific project attributes, a nonresidential new construction project must submit some or all of the forms listed below.

Access the NR Mandatory Measures Forms via the Nonresidential Prescriptive or Performance reports:

- Commissioning (NRCC-CXR-E)

- Electric Power Distribution (NRCC-ELC-E), and

- Solar and Battery (NRCC-SAB-E).

There are four groups of NR T24 Prescriptive forms, to be submitted at various stages in the project design and construction, including:

- Certificates of Compliance (NRCC)

- Certificates of Installation (NRCI)

- Certificates of Acceptance (NRCA)

- Certificates of Verification (NRCV)

Each group contains various forms for each end-use, including:

- NR T24 Prescriptive Forms

- Envelope

- Indoor Lighting

- Outdoor Lighting

- Sign Lighting

- Mechanical

- Plumbing, and

- Covered Processes.

The forms are posted on the CEC web site and listed in the 2022 Nonresidential Compliance Manual, Appendix A.

Which Forms Go On the Drawings?

Standards Section 10-103 lists the compliance documentation requirements throughout the design and construction process. According to Section 10-103 (a)(2) of the state's Administrative Regulations *"When the enforcement agency requires building design plans and specifications to be submitted with the application for a building permit, the plans shall conform to the specifications for the features, materials, components, and manufactured devices identified on the Certificate(s) of Compliance, and shall conform to all other applicable requirements of Part 6.*

When Section 10-103(a)1 requires document registration, the certificate(s) that are incorporated into the building design plans shall be copies of the registered Certificate of Compliance documents from a HERS provider data registry, or a data registry approved by the Commission"

NR T24 Prescriptive Results

Envelope

TDV Energy: EnergyPro calculates NR T24 Prescriptive envelope compliance using the Envelope Component Approach. The calculation results display a statement that the envelope complies or does not comply. The Warnings Tab of the results lists any components that don't meet the prescriptive requirements and displays error messages listing the proposed value and the minimum requirement for each component. Double-click on the item in the Location table to go directly to that component.

The project complies with the Title 24 Standards if each component meets the prescriptive requirement listed in Standards Table 140.3-B, 140.3-C, or 140.3-D depending on the specific occupancy type. For additional details, see Chapter 3 of the Nonresidential/Multifamily Compliance Manual.

Lighting

Prescriptive Lighting calculations include up to four separate components depending on the building design: Indoor Conditioned Lighting Power Density (LPD), Indoor Unconditioned LPD, Outdoor Lighting Power, and/or Sign Lighting.

NR Prescriptive Lighting calculations results display the total indoor lighting power density in watts per square foot for the Standard design (the maximum lighting allowed) and the Proposed design for the entire modeled area. EnergyPro displays the LPD information for the indoor conditioned and unconditioned areas separately. Proposed LPD must be **equal to or less than** the Standard in each area for the proposed building to meet the Prescriptive lighting requirements. Outdoor Lighting power is displayed for both the standard and proposed designs in Watts.

Indoor Conditioned, Indoor Unconditioned, and Outdoor lighting must comply with the requirements independently; there are no tradeoffs between them. Refer to Chapter 5 of the *Nonresidential/Multifamily Compliance Manual* for additional information regarding the Prescriptive indoor lighting requirements, and Sections 6.3 and 6.4 for additional information regarding Outdoor Lighting Power compliance.

Mechanical

Heating (Btuh): For each mechanical System listed, the Standard design heating load is the maximum allowed, and the Proposed installed heating capacity must **be equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

Cooling (Btuh): For each System listed, the Standard design cooling load is the maximum allowed, and the Proposed installed cooling capacity must be **equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

Fan Power (W/cfm): For each Fan System listed larger than 25 hp, the Standard design fan power (in watts per cfm) is the maximum allowed, and the Proposed installed fan power must be **equal to or less than** the Standard for each System for the building to meet the Prescriptive Mechanical requirements.

For further details, see Section 4.6 of the *Nonresidential Manual* or Section 140.4 of the *Standards.*

NR/MF Title 24 Performance Calculation (for Title 24 Compliance)

EnergyPro is a state-approved nonresidential computer Performance method for documenting compliance with Title 24, Part 6, also known as an Alternative Calculation Method (ACM) as defined in the Standards, Section 10-109(c), Compliance Software. The Nonresidential/Multifamily Title 24 Performance Module runs the simulation via the CEC 2022 Compliance Manager, the simulation and compliance rule implementation software required by the Commission.

As part of the compliance software requirements, all programs must access electronic versions of the compliance forms from an Energy Commission web server. Energy analysts using the software for

Nonresidential/Multifamily Title 24 compliance will need internet access to generate the final Title 24 reports for building department submittal.

The program performs a NR or Multifamily T24 Performance compliance analysis of the building when you select the NR/MF T24 Performance calculation, check the **Run Standard** and **Run Proposed** calculation options, and specify the Scope using the **Envelope, Lighting, Mechanical and/or DHW** checkboxes.

If the typical options are selected, the program runs a full annual compliance simulation on both the Standard Design and the Proposed Design. As explained in Chapter 12 of the *Nonresidential/Multifamily Manual*, the Standard Design TDV Energy Budget sets the standard for the building under each individual metric. It is a custom energy budget because it is based on the proposed design, and becomes the minimum level of energy efficiency that the Proposed building must meet.

The Standard Design

The Standard Design is generated automatically by the program based on the characteristics of the Proposed Design. The Standard Design:

- Has exactly the same physical size and shape as the Proposed Design;

- Has the same occupancy schedules and zoning as the Proposed Design;

- Has the prescriptive assembly U-Factors and prescriptive glazing U-Factors and solar heat gain coefficients, based on climate zone;

- Has the prescriptive lighting allotment based on occupancy or task requirements;

- Has the mandatory ventilation rates by occupancy;

- Has a mechanical system appropriate for the type installed in the proposed design;

- Has a mechanical system size which is appropriate for the design heating and cooling loads of the Standard Design; and,
- Has the prescriptive PV and battery storage system.

Full details on the assumptions used to generate the Standard Design building are contained in the *Nonresidential/Multifamily Alternative Calculation Method (ACM) Reference Manual for the 2022 Building Energy Efficiency Standards*.

Because the Standard Design is based upon many of the characteristics of the Proposed Design, the energy budget changes when any change is made to the proposed building design. If you change an attribute of the building, you must re-calculate.

NR/MF Title 24 Performance Options

Calculations

Run Standard: Runs the Standard Design which sets the energy Performance budget for the building as explained in Chapter 12 of the Nonresidential/Multifamily Manual.

Run Proposed: Runs the Proposed Design whose energy use is compared with the energy Performance budget as explained in Chapter 12 of the Nonresidential/Multifamily Manual.

Scope: Check Envelope, Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis. Include all project components for which a permit is desired.

Delete Temporary Files After Simulation is Complete: Deletes the interim files once the simulation is complete. Only the final results are saved in the software file (.bld file). You must un-check the box and re-calculate to produce the NRCC-PRF-01-E form.

Do not check this box if you wish to keep a copy of the approximately 75 temporary files created by the compliance engine. The detailed files are often helpful in troubleshooting a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Creates a .csv file for the standard and for the proposed design that contains hourly energy usage data. Do not check this box if you do not need the files.

Run Quick Analysis (Not for Compliance): Check this box to run an analysis that produces approximately 40 percent faster than a full compliance simulation. Results are typically within 5% of the more detailed and lengthy compliance simulation. You must run the full compliance simulation to obtain a report for submittal.

View CBECC log file: The CBECC log file is a text file that lists the steps the software executes in the simulation, as well as any warnings or errors, and can be helpful when troubleshooting. You must save the temporary files (un-check the Delete Temporary Files checkbox) to view the CBECC log file.

Do not Generate PRF-01 at end of Calculation (allows offline calcs): All compliance software is required to use the CBECC-Com compliance calculation engine to document compliance with the Standards. As part of the compliance software requirements, all programs must access electronic versions of the compliance forms from an Energy Commission web server. Check the box if you wish to run the simulation offline and view the results on-screen only. You will need to re-run the simulation to create a report.

Nonresidential/Multifamily Title 24 Performance Results

When the calculation is complete, the display summarizes the results of the NR T24 Performance calculation according to category of energy end use. The NR T24 Performance Annual TDV Energy Use Estimate (TDV kBtu/sqft-yr) is shown for both the **Standard** Design Total energy budget, and the **Proposed** Building Total energy use.

For a building to comply, the **Proposed** Total TDV energy use must be equal to or less than the **Standard** Total TDV energy budget.

All calculation results displayed are for the building as a whole. Categories of TDV energy end use are as follows:

Heating: Annual TDV energy used for space heating

Cooling: Annual TDV energy used for space cooling

Lighting: Annual TDV energy used for electric lights

Process Lighting: Annual TDV energy used in process lighting input within the program

Receptacle: Annual TDV energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

PV: Annual TDV energy offset by PV system generation

Battery: Annual TDV energy used by the battery storage system

Fans: Annual TDV energy used for fans moving conditioned air

Heat Rejection: Annual TDV energy used for cooling tower operation

Pumps: Annual TDV energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual TDV energy used in process loads input within the program

DHW: Annual TDV energy used for domestic (service) hot water

A discussion of the various components of energy use in typical nonresidential buildings is contained in Chapter 1 of the *Nonresidential Manual*.

NOTE: You should have a copy of the current Standards and Nonresidential/Multifamily Compliance Manual available from the California Energy Commission Publications Unit. This software's on-screen Help documentation refers to topics explained in detail in both documents. The state's ACM Reference Manual contains detailed information on the rules which define the Standard Design.

The simulation time required to complete a NR/MF Title 24 Performance compliance analysis, which is really two full simulations, depends on such variables as the:

- complexity of the building input file (especially the number of zones and systems),

- type and speed of the computer's CPU, and

- the amount of the computer's available random access memory (RAM)

Nonresidential/Multifamily Title 24 Performance Compliance Reports

The program can print either prescriptive or performance Title 24 reports, or both. See Printing Reports for instructions. Select Reports from the options in the lower-left window pane to select the appropriate report, and the specific pages/forms. Refer to Appendix A in the *Nonresidential/Multifamily Manual* to see sample compliance forms.

Submit only those forms which are appropriate to the category covered by the permit (envelope, lighting and/or HVAC). Within each category print *all* forms except as noted below.

NOTE: The program will print a NR Title 24 performance compliance report for a building that does not meet the Standards, however, it will stamp the PRF Form with a message stating "Building Does Not Comply". Also, EnergyPro displays a message that the report is out of date if you attempt to print or preview a report after changes were made but no re-calculation was run. If you select the option, it will print the report with outdated results.

The software compliance documentation for the NR/MF Title 24 Performance approach for envelope, lighting, and HVAC includes:

- Cover Sheet (optional)

- Table of Contents (optional)

Nonresidential or Multifamily Title 24 Performance Compliance Forms (NRCC)

- Form NRCC/LMCC-PRF-01-E   Performance Certificate of Compliance

- In addition, depending on the project scope, the report may also include compliance forms in the following end-use categories:

    - Commissioning (CXR)

    - Electrical Power Distribution (ELC)

- Envelope (ENV)

- Indoor Lighting (LTI)

- Outdoor Lighting (LTO)

- Sign Lighting (LTS)

- Domestic Water Heating Systems (PLB)

- Processes (PRC)

- Solar Ready (SRA)

- HVAC System, Zone, and Room Heating and Cooling Load Summary (optional)

- Energy Use and Cost Summary (optional)

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Runcode, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

Energy Conservation Measures Modeled by NR/MF Title 24 Performance

The NR/MF Title 24 Performance module models many building and system features. Given that the Standard Design is based upon the proposed design features, is automatically generated by the program and used to set the annual TDV energy budget, it is important to keep track of and understand:

- Which building measures and/or program inputs are modeled the same in the Standard Design and the Proposed Design; and

- Which building measures and/or program inputs are modeled a certain way in the Standard Design, but may be modeled as an energy penalty, an energy credit, or as energy neutral in the Proposed Design.

Measures Modeled the Same in Standard and Proposed Designs

The following measures, or building/system attributes, are modeled the same way in the Standard Design to set the TDV energy budget as in the Proposed Design TDV energy use calculation.

Envelope and Lighting

- Zoning of the building

- Hourly schedules (including occupants, lights, equipment, fans, thermostats, infiltration, and service hot water)

- Gross wall areas, by orientation and tilt, per zone

- Wall framing type: metal, wood, or other

- Glazing area in each exterior wall, _except_ _when the window-wall ratio (WWR) for either the whole building or the west wall is greater than 40% and no display perimeter is specified._

- Areas and types of doors, by zone

- Gross roof/ceiling areas, by orientation and tilt, per zone

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- Glazing area in each roof/ceiling, <u>except</u> *when the skylight-roof ratio (SRR) for the building is greater than 5%*

- Gross raised floor and slab-on-grade areas, per zone

- Opaque surface absorptivity*, excluding roofs.*

- Heat capacity of walls, roofs/ceilings and floors per zone

- Interior partitions between zones

- Demising partitions

- Unconditioned spaces

- Return air plenums

- Receptacle load

- Infiltration rate

- Ventilation rate (generally)

- Process loads

- Modeled LPD when lighting is not included in the project scope: Value is set to the appropriate lighting allotment for the occupancy*.*

HVAC and Service Hot Water

- Proposed heating system capacity oversizing (heating system output divided by design heating load) up to 143%

- Proposed cooling system capacity oversizing (sensible cooling system output divided by design sensible cooling load) up to 121%

- Fan system operation

- Pump size (for boiler, chiller, and/or cooling tower)

- Piping heat gains and heat loss

- All natural gas service hot water system attributes *except* recovery efficiency

Measures Modeled as a Penalty or Credit in Proposed Design

The following measures, or building/system attributes, are modeled in the Proposed building as designed. These features may be an energy credit, energy penalty, or be energy neutral as compared to the assumptions used in the Standard Design.

Envelope and Lighting

- Exterior roof/ceiling, wall, or raised floor insulation: *credit, neutral, or penalty*

- Placement of insulation in heavy mass roof, wall, or raised floor assemblies: *credit or penalty*

- Fenestration areas in walls greater than 40% window-wall ratio: *penalty*

- Fenestration areas in roofs greater than 5% skylight-roof ratio: *penalty*

- Fenestration U-Factors: *credit, neutral, or penalty*

- Fenestration solar heat gain coefficients: *credit, neutral, or penalty*

- Fenestration overhangs and sidefins: *credit (generally*)

- Lighting power density: *credit, neutral, or penalty*
- Lighting and daylighting controls: *credit or neutral*

HVAC and Service Hot Water

- Proposed heating system capacity oversizing (heating system output divided by design heating load) over 143%: *penalty*
- Proposed cooling system capacity oversizing (sensible cooling system output divided by design sensible cooling load) over 121%: *penalty*
- Heating equipment efficiency rating: *neutral or credit*
- Cooling equipment efficiency rating: *neutral or credit*
- System type: *credit, neutral, or penalty*
- Equipment part load performance: *credit, neutral, or penalty*
- Heat pump auxiliary (strip) heating sizing: *neutral or penalty*
- Design fan power, i.e., fan size and fan motor efficiency: *credit, neutral, or penalty*
- System supply air control: *credit, neutral, or penalty*
- Zone terminal controls: *credit, neutral, or penalty*
- Up to three different chillers staged with energy management system (EMS) controls: *credit, neutral, or penalty*
- Cooling tower sizing, approach temperature, fan speeds, pumps: *credit, neutral, or penalty*
- Design fan power (i.e., fan size and fan motor efficiency) greater than 0.8 watts/cfm for constant volume fans over 25 horsepower, and greater than 1.25 watts/cfm for VAV fans over 25 horsepower: *penalty*
- Pump control, flow rate, minimum operating ratio: *credit, neutral, or penalty*
- Fan system configuration: *credit, neutral, or penalty*
- Fan volume control (e.g., constant volume, forward curved centrifugal fan w/ discharge dampers, forward curved centrifugal fan w/inlet vanes, variable speed drive): *credit, neutral, or penalty*
- Air economizers: *credit, neutral, or penalty*
- Water side economizers: *credit, neutral, or penalty*
- Air-cooled, water-cooled, and evaporatively cooled condensers: *credit, neutral, or penalty*
- Evaporative cooling and evaporative pre-cooling: *credit, neutral, or penalty*
- Electric resistance hot water heaters: penalty (Note that although there are no prescriptive requirements, the water heater baseline changed to a natural gas system. You may use the prescriptive method to document compliance for electric storage water heaters.)
- Service hot water system recovery efficiency: *neutral or credit*

Which Forms Go On the Drawings?

According to Section 10-103 (a)(2) of the state's Administrative Regulations "the [permit] applicant shall file the appropriate Certificate(s) of Compliance on the plans." This means that the permit drawings must include a signed copy of the NRCC-PRF-01-E form, as well as any other supporting forms, as appropriate for the scope of the project. Also include the appropriate Mandatory Measures.

Building Features Modeled by NR/MF Title 24 Performance

NR/MF Title 24 Performance handles a wide range of common building energy conditions and conservation strategies. These include:

Envelope Parameters

Thermal Mass

Solar Heat Gain

Internal Gains

HVAC Equipment

Envelope Parameters

These include U-Factors for all conduction surfaces of the building: roofs, walls, floors, windows, skylights, and doors. Outside air is also included, either through infiltration or ventilation. The program calculates the effects of these parameters using standard ASHRAE methodology, based on the areas and assemblies for each type of surface, and the values input for infiltration and ventilation rates. In the software, conduction surfaces are input in the Room element, with opaque assemblies defined in the Assembly Library and glazing types defined in the Fenestration Library. Infiltration and Ventilation Schedules are input in the Zone element, but are fixed by the CEC for Title 24 compliance calculations. Input Rates of Infiltration (AC/H) and Ventilation (cfm/occupant) in the Room Element.

Thermal Mass

Thermal mass in the building walls acts like a flywheel to moderate the temperature flows between the building and the environment. The software calculates the thermal mass effects for each building based on the characteristics of the assemblies selected for roofs, walls, floors, and windows in each Room Element, with opaque assemblies defined in the Assembly Library, and glazing types defined in the Fenestration Library.

Solar Heat Gain

Solar heat gains enter the building by two routes: through the glazing, which may have shading devices, and through the opaque surfaces. Solar gain depends on the solar heat gain coefficient of the glazing, the interior and exterior shades, and the absorptivity of the opaque surfaces. Define solar heat gain coefficients in the Fenestration Library. Overhangs and Sidefins are defined in the Overhang and/or Sidefin Libraries. The absorptivity of opaque surfaces is fixed by the CEC for compliance and calculated automatically (although it may be adjusted in the Assembly Library for heating and cooling loads calculations).

Internal Gains

Internal gains include all indoor heat-generating components: lighting, occupants, receptacle electric usage, and supply fans. The values of these components for each hour are used to determine the internal gain energy. Gains for occupants and receptacles are fixed values set by the CEC for each occupancy type and are calculated by the software automatically.

HVAC Equipment

All building characteristics for the zone(s) served are properly aggregated and assigned to the HVAC system element above the particular zone(s). Schedules for HVAC equipment are set in the Zone Element. Specific data for each system may be found in the CEC Modernized Appliance Efficiency Database System (MAEDbS) and in manufacturer's literature. See **Libraries** for further information on each of these libraries and the inputs required for each system type.

HVAC System Types

Many nonresidential HVAC system types may be modeled using NR/MF Title 24 Performance. These include:

- Split DX Constant Volume Single Zone
- Packaged DX Constant Volume Single Zone
- Packaged DX Vertical Unit
- Room Air Conditioner/Heat Pump
- Packaged DX Terminal Air Conditioner/Heat Pump (PTAC/PTHP)
- Variable Refrigerant Flow
- Packaged DX Variable Air Volume (VAV) Single Zone
- Packaged DX VAV w/Terminal Boxes
- Chilled Water Constant Volume Single Zone
- Chilled Water VAV Single Zone
- Chilled Water VAV w/Terminal Boxes
- Four-Pipe Fan Coil System
- Chilled Water Chilled Beam
- Hydronic Heat Pump
- Evaporative Cooling System

ASHRAE 90.1 Performance Module

EnergyPro's ASHRAE 90.1 Performance module for nonresidential projects allows you to document project performance with ASHRAE 90.1: 2019 Energy Standard for Buildings Except Low-Rise Residential Buildings. EnergyPro uses the Performance Rating Method, as defined in Appendix G of the standard to model the building energy performance. The 2019 version is the commercial building reference standard for state building energy codes.

ASHRAE 90.1 Performance Rating Method (Appendix G):

EnergyPro's ASHRAE 90.1 Performance module uses the Performance Rating Method specified in Appendix G of the standard to create an hourly simulation to generate the baseline and proposed energy use and cost data. EnergyPro automatically creates the baseline data required by the standard based on the proposed design data.

To calculate the baseline data, Appendix G requires the building to first be modeled at its actual orientation, then it must be rotated by 90, 180, and 270 degrees. The baseline against which the proposed design is compared is the average of the four runs, calculated automatically by the program. EnergyPro displays the end-use energy usage results for each orientation, automatically calculates the average, and displays both the baseline and the proposed energy cost estimates and the margin between the baseline and proposed design.

Refer to the ASHRAE web site to obtain additional details and/or copies of the ASHRAE 90.1-2019 Standard.

ASHRAE Policy Statement

ASHRAE 90.1 Performance Results

When the calculation is complete, the display summarizes the results of the ASHRAE 90.1 Performance calculation according to category of energy end use. The NR 90.1 Performance **Baseline** Annual Site Energy Use Estimate (in kBtu/sqft-yr) is shown for each orientation, and the **Proposed** Building Total energy use.

All calculation results displayed are for the building as a whole in kBtu/sqft-yr. Categories of energy end use are as follows:

Heating: Annual energy used for space heating

Cooling: Annual energy used for space cooling

Lighting: Annual energy used for electric lights

Process Lighting: Annual energy used in process lighting input within the program

Outdoor: Annual energy used for outdoor lighting

Receptacle: Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

PV: Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.

Exceptional: Annual Energy saved from reducing process loads. This value is only used for LEED projects.

Fans: Annual energy used for fans moving conditioned air

Heat Rejection: Annual energy used for cooling tower operation

Pumps: Annual energy used pumps for hot water, chilled water, and condenser water piping systems

Process: Annual energy used in process loads input within the program

DHW: Annual energy used for domestic (service) hot water

Total: The Total annual energy used by the building.

Baseline Energy Cost: The estimated annual energy cost for the baseline building design. EnergyPro automatically calculates the average cost (across the four orientations).

Proposed Energy Cost: The estimated annual energy cost of the proposed building design.

Percent Better: The difference (percentage) between the proposed and baseline design energy costs. If this number is negative, the estimated proposed design energy costs are higher than the baseline design.

LEED EAc1 Points: The number of LEED Energy and Atmosphere points the proposed design is eligible to earn through optimizing energy performance (LEED Energy and Atmosphere, Credit 1). Among other options, the LEED program provides points for optimizing the project energy performance, advanced commissioning, advanced energy metering, and participating in a demand response program.

Process: The percentage of the energy cost attributed to process loads. LEED default assumption is 25%. If the process energy cost for the proposed design is less than 25%, you must submit documentation substantiating the values.

NOTE: You should have a copy of the appropriate ASHRAE 90.1 Standard available for reference when using the NR 90.1 Performance module.

ASHRAE 90.1 Performance Calculation Options

Calculations

Run Baseline(s):

> ASHRAE 90.1: Runs the four Baseline simulations which sets the energy cost budget for the building. Appendix G of ASHRAE 90.1 uses the average results from the four simulations (actual, +90, +180, and +270 degrees) to set the budget.

Run Proposed: Runs the Proposed Design whose energy use is compared with the energy cost budget.

Scope: Check Envelope, Indoor Lighting, Outdoor Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis. Include all project components for which a permit is desired or that are part of the project scope.

Delete Temporary Files After Simulation is Complete: Deletes the DOE-2.1E files once the simulation is complete. Only the final results are saved in the software file. Do not check this box if you wish to keep a copy of the DOE-2 input (BDL) or output (SIM) files, or if you need to troubleshoot a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 6\Results folder under the project name with a .csv extension.

The ASHRAE 90.1 Performance calculation uses the U. S. Department of Energy's DOE-2.1E (version 124) program, which is a comprehensive hourly building energy simulation program.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

NOTE: If you need to review the intermediate NR ASHRAE 90.1 Performance files to identify a program error, look at the .BDL file first; then look at the .SIM file. This can be done with a word processor.

ASHRAE 90.1 Performance Reports

EnergyPro creates reports documenting the project's energy features, estimated energy usage, and energy costs. See Printing Reports for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

EnergyPro ASHRAE 90.1 Performance reports include the following forms:

- Cover Sheet
- Table of Contents
- Form EAP-2 - LEED Compliance Summary
- Form EAP-S - LEED Compliance Details
- Form ECON-1 – Energy Use and Cost Summary
- Form ECON-2 – Energy Upgrade Recommendations
- HVAC System Heating and Cooling Load Summary
- Zone Load Summary
- Room Load Summary

- Room Heating Peak Loads
- Room Cooling Peak Loads
- Room Cooling Coil Loads
- DOE-2 Simulation Output – Proposed
- DOE-2 Simulation Output – Standard

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Run Code, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

The program will also generate a preset selection of DOE-2.1E reports if **Delete Temporary Files After Simulation is Complete** is cleared (NOT checked) when performing ASHRAE 90.1 Performance calculations. These reports will be saved in the Results subfolder to a text file with the same name as your input file plus the extension of .SIM (i.e., *filename*.SIM).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

NR Performance Calculation Module (non-T24 compliance)

Use the NR Performance Module to simulate the energy performance of a project that doesn't involve a particular code or standard. NR Performance performs a DOE-2 hourly simulation on the building to determine annual site energy consumption and energy cost.

NR Performance can be used to:

- determine the annual energy use of a proposed building *without using fixed Title 24 or ASHRAE 90.1 inputs* such as occupancy schedules and equipment type;

- determine the monthly and annual electricity usage and demand charges for a proposed building using any utility rate structure.

The NR Performance module allows you to modify certain inputs normally fixed or restricted for code compliance calculations. You may run NR Performance with user-defined schedules and occupant densities, as well as any rate structure from the Utility Rate Library. In addition, this module can be used in some utility incentive programs to analyze non-code energy uses (under certain circumstances, check with the utility regarding eligibility)

If you wish to save the detailed DOE-2 input and output files, in the NR Performance Calculations Options, clear (un-check) **Delete Temporary Files After Simulation is Complete**.

To run DOE-2.1E as a stand-alone program from the BDL input file generated by **EnergyPro**, see <u>Using NR Performance as a DOE-2 BDL and Report Generator</u>.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

NR Performance Options (non-T24 compliance)

<u>Calculations</u>

Scope: Sets the project Scope. Check Envelope, Lighting, Mechanical and/or Domestic Hot Water to set the scope of the analysis.

Delete Temporary Files After Simulation is Complete: Deletes the DOE-2.1E files once the simulation is complete. Only the final results are saved in the software file. Do not check this box if you wish to keep a copy of the DOE-2 input (BDL) or output (SIM) files, or if you need to troubleshoot a file that doesn't run properly.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 8\Results folder under the project name with a .csv extension.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy. If you need to review the intermediate NR Performance files to identify a program error, look at the .BDL file first; then look at the .SIM file. This can be done with a word processor.

NR Performance Results (non-T24 compliance)

When the calculation is complete, the display summarizes the results of the NR Performance calculation according to category of energy end use. All calculation results displayed are for the building as a whole in kBtu/sqft-yr. Categories of energy end use are as follows:

Heating: Annual energy used for space heating

Cooling: Annual energy used for space cooling

Lighting: Annual energy used for electric lights

Process Lighting: Annual energy used in process lighting input within the program

Outdoor: Annual energy used for outdoor lighting

Receptacle: Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.

PV: Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.

Exceptional: Annual Energy saved from reducing process loads. This value is only used for LEED projects.

Fans: Annual energy used for fans moving conditioned air

Heat Rejection: Annual energy used for cooling tower operation

Pumps: Annual energy used pumps for hot water, chilled water, and condenser water piping systems

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Process: Annual energy used in process loads input within the program

DHW: Annual energy used for domestic (service) hot water

Total: The Total annual site energy used by the building.

NR Performance Reports (non-T24 compliance)

EnergyPro creates reports documenting the project's energy features, estimated energy usage, and energy costs. See Printing Reports for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate pages for a report.

EnergyPro NR Performance reports include the following forms:

- Cover Sheet
- Table of Contents
- Form ECON-1 – Energy Use and Cost Summary
- Form ECON-2 – Energy Upgrade Recommendations
- HVAC System Heating and Cooling Load Summary
- Zone Load Summary
- Room Load Summary
- Room Heating Peak Loads
- Room Cooling Peak Loads
- Room Cooling Coil Loads
- DOE-2 Simulation Output – Proposed

NOTE: All pages of the performance report are automatically stamped by the program with a Run Initiation Time, Run Code, and Date. The local enforcement agency may reject a compliance report if all these values are not the same on every page.

The program will also generate a preset selection of DOE-2.1E reports if **Delete Temporary Files After Simulation is Complete** is cleared (NOT checked) when performing NR Performance calculations. These reports will be saved in the Results subfolder to a text file with the same name as your input file plus the extension of .SIM (i.e., *filename*.SIM).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

Using NR Performance (non-T24 compliance) as a DOE-2 BDL and Report Generator

The software's NR Performance module is designed to use the DOE-2.1E energy analysis program to simulate a building's annual energy use for non-compliance analyses; it <u>may not</u> be used to demonstrate compliance with the California energy standards. Users familiar with DOE-2 may also use the software to generate standard DOE-2 input files (BDL) which include most of the required building data, and generate a DOE-2 output report that can be printed or edited outside of the program. The BDL (Building Description Language) input files can be edited using a word processor to add features or reports not applicable to Title 24 compliance. Once the BDL input file has been edited, it can be run outside of the software shell using the version of DOE-2.1E which comes with the NR Performance module.

NOTE: This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

To use NR Performance as a DOE-2.1E input file generator, and to run calculations on a DOE-2 input file outside of the software's interface, follow these steps:

1. Use the software to input and save all building information, including correct zoning, HVAC systems, operating schedules, and construction assemblies. See item 4 below if you prefer to use DOE-2's default material library.

2. Select the NR Performance calculation from the Calculations tab in the lower left window pane. To create a DOE-2 input file, in the NR Performance Calculations Options, un-check (clear) the **Delete Temporary Files After Simulation is Complete** checkbox and run the calculation.

The new BDL input file is saved in the Project sub-folder of the EnergyPro Results folder. The file has whatever name you gave it when you saved it, plus the extension .DOE. This extension must be present to analyze any input file with Win/DOE. For example, the nonresidential sample building file is named *NonRes Sample.bld* within the software. A BDL input file for it would be named *NonRes Sample.DOE*.

1. Edit the file with any word processor in non-document mode. To do this you must be familiar with the standard DOE-2 commands and input structure.

2. To run DOE-2 on the revised file, from the WinDOE folder, type:

    > **DOE21e** *inputfile weatherfile* and press <Enter>.

inputfile is the BDL input file name with the extension .DOE (e.g., *NonRes Sample.DOE*)

NOTE: If the input filename contains a space in the name (e.g., NonRes Sample.DOE), you must enclose the name in quotes. See below for sample.

weatherfile is the path and file name of the weather data file for your project (e.g., *C:\EP3\WEATHER\CZ12RV2.WY2*).

For example, to run the file *NonRes Sample.DOE* with the weather file named *CZ12RV2.WY2* (Climate Zone 12) type:

DOE21e "NONRES SAMPLE.DOE" C:\EP3\WEATHER\CZ12RV2.WY2 and press <Enter>.

If you want to edit the BDL input file to use DOE-2's default material library instead of the material library included with **EnergyPro**, then you need to change the library reference files before running calculations. First, go to the WinDOE folder and rename the **EnergyPro** material library file, *BDLLIB.BIN*, to save it for later projects using Windows Explorer. Next, copy the file named *DOE2.BIN*, the file with the DOE-2 libraries, to BDLLIB.BIN. Now you are ready to run DOE-2 calculations as described above. To use the **EnergyPro** material library in a later project, copy that file back to *BDLLIB.BIN*.

1. When all calculations are complete, the output files are located in the Win/DOE folder. Files with the extension .BDL (e.g., *NonRes Sample.BDL*) are processed versions of the BDL input file, including any

error messages or warnings. Files with the extension .OUT (e.g., *NonRes Sample.OUT*) include all final DOE-2 calculations and reports for further review or analysis. See Default DOE-2.1E Reports in the NR Output .SIM File for a list of the default DOE-2 reports generated in each .SIM file.

Default DOE-2.1E Reports in the NR Output (.SIM) Files

Whenever the software performs NR non-T24 simulations using DOE-2, it creates input and output files. The program automatically displays the results on-screen and populates a default set of DOE-2 output reports. As DOE-2 files can be quite large, the software saves only the results and deletes the temporary DOE-2 files unless you specify otherwise.

If you would like to save the DOE-2 files, you must instruct EnergyPro to save them. Select Calculations from the list in the lower left window pane, then the NR Performance calculation from the list. In the Calculations Options, clear (uncheck) the **Delete Temporary Files After Simulation is Complete** check box. Specify all other calculation options as usual. The DOE-2 files are saved in your Results folder (specified in the Tools/Options… menu).

You may customize which DOE-2 reports are included in the .sim file in the Utility Tab of the Building Element. DOE-2 reports are divided into four different groups: Loads, Systems, Plant, and Economics Reports. Each group is further sub-divided into two types, verification reports and summary reports. When you select a report for inclusion in the output file, the default selections for that report type are nullified. For example, if you select the PS-A report, the output file will not contain the PS-B or PS-D reports unless you also select them. All other default reports will still be included in the file. If you do not select specific DOE-2 reports, the output file will contain only the default reports listed below.

Three reports will always be included in the output file regardless of your selections: BEPS, ES-D, and ES-F. These reports are not shown as selections in the DOE-2 Report Choices dialog box.

NOTE: DOE-2.1E bug. DOE-2 registers the SS-P report command as an invalid command. If you select the SS-P report, the DOE-2 simulation will **not** run.

The .SIM file includes the following default DOE-2 reports:

Loads Reports:

LS-D: Building Monthly Loads Summary

Systems Reports:

SV-A   System Design Parameters

SS-P: Load, Energy and Part Load Heating and Cooling for System and/or Plant-Assignment

SS-A: System Monthly Loads Summary

SS-Q: Heat Pump Cooling and Heating Summary

Plant Reports:

PV-A: Equipment Sizes

PS-B: Monthly Utility and Fuel Use Summary

PS-D   Plant Loads Satisfied

Economic Reports:

ES-A   Annual Energy and Operations Costs and Savings

ES-D: Energy Cost Summary

ES-E: Summary of Utility Rate

ES-F: Block Charge and Ratchet Summary

NOTE: This software is not endorsed, authorized or associated with the U.S. Department of Energy.

NR Loads Calculation

Section 140.4(b) of the *Standards* states that for load calculations done in conjunction with compliance (with the *Standards)*, indoor design conditions shall be in accordance with ASHRAE 55, except that humidification and dehumidification need not be considered. Heating and cooling design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, *Fundamentals*, the ASHRAE *Cooling and Heating Load Calculation Manual*, or an equivalent computation procedure approved by the Executive Director of the CEC. Outdoor design air temperatures shall be taken from Reference Appendices, Joint Appendix JA2 (based on ASHRAE Climatic Data for Region X). Heating design temperatures shall be no lower than the temperature listed in the Winter Median of Extremes column, and no greater than the 0.5% Cooling Dry Bulb and Mean Coincident Wet Bulb columns for cooling.

The NR Loads calculation is based on the ASHRAE *Cooling and Heating Load Calculation Manual* as applied to each Mechanical System specified within the program. The program performs a simulation to determine cooling loads using explicitly calculated solar gain factors, and explicitly calculated weighting and response factors for thermal mass effects. The Schedules selected control the lights, equipment, infiltration, occupants, ventilation and thermostats each hour of the design day. The summer dry bulb and wet bulb design temperatures affect the sensible output capacity of the Mechanical System according to a standard equipment performance curve used by the NR Performance program.

The program calculates cooling loads for all months and displays the peak loads on screen. The peak month and hour are shown on the Room Cooling Loads Summary form in the final report. Use Print Preview to view the data prior to printing.

NOTE: Cooling design temperatures for January through June and September through December are automatically modified by the program (reduced somewhat) in relation to the values listed in the Location Library to reflect a lower probability of reaching the listed design temperature in months other than July and August.

NR Loads Calculation Options

Winter Design Conditions: Select the winter design conditions to use for the load calculations from the drop-down list. Choices include: Median of Extremes, 2.0% Design Data, and 6.0% Design Data. Median of Extremes is the default value. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982.*

Summer Design Conditions: Select the summer design conditions to use for the load calculations from the drop-down list. Choices include: 0.5%/0.4% Design Data, 1.0% Design Data, and 2.0% Design Data. For an explanation of these categories, see the Preface to the ASHRAE publication #96500*, Climatic Data for Region X…1982.*

Use Design Wet Bulb (not Mean Coincident): Check the checkbox to use the Design Wet Bulb rather than the Mean Coincident value in the load calculations.

Ignore Exterior Shades in Load Calculations: check the checkbox if you wish to calculate loads without the effects of any exterior shades.

Design Day for Schedules: Select a day of the week to use as the Design Day for Schedules, or select Ignore to set all to 100%. The program will use the weekly schedules you have selected throughout the building description, using the day of the week you have selected. When the variable is set to

Ignore Schedules (use 100%), the program automatically overrides the schedules selected and runs maximum (100% on, 24 hours per day) schedules in all load calculations.

Generate CSV Output File Containing Detailed Results: Select this option to instruct EnergyPro to produce an output file that includes hourly temperature and loads data for each fuel and end use. Use Microsoft Excel® or another spreadsheet program to view and analyze the data. The CSV files will be saved in the EnergyPro 6\Results folder under the project name with a .csv extension.

NR Loads Results

Components of the NR Loads Calculation Results

System: The name of the Mechanical System serving the Zone(s) selected.

Heating Load: The design block heating load of all the Zones served by the System, in Btu/hr.

Heating Output: The heat output of the mechanical system, in Btu/hr.

Sensible Load: The design block sensible cooling load of all the Zones served by the System, in Btu/hr.

(tons): The design block sensible cooling load of all the Zones served by the System, in tons.

Sensible Output: The cooling output of the mechanical system, in Btu/hr.

(tons): The cooling output of the mechanical system, in tons.

Latent Load: The design block latent cooling load of all the Zones served by the System, in Btu/hr.

Latent Output: The design block latent cooling output of all the Zones served by the System, in Btu/hr.

Detailed Calculation Data

You may save detailed calculation data from any residential or nonresidential calculation module that runs an hourly simulation. First, select Calculations from the options in the left window pane, then place a check in the checkbox for each calculation you wish to run. Select the module in the list to display the calculation options, which allow you to customize the specific calculation features and the data you wish to save for additional analysis.

The default setting for all modules is to Delete Temporary Files when the simulation is complete. Clear the checkbox to save the files. You must clear the Delete Temporary Files box to enable the option to Generate CSV Output File, which contains the detailed hourly output files in the comma-separated values (.csv) format.

Note: The Delete Temporary Files option will overwrite the Generate CSV Output Files option. If you select the Generate CSV Output File option, then re-select the Delete Temporary Files checkbox, the program will delete the files, and will NOT generate a csv file.

Single Family Performance Modules generate project input files (.inp) for all selected simulations, including alternative runs. The NR/MF Title 24 Performance module generates a series of files that are used by CBECC and EnergyPlus. The NR Performance Module (non-T24 compliance) generates three DOE-2 files: two input files (.bdl and .doe), and the simulation results (.sim). All temporary files can be read using text editor or word processing software such as Notepad™ or Wordpad™.

CSV files include detailed hourly temperature and energy use data for each fuel type and end use in the simulation. Use Excel™ or another spreadsheet program to open the .csv files.

Alternatives Tab

Use the Alternatives Tab in the Residential or Nonresidential Performance (non-Title 24) modules to simulate the effect of energy-savings measures on a project's energy use. EnergyPro will run the primary calculation, followed by each alternative you select and will display the results in tabbed format in the lower-right window pane. You may click on any tab to display the results for that module.

The Alternative Measures DO NOT apply to the Title 24 compliance calculations. Note that if you run multiple calculations at one time, EnergyPro will automatically run the same Alternatives for each calculation, provided you check the box(es) on the Options Tab for that calculation. You may not run different alternatives for each module in the same calculation event.

For each alternative measure you wish to simulate, check the checkbox and enter the alternative energy feature. You must also select either Run Individual or Run Measures Combined Together in the appropriate Options Tab.

Cost Data: Note that the Measure Cost fields are used only to generate cost-effective measure recommendations for the project. Enter the Name and Quantity of each measure and the measure cost. You must submit the resulting XML file to a HERS Provider for processing to print the HERS Report and view the alternative measure recommendations.

If you mark a building feature or equipment as "New", EnergyPro will not replace that feature when it runs alternatives. This is especially useful when modeling a multifamily project or other projects with multiple pieces of equipment where the owner plans to retrofit only some of the units or features.

Narrative for Report
Enter a description of the recommended upgrade measure. The description will appear on the Recommendations page of the Home Energy Performance Report.

<u>Selection of Upgrade Measures</u>

Roof, Wall or Floor Insulation: Select the upgraded Roof assembly from the Assembly Library

Windows: Select the upgraded windows from the Fenestration Library.

HVAC System: Select the upgraded HVAC System from the Central System Library.

HVAC Distribution: Select and/or enter the features of the upgraded duct distribution system.

HVAC Duct Leakage: Enter the upgraded leakage level in the space provided.

HVAC Duct Insulation: Enter the upgraded Duct Insulation R-Value.

Refrigerant Charge Verification: Check the checkbox to select Refrigerant Charge Verification from the measure Upgrade List.

System Airflow Verification: Check the checkbox to select System Airflow Verification from the measure Upgrade List.

System Fan Wattage Verification: Check the checkbox to select System Fan Wattage Verification from the measure Upgrade List. To claim this credit, the system must also have verified system airflow.

Building Leakage: Enter the tested Building Leakage rate, or the number of air changes per hour at 50 pascals (ACH50).

Appliances: Enter the upgraded Appliance characteristics for the inside or outside refrigerator, or dishwasher (displayed as DW). Enter the annual energy usage for the alternative refrigerator using the published EnergyGuide label information, if known. The default values are 775 kWh/yr for the inside refrigerator, 1,013 kWh/yr for each additional refrigerator, and 929 kWh/yr for each standalone freezer.

Enter the alternative Energy Factor for the dishwasher, using the published value, if available. The default value is 0.46.

Indoor Lighting: Select the upgraded Fixture Type and Control for ALL indoor lights. Choices include: High Efficacy, Screw-in CFL, or Incandescent fixture types, and On/Off Switch, Dimmer, or Occupant Sensor controls. You may not select only a portion of the indoor lighting for this alternative calculation.

Outdoor Lighting: Select the upgraded Fixture Type and Control for ALL outdoor lights. Choices include: High Efficacy, Screw-in CFL, or Incandescent fixture types, and On/Off Switch, Dimmer, or Occupant Sensor controls. You may not select only a portion of the indoor lighting for this alternative calculation.

Domestic Hot Water Heater: Select the upgraded Domestic Hot Water heater from the Boiler Library.

DHW Distribution: Select the upgraded distribution type from the drop-down list.

Solar Domestic Hot Water: Enter the upgraded Net Solar Fraction (portion of the annual water heating energy provided by a solar system). You may use this alternative to either specify the addition of solar water heating (from 0% Net Solar to some specified percentage, or to simulate a change to an existing system that increases the percentage of energy provided by solar).

Heating Boiler: Select the upgraded heating boiler from the Boiler Library.

Renewables: Enter the upgraded energy cost savings ($) and energy production from a renewable source, in kWh/yr and TDV energy.

Pool Pumps: Enter the characteristics of the upgraded pool pump(s).

Custom: This is a user-defined measure. Enter the electricity and/or natural gas energy and cost savings.

All Improvements: Check the checkbox to simulate all applicable upgrade measures. EnergyPro automatically excludes features that have been identified as "New" in the Building Tree (indicating they have been recently upgraded and should not be included in the recommended measure upgrades).

Calibration Tab (All Modules)

The Calibration feature allows you to compare the results of the simulation to the actual energy usage and costs for a project. Select Calculations from the list in the lower-left window pane, select the appropriate calculation module, then select the Calibration Tab.

You must enter the Utility Rate information in the Schedule Library prior to the calculation to generate a utility cost estimate. Then, in the Calibration Tab, enter the monthly usage and cost data using the Electricity and Gas tabs. You may now compare the simulated results to the actual usage and cost data to identify any major discrepancies and to calibrate your building model.

Error Messages

Below is a list of error messages that may be encountered. Each error message has a numerical code

listed below. Please note that this list is not comprehensive and may not contain all error messages that are reported in the log file.

1. pszBEMBasePathFile doesn't exist
2. pszRulesetPathFile doesn't
3. pszSimWeatherPath doesn't
4. pszDHWDLLPath specified, but doesn't
5. Invalid project log file name (too long)
6. Error writing to project log
7. Building model input/project file not found
8. Error reading/initializing model input/project file
9. Errors encountered evaluating input model defaulting rules
10. Errors encountered evaluating input model defaulting rules (multiple times)
11. Error(s) encountered performing required data & numeric range checks
12. Error(s) encountered checking input model for simulation compatibility
13. Error(s) encountered checking input model for code requirements
14. Error encountered initializing weather file locations and/or names
15. Error creating or accessing the analysis processing directory
16. Error generating Proposed Sizing model
17. Error generating Proposed (final) model
18. Error generating Standard Sizing model
19. Error generating Standard (final) model
20. Error initializing Standard Sizing model
21. Error initializing Standard (final) model
22. Analysis aborted - user chose not to overwrite SDD XML file
23. Error: Unable to write SDD XML file
24. Error(s) encountered simulating Proposed model
25. Error(s) encountered simulating Standard Sizing model
26. Error(s) encountered simulating Standard (final) model
27. Error(s) encountered retrieving Proposed model simulation results
28. Error(s) encountered retrieving Standard Sizing model simulation results
29. Error(s) encountered retrieving Standard (final) model simulation results
30. Proposed model zone(s) exceed unmet load hours limits
31. Error initializing building model database
32. Error loading analysis ruleset
33. User aborted analysis via progress dialog 'Cancel' button
34. Invalid results object types
35. Error copying results objects from a previous model
36. Error copying equipment sizes/flows from source model
37. Error(s) encountered reading building model (input/project) file
38. Error: EnergyPlus simulation engine not found.
39. Error: Version of EnergyPlus installed not compatible with analysis.
40. Error setting up check of weather & design day file hashes
41. DHW simulation not successful

(Return values in the range 101–200 describe issues encountered during/by simulation.)

101 : SDD XML simulation input file not found

102 : Simulation weather file not found

103 : Simulation processing path not valid

104 : Simulation executable path not valid

105 : Simulation error output path/file not valid

106 : User aborted analysis

131 : Error encountered in OpenStudio loading SDD XML file

132 : Error encountered in OpenStudio saving model to OSM file

133 : Unable to locate EnergyPlus simulation SQL output file

134 : OpenStudio Model not valid following simulation

135 : OpenStudio Facility not valid following simulation

136 : Error creating OpenStudio Model object

161 : Fatal error(s) occurred in EnergyPlus simulation

162 : EnergyPlus simulation did not complete successfully

181 : User aborted analysis during building model simulation

Special Topics

This section presents special issues with which you should be familiar with respect to Title 24 Standards as well as the other calculation modules. The information here may be useful when using EnergyPro for compliance with Title 24 or other standards, such as ASHRAE 90.1, or to produce GreenPoint Rated calculations. This chapter covers the following topics:

Single Family Residential Compliance Modeling Topics. How to properly zone and model residential buildings for compliance and HVAC equipment selection. Topics include zoning, zonal controls, no setback thermostats, underground walls, floors, and conditioned spaces, heating/cooling distribution systems, hydronic systems, no cooling installed, HERS compliance credits, calculating all four orientations and attached sunspaces, garages and others.

Multifamily Compliance Modeling Topics. How to properly zone and model multifamily residential buildings for compliance and HVAC equipment selection. Topics include partial permit applications, inputting zones by thermal characteristics and occupancy

Nonresidential Compliance Modeling Topics. How to properly zone and model nonresidential buildings for compliance and HVAC equipment selection. Topics include partial permit applications, inputting zones by thermal characteristics and occupancy type, standard HVAC system according to proposed system type, modeling like HVAC systems together, unconditioned spaces, demising partitions, interior partitions between zones, underground walls and floors, return air plenums, T-bar ceilings, process loads, tailored and process ventilation, exhaust fans, tailored lighting allotment, and inputs not used for compliance calculations.

Mandatory Measures. An overview of mandatory measures, HERS verification requirements and how they relate to the compliance calculations.

Covered Processes The 2019 Standards include both mandatory and prescriptive requirements for several "Covered Process" activities that commonly occur within nonresidential buildings, including: Refrigerated Warehouses, Commercial Refrigeration, Enclosed Parking Garages, Process Boilers, Compressed Air Systems, Elevators, Escalators and Moving Walkways, Computer Rooms, Commercial Kitchens, and Laboratory Exhaust Systems. EnergyPro version 8 includes a Process module that will assist you in completing the required compliance documentation for all covered processes.

Additions. How to use the program to show Title 24 compliance for additions alone or additions and alterations together with the existing building.

Mixed Occupancy Buildings. How the Title 24 *Standards* and the program treat mixed occupancy buildings.

Mechanical Systems. An overview on how to model some typical mechanical systems using EnergyPro, including case studies.

Default DOE-2.1E Output Reports in the Nonresidential Performance (.SIM) File. A list of the DOE-2.1E calculation output reports generated when you clear the Delete Temporary Files after Simulation is Complete checkbox in the NR Performance Calculation Options tab.

Single Family Residential Title 24 Compliance Modeling Topics

The zoning of residential buildings for the HVAC system(s), for calculating design loads, and for calculating energy compliance is a complex topic. There are basic principles and guidelines which you should consider in deciding how a building is modeled. This section presents guidelines and special techniques which may assist you in modeling residential buildings. Topics include:

Energy Design Rating

Photovoltaic Systems

Battery Storage

Measures that Require HERS Verification

HERS Registration

Accessory Dwelling Units

Single Family Dwelling Units

Heat Pump Water Heating

Modeling Interior Surfaces

Dividing the Building into Zones and Systems

Underground Walls, Floors, and Conditioned Spaces

Calculating All Four Orientations

Radiant Barriers

Cool Roofs

Building Story

Variable Capacity Heat Pumps

Ductless Heat Pumps

Zonal Controls

No Setback Thermostats

Heating and Cooling Distribution Systems

Hydronic Systems

No Cooling Installed

Attached Sunspaces and Garages

Pool and Spa Equipment

Energy Design Rating (EDR)

For a building to comply, it must meet three criteria:

(1) The hourly source energy (HSE) must be equal to or less than the HSE of the Standard Design,

(2) the proposed Efficiency EDR2 (EDR2eff) must be equal to or less than the EDR2eff of the Standard Design, and

(3) the proposed Total EDR2 (EDR2total) must be equal to or less than the EDR2total of the Standard Design.

The two-stage EDR2 concept is consistent with California's "loading order" which prioritizes energy efficiency ahead of renewable generation. Each project must meet the EDR2eff threshold before PV is credited but allows for PV to be traded off with additional efficiency when meeting the EDR2total. In other words, a project may improve on building efficiency beyond the minimum required and reduce the PV generation capacity required to achieve the required EDR2total but may not increase the size of the PV system and trade this off with a reduction of efficiency measures.

The Efficiency EDR Score includes energy used for space heating, space cooling, ventilation, and water heating. Efficiency may also include a portion of the battery storage energy savings when the self-utilization credit is specified (otherwise that credit is applied to the Total EDR). The Total EDR Score includes the efficiency end uses plus interior lighting, appliances, cooking, plug loads, exterior lighting, and if specified, PV generation and flexibility measures.

The following text is an excerpt from Section 1.5 of the 2022 Single Family Residential ACM Reference Manual.

> There are two independent EDR metrics based on source energy and TDV. The EDR metric based on source energy is referred to as EDR1, and the EDR metric based on TDV is referred to as EDR2. No tradeoffs are allowed between EDR1 and EDR2.

> ### 1.5.1 Energy Design Rating 1 (EDR1)

> EDR1 is a dimensionless metric based on the hourly source energy consumption of a proposed or standard design divided by the hourly source energy consumption of the reference design. EDR1 accounts for the source energy of all end uses, including space heating, space cooling, ventilation, and water heating, interior lighting, appliances, exterior lighting, PV generation and flexibility measures, as well as the Renewables Portfolio Standards (RPS) and similar obligations.

> In addition to efficiency, projects receive EDR1 benefits from generating renewable energy and shifting energy demand to times when the utility generates low-carbon electricity. The EDR1 is a way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a reference design building meeting the efficiency requirements of the 2006 International Energy Conservation Code (IECC). A lower EDR1 score represents less source energy use. The proposed building must have an EDR1 score that is equal to or less than the EDR1 score of the standard design.

> The physical bounds for source energy are about 10,500 British thermal units per kilowatt-hour (Btu/kWh) upper bound (proxy low-efficiency power plant) and 0 Btu/kWh lower bound (renewable generation). Delivery losses are the same as the delivery losses used for TDV.

> Avoided source energy from incremental renewable generation varies based on RPS goals. This source energy is a represented as an RPS percentage value that increases annually. The avoided source energy can further vary based on the specific resource used, such as wind, solar or energy storage.

> Natural gas long-run source energy is based on the percentage of renewable gas used by utilities. Increased use of renewable gas will decrease the source energy impact of retail natural gas consumption.

> Propane long-run source energy does not vary annually because there are no renewable gas offsets that can be used to support propane. The long-run marginal source energy of propane is

constant and considered to be the source energy of propane gas. This long-run marginal source energy is calculated as a direct conversion factor of 100 kBtu/therm.

The hourly source energy determined by the CEC is used to determine compliance.

1.5.2 Energy Design Rating 2 (EDR2)

EDR2 is a dimensionless metric based on the TDV energy consumption of a proposed or standard design divided by the TDV energy consumption of the reference design.

The EDR2 is a way to express the energy performance of a building using a scoring system where 100 represents the energy performance of a reference design building meeting the efficiency requirements of the 2006 IECC. The EDR2 is similar to the energy rating index in the 2014 Residential Energy Services Network (RESNET) standard. A score of zero represents a building that has zero-net-energy consumption based on the TDV energy consumption. By combining high levels of energy efficiency with renewable energy generating or demand flexibility measures, a score of zero or less could be achieved.

Buildings complying with the current California Building Energy Efficiency Standards are more efficient than the 2006 IECC, so most newly constructed buildings will have EDR2 scores below 100. Buildings with renewable generation can achieve a negative score. If an EDR2 is calculated for an older, inefficient home, the score would be more than 100.

The Total EDR2 is composed of two components, Efficiency EDR2 and PV/flexibility EDR2.

The efficiency EDR2 is based on the energy efficiency features of the building. PV/flexibility EDR2 includes the effects of the PV system, battery storage system, precooling, and other demand-responsive measures. Total EDR2 combines the efficiency EDR2 and PV/flexibility EDR2 into one final score.

The efficiency EDR2 does not include solar electric generation but can include a self-utilization credit for batteries. The total EDR2 includes the effects of solar generation and any battery storage beyond the self-utilization credit.

Photovoltaic Systems

The 2022 Standards prescriptive baseline assumes all new single family and low-rise multifamily residential construction projects install a photovoltaic system sized to generate just enough electricity to offset the estimated annual kWh load of a mixed-fuel building that uses natural gas for the fuel source for space heating, water heating, cooking and clothes drying. The requirement is a prescriptive assumption

and is not mandatory. The annual kWh load of the Standard Design building is the sum of the electricity usage of the following loads:

1. Space heating
2. Space cooling
3. IAQ ventilation
4. Water heating
5. Battery storage
6. Inside lighting
7. Appliances and cooking
8. Plug loads
9. Exterior lighting

When calculating the minimum PV system size, the Standards assume natural gas is the fuel source for space heating, water heating, cooking and clothes drying. This ensures that building designs that use electricity for one or more of the four end uses are not required to install larger PV systems than a similar home with gas-powered equipment. However, it also results in a PV system that doesn't offset all of the estimated electricity usage for a 2022 home that uses electricity for at least one of the four end uses. Installing a larger system to offset a greater portion of the load in an electric home will offset more electricity use, reduce the Total EDR2 Score and may be more cost-effective. In addition, a larger system may help prepare for electrification of additional equipment in the future.

For the sizing calculations, the software assumes the California flexible installation (CFI) orientation (170 degrees), standard efficiency for modules and inverters, fixed tracking, standard shading, roof tilt of 22.61 degrees (5:12 pitch), and annual solar access percentage equal to 98 percent. Refer to the PV+Batt Tab of the Building Element for information and options for calculating PV system sizing in EnergyPro.

Proposed System: To use the California Flexible Installation 1 (CFI1) simplified modeling option in the performance method, the PV array must be installed between 150 to 270 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12.

When the CFI2 option is selected in the performance calculation, the PV array must be installed between 105 and 300 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12. Note, when selecting CFI2, the performance of the proposed system is derated by approximately 10 percent.

You must enter the actual orientation and tilt of the PV array if it doesn't meet the conditions for either CFI1 or CFI2.

Exceptions to PV System Requirements: There are five exceptions to the minimum PV system requirements, most of which allow a reduction in PV system size in cases with limited solar access. There is also an exception which allows a 25% reduction in system size if paired with a battery with minimum usable capacity equal to 7.5kWh.

Refer to Section 150.1(c)14 in the Standards, 2.1.5 of the Single Family Residential ACM Reference Manual, and Chapter 7 of the Single Family Residential Compliance Manual for additional information regarding PV system requirements.

Battery Storage

When a single family or low-rise multifamily residential PV system is coupled with a battery storage system with minimum 5kWh capacity, the battery is eligible for a compliance credit. A battery is the only measure for which a portion of the credit may be applied to the Efficiency EDR2 score (Self-Utilization Credit). This credit can be used for tradeoffs against building envelope and efficiencies of the equipment installed in the building.

The battery must be controlled in one of the following three methods (or an alternative method approved by the Energy Commission): Basic, Time of Use and Advanced DR control. There is no compliance credit if the battery is programmed for "static" operation (in backup mode) as it provides little benefit to the customer and none to the grid. The three control strategies currently available are:

- Basic: Battery is charged when PV generation is greater than the house load and discharged when load exceeds generation. This control strategy does not allow the batteries to discharge into the grid.

- Time of Use: Battery storage system default operation mode must allow charging from an on-site PV system or from the utility grid if a stand-alone battery storage system. The battery storage system shall begin discharging during the highest-priced TOU hours of the day, which varies by time of year and local utility. At a minimum, the system shall be capable of programming three seasonal TOU schedules, such as spring, summer, and winter. This option allows discharging directly into the grid.

- Advanced Demand Flexibility Control: Battery storage system must be programmed by default as basic control or TOU control, as described above. The battery storage control shall meet the demand-responsive control requirements specified in Section 110.12(a). The battery storage system shall have the capability to change the charging and discharging periods in response to signals from the local utility or a third-party aggregator. Upon receiving a demand response signal from a grid operator, this option allows discharging directly into the grid.

Refer to 2.1.5 of the Single Family Residential ACM Reference Manual and Chapter 7 of the Single Family Residential Compliance Manual for additional information regarding battery storage requirements.

Measures That Require HERS Field Verification

The Standards include mandatory HERS measures in addition to HERS measures that are prescriptive requirements or opportunities for compliance credit. Diagnostic testing and field verification protocol and requirements are described in detail in Sections RA2 and RA3 of the Reference Residential Appendices.

The primary document at the time of permit is the Certificate of Compliance (for projects using the performance method, the CF1R-PRF-01-E). If a project includes HERS measures, the Compliance Results section on the first page of the CF1R form includes the following note "This building incorporates features that require field testing and/or verification by a certified HERS rater under the supervision of a CEC-approved HERS provider:". In addition, each measure is shown in the HERS Feature Summary and in the appropriate section of the detailed results, e.g., Building Envelope – HERS Verification.

When compliance requires HERS verification, you must register the compliance documentation with a HERS provider before applying for a building permit (see Single Family *Residential Compliance Manual*, Section 2.1.2). The installation contractor must complete Certificates of Installation (CF2R) forms, and provide the CF-2R forms to the HERS Rater. The HERS Rater completes the Certificates of Verification (CF-3R) confirming the installed measures meet all requirements.

Table RA2-1 from the Residential Reference Appendices lists the features that require HERS field verification and/or diagnostic testing.

Table RA2-1 – Summary of Measures Requiring Field Verification and Diagnostic Testing

Measure Title	Description	Procedure(s)
Duct Measures		
Duct Sealing	Component Packages require that space conditioning ducts be sealed. If sealed and tested ducts are claimed for compliance, field verification and diagnostic testing is required to verify that approved duct system materials are utilized, and that duct leakage meets the specified criteria.	RA3.1.4.3

Duct Location, Surface Area and R-value	Compliance credit can be taken for improved duct location, surface area and R-value. Field verification is required to verify that the duct system was installed according to the design, including location, size and length of ducts, duct insulation R-value and installation of buried ducts.[1] For buried ducts measures, Duct Sealing and High Quality Insulation Installation (QII) is required.	RA3.1.4.1
Verification of low leakage ducts located entirely in conditioned space	Duct system location shall be verified by visual inspection and diagnostic testing.\n\nCompliance credit can be taken for verified duct systems with low air leakage to the outside when measured in accordance with Reference Residential Appendix Section RA3.1.4.3.8. Field Verification for ducts in conditioned space is required. Duct sealing is required.	RA3.1.4.3.8
Low Leakage Air-handling Units	Compliance credit can be taken for installation of a factory sealed air handling unit tested by the manufacturer and certified to the Commission to have met the requirements for a Low Leakage Air-Handling Unit. Field verification of the air handler's model number is required. Duct Sealing is required.	RA3.1.4.3.9
Verification of Return Duct Design	Verification to confirm that the return duct design conform to the applicable criteria given in Table 150.0-B, TABLE 150.0-C, Table 160.3-A, or 160.3-B.	RA3.1.4.4
Verification of Air Filter Device Design	Verification to confirm that the air filter devices conform to the requirements given in applicable Standards Sections 150.0(m)12 or 160.2(b)1.	RA3.1.4.5
Verification of Prescriptive Bypass Duct Requirements	Verification to confirm zonally controlled systems comply with the bypass duct requirements in Section 150.1(c)13 or 170.2(c)3C.	RA3.1.4.6
Air Conditioning Measures		
Improved Refrigerant Charge	Component Packages require in some climate zones that air-cooled air conditioners and air-source heat pumps be diagnostically tested in the field to verify that the system has the correct refrigerant charge. For the performance method, the Proposed Design is modeled with less efficiency if diagnostic testing and field verification is not performed. The system must also meet the prerequisite minimum System Airflow requirement.	RA3.3\n\nRA3.2\n\nRA1.2
Installation of Fault Indicator Display	Component Packages specify that a Fault Indicator Display can be installed as an alternative to refrigerant charge testing. The existence of a Fault Indicator Display has the same calculated benefit as refrigerant charge testing. Field verification is required.	RA3.4.2
Verified System Airflow	When compliance requires verified system airflow greater than or equal to a specified criterion, field verification and diagnostic testing is required.	RA3.3
Air-handling Unit Fan Efficacy	When compliance requires verified fan efficacy (Watt/cfm) less than or equal to a specified criterion, field verification and diagnostic testing is required.	RA3.3

Verified Energy Efficiency Ratio (EER/EER2)	Compliance credit can be taken for increased EER/EER2 by installation of specific air conditioner or heat pump models. Field verification is required.[2]	RA3.4.3 RA3.4.4.1
Verified Seasonal Energy Efficiency Ratio (SEER/SEER2)	HERS Rater field verification of the SEER/SEER2 rating is required for some systems.	RA3.4.3 RA3.4.4.1
Rated Heat Pump Capacity Verification	When performance compliance uses a heat pump, the rated capacity of the installed system shall be verified to be greater than or equal to the specified value.	RA3.4.4.2
Evaporatively Cooled Condensers	Compliance credit can be taken for installation of evaporatively cooled condensers. Field verification of duct leakage is required. Field verification of refrigerant charge is required. Field verification of EER/EER2 is required.	RA3.1.4.3, RA3.2 RA3.4.3. RA3.4.4.1
Variable Capacity Heat Pump (VCHP) Compliance Option	When performance compliance uses the VCHP compliance option, the system shall be field verified to confirm it meets the eligibility requirements.	RA3.4.4.3
Ventilation Cooling Measures		
Whole House Fan	When performance compliance uses a whole house fan, the installed whole house fan airflow rate (cfm) and fan efficacy (W/cfm) shall be verified to be equal to or better than the specified values.	RA3.9
Central Fan Ventilation Cooling System	When performance compliance uses a central fan ventilation cooling system (CFVCS), the installed CFVCS ventilation airflow rate (cfm) and fan efficacy (W/cfm) shall be verified to be equal to or better than the specified values.	RA3.4.1
Mechanical Ventilation Measures for Improved Indoor Air Quality		
Continuous Whole-Building Mechanical Ventilation Airflow	Measurement of whole-building mechanical ventilation is mandatory for newly constructed buildings.	RA3.7.4.1
Intermittent Whole-Building Mechanical Ventilation Airflow	Measurement of whole-building mechanical ventilation is mandatory for newly constructed buildings.	RA3.7.4.2
Kitchen Local Mechanical Exhaust Verification	Verification of kitchen local mechanical exhaust is mandatory for newly constructed buildings.	RA3.7.4.3
Heat Recovery Ventilation (HRV) or Energy Recovery Ventilation (ERV) Rated Performance Verification	When performance compliance requires verification of the HRV/ERV fan efficacy (W/cfm) or heat recovery efficiency, then the installed ventilation system shall be verified.	RA3.7.4.4
Building Envelope Measures		
Building Envelope Air Leakage	Compliance credit can be taken for reduced building envelope air leakage. Field verification and diagnostic testing is required.	RA3.8

	Multifamily dwelling units are required to have enclosure leakage verified when supply or exhaust ventilation systems are installed.	
Quality Insulation Installation (QII)	Compliance Software recognizes standard and improved envelope construction. Quality Insulation Installation is a prescriptive measure in all climate zones for newly constructed buildings and additions greater than 700 square feet, except low-rise multifamily buildings in Climate Zone 7. Field verification is required.	RA3.5
Quality Insulation Installation for Spray Polyurethane Foam (SPF) Insulation	A HERS Rater shall verify the installation of SPF insulation whenever R-values other than the default R-value per inch are used for compliance.	RA3.5.6
Single Family Domestic Hot Water Measures		
Verified Pipe Insulation Credit (PIC-H)	Inspection to verify that all hot water piping in non-recirculating systems is insulated and that corners and tees are fully insulated. No piping should be visible due to insulation voids with the exception of the last segment of piping that penetrate walls and delivers hot water to the sink, appliance, etc.	RA3.6.3.
Verified Parallel Piping (PP-H)	Inspection that requires that the measured length of piping between the water heater and single central manifold does not exceed five feet	RA3.6.4
Verified Compact Hot Water Distribution System Expanded Credit (CHWDS-H-EX)	Field verification to insure that the eligibility criteria specified in RA 3.6.5 are met.	RA3.6.5
Demand Recirculation: Manual Control (RDRmc-H)	Inspection to verify that all recirculating hot water piping is insulated and that corners and tees are fully insulated. No piping should be visible due to insulation voids	RA3.6.6
Demand Recirculation: Sensor Control(RDRsc-H)	Inspection to verify that all recirculating hot water piping is insulated and that corners and tees are fully insulated. No piping should be visible due to insulation voids.	RA3.6.7
Verified Drain Water Heat Recovery System (DWHR-H)	Inspection to verify that the DWHR unit(s) and installation configuration match the compliance document and the DWHR(s) is certified to the Commission to have met the requirements.	RA3.6.9
Multi Family Domestic Hot Water Heating Measures		
Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units	Inspection that a central DHW system serving a building with more than eight dwelling units has at least two recirculation loops, each serving roughly the same number of dwelling units. These recirculation loops may the same water heating equipment or be connected to independent water heating equipment.	RA3.6.8
Verified Drain Water Heat Recovery System (DWHR-H)	Inspection to verify that the DWHR unit(s) and installation configuration match the compliance document and the DWHR(s) is certified to the Commission to have met the requirements.	RA3.6.9

1. Note: Compliance credit for increased duct insulation R-value (not buried ducts) may be taken without field verification if the R-value is the same throughout the building, and for ducts located in crawlspaces and garages where all registers are either in the floor or within 2 feet of the floor. These two credits may be taken subject only to enforcement agency inspection.

2. Note: The requirement for verification of a high EER/EER2 does not apply to equipment rated only with an EER/EER2.

HERS Registration Requirements

The 2022 Title 24 Standards require Title 24 documentation authors to register nearly all single family residential new construction projects with a HERS Provider. The Standards include a mandatory requirement that new homes and additions larger than 1,000 ft² be field verified by an approved HERS rater to comply with the ventilation requirements for indoor air quality. In addition, if the home has a ducted HVAC system, a HERS rater must verify that the ducts are adequately sealed to limit leakage. Refer to the Single Family Residential Compliance Manual, Section 2.1.2, for additional information regarding the registration process and requirements.

Single Family Dwelling Units

Define dwelling unit data at the Zone Element level to calculate the IAQ ventilation requirements. The Dwelling Units tab is used to document the floor area, number of bedrooms and type (and number) of appliances located in the zone. The appliance data is fixed for compliance calculations but is included in the Appliances and Miscellaneous Energy Loads used in the Energy Design Rating (EDR) calculations. For more information about the Energy Design Rating, refer to Section 1.5 in the Residential ACM Reference Manual and 8.2.1 of the Residential Compliance Manual.

Dwelling units are defined in Standards Section 100.1 as:

> *"DWELLING UNIT is a single unit providing complete, independent living facilities for one or more persons including access to permanent provisions for living, sleeping, eating, cooking and sanitation."*

Note that EnergyPro treats the Dwelling Unit data somewhat differently depending on the occupancy type (Single Family or Multifamily), or when compliance is documented using the Addition Alone method. Some of the calculations on the Dwelling Unit tab are overridden by the software, such as the example that follows.

Use caution when completing these values to ensure your data is consistent between the Dwelling Units tabs and Room Elements. If there is an inconsistency, the final calculation in the compliance report may be different than the on-screen results. For example, EnergyPro will always assume one dwelling unit when the building type is Single Family (new or E+A+A) irrespective of the number entered in the dwelling unit tabs. However, EnergyPro does use the "Number of Bedrooms" entries, even if the Floor Area and Number of Units are both set to zero in that unit.

Single Family: EnergyPro ignores the Floor Area and Number of Units entered in the Dwelling Units tab(s), and uses the Room Element floor area in the IAQ calculation. When you select Single Family, both New, and Existing Plus Addition Plus Alteration, EnergyPro always assumes there is one dwelling unit irrespective of the Dwelling Unit tab entries. You may leave the Dwelling Unit floor area and Number of Units set to zero when modeling single family homes (except if an Addition Alone).

Addition Alone: If you are modeling an Addition Alone, select "Addition" when specifying the Building Type in the Building Element, General tab. For Number of Units, enter a decimal fraction indicating the ratio of the addition area relative to the area of the entire house (existing plus addition). The calculation is as follows: Area of addition/(Area of existing + addition).

Duplexes and Townhomes: A duplex or townhome must be modeled as a single-family building. Each dwelling unit will be a separate input file rather than modeling a building with multiple dwelling units.

Accessory Dwelling Units

The California Department of Housing and Community Development defines accessory dwelling units as:

". . . an attached or detached residential dwelling unit which provides complete independent living facilities for one or more persons. An ADU shall include permanent provisions for living, sleeping, eating, cooking, and sanitation on the same parcel as the single-family dwelling is situated.,

For Part 6 compliance purposes, only newly constructed, detached units are considered new construction. If the ADU is attached to the existing home, whether newly constructed or converting existing unconditioned space, it is considered an addition. If existing, detached unconditioned space is being converted to an ADU, that is also considered an addition.

The 2022 Energy Code adds a new definition for junior accessory dwelling unit (JADU). A JADU is a dwelling unit that is no more than 500 square feet in size and contained entirely within an existing single-family building. A JADU includes a kitchen, a separate entrance from the main entrance to the building, and an interior entry to the main living area. A JADU may include separate sanitation facilities, or may share sanitation facilities with the existing single-family building.

Refer to Section 9.3.5 in the Single Family Residential Compliance Manual for additional information specific to ADUs.

Heat Pump Water Heaters

In most climate zones, the prescriptive basecase assumption for new single family homes is a heat pump water heater. In Climate Zones 3, 4, 13, and 14, if a gas system (instantaneous) is used, the basecase assumption is heat pump space heating.

Heat pump water heaters are a significant component in the new all-electric baseline for water heating systems serving individual residential dwelling units. The prescriptive baseline has two options for heat pumps in most climate zones: install a high-efficiency, NEEA-rated unit OR install a minimum efficiency unit plus other measures.

NEEA, the Northwest Energy Efficiency Alliance, has created an "Advanced Water Heating Specification" and established the rating test criteria to ensure newly installed HPWHs perform adequately, especially in colder climates. The NEEA rating requires a minimum Uniform Energy Factor (UEF) equal to the ENERGY STAR performance level and includes requirements regarding noise and prioritizing heat pump use over supplemental electric resistance heating.

In Climate Zones 1-15, if the project includes a 240V HPWH with a NEEA Tier 3.0 rating, it meets the minimum prescriptive requirements. In Climate Zone 16, the project must also install a drain water heat recovery system and the tank must be located in either the garage or conditioned space.

Minimum efficiency HPWHs must also include one of the following options:

- All Climate Zones: Must be installed in garage or conditioned space, and

- In Climate Zones 1, 16: Install a compact hot water distribution system, and

- In Climate Zone 16: Install a drain water heat recovery system.

Under the prescriptive method, a project is also allowed to install a solar water heating system with a minimum solar savings fraction (SSF) equal to 0.7 with electric backup.

There are exceptions to the prescriptive requirements. Refer to Standards Section 150.1(c)8 for additional information on prescriptive requirements for single family water heating.

Enter data for heat pump water heating equipment in the Domestic Hot Water Tab of the Plant Element.

Modeling Interior Surfaces

You must model interior surfaces between zones (both conditioned and unconditioned). Use the Interior Surfaces Element to specify the type of surface for the assembly (wall, floor, door, etc.), and to indicate where in the building the surface is located. Note that you must create an unconditioned zone to model an attached garage or other unconditioned space, but the software will automatically create and model the attic. There is no need to create an attic zone, but you must model the Interior Surfaces that are adjacent to it.

When modeling a single family garage, create the interior surface within the conditioned zone. Do not create it in the garage, or it will result in an error in the residential calculation engine.

You must specify the Floor Elevation for Interior Surfaces, although the elevation is specified at the Zone level for all other assemblies. In most cases, the Floor Elevation of your Interior Surface will be equal to the Floor Elevation in the Zone.

Ensure your data is consistent, especially with respect to the elements that connect zones within the model. For example, if you are modeling a 2-story home (one zone per floor), you may model the assembly between the two floors as an interior ceiling or an interior floor. However, you must make sure to place the assembly in the correct Room, select the correct "Adjacent to" Room, AND ensure the Floor Elevation is correct for the assembly you selected and the Zone.

Dividing the Building Into Zones and Systems

A basic and important question that must be considered before taking the areas of walls, windows, roofs and floors off the plans, is:

> How is the building zoned?

NOTE: You will use both the Zone and Room elements to enter data for what is described here as a "residential zone". You will use the Zone element to name the zone, select the occupancy type, set the number of floors, and complete the dwelling unit data; use the Room element within that zone to describe that zone's envelope features (floor elevation, types of walls, floors, glazing, etc.). In practice, the Room element will usually include multiple rooms, or possibly an entire floor.

In considering the HVAC zoning for a residential building, a few primary issues come up:

- As a general rule, use the minimum number of Zones and Systems to produce the information needed for both compliance and equipment selection. Can comfort throughout the building be maintained with a single thermostat? If not, how must the building be divided up to maintain comfort?
- What type of mechanical system will be installed? A standard split system forced air furnace and air conditioner with no special duct damper controls can serve only a single thermostat zone. Two such systems can serve two separate zones. A radiant hydronic space heating or variable refrigerant flow cooling system can serve many different thermostatically controlled zones.
- Standard residential air conditioning equipment goes up to a nominal 5-ton cooling capacity (up to approximately 45,000 Btuh sensible capacity under typical design conditions). If the building has larger cooling loads, additional condensing units might be needed to meet the load.
- Because EnergyPro allows you to calculate design heating and cooling loads by system and room, you can use the program in various ways. For example, you may not be sure whether a certain piece of equipment can meet the entire house cooling load. In this case you may choose to input the house description as several zones. If the equipment cannot meet the entire load, you may add a new system and simply drag one (or more) of the zones to the new system.
- If the home meets the design requirements to be eligible for zonal control credit, you may wish to divide the building into a Living Zone and a Sleeping Zone. Refer to Section 150.0(m)13 in the Standards, and the Residential Compliance Manual, Sections 4.4.1.18, 4.4.1.19, and 4.5.2 for additional information regarding the requirements for zonal controls.

- The program adds up all the attributes of all [Zones](#) and [Systems](#) within the building when it performs the compliance calculations. Although HVAC system efficiencies are area-weighted by System, zoning is primarily a design issue, not a compliance issue.

- If it is clear from the outset that, for example, there is no mechanical cooling and/or the whole house will operate on a single thermostat, you may then treat the house effectively as a single Zone, although many people still divide the inputs by floor for clarity. If you only use one zone, set the [Number of Floors](#) to the number of habitable stories in the building although the Zone includes the attributes of all floors, roofs, walls, etc.

- If air conditioning will be installed or is optional, the sensible cooling loads and air flow requirements are likely to dictate how the house is zoned. If you are uncertain whether the proposed HVAC system will meet the loads, it might be a good idea to break the building description into several Zones. When performing load calculations, you may be able to aggregate Zones and evaluate which piece or pieces of HVAC equipment are suited to serve each Zone.

- When two or more different pieces of equipment are specified, create separate Systems and define separate Zones within each to properly model the performance of the Systems for both compliance and design purposes.

Underground Walls, Floors, and Conditioned Spaces (Residential)

For low-rise residential construction projects, you must model underground conditioned spaces. In the [Zone Element](#), set the "Elevation Above Grade" entry in the Select the Building Story dialog box to a value that reflects the actual elevation relative to the surface grade. In Underground zones, the number will be negative. Use the [Underground Wall element](#) to model basement or other walls below grade. Use the [Underground Floor element](#) to model basement (below grade) floors. Model the construction assembly as it exists.

Calculating All Four Orientations

You may show compliance for a single family home plan so that it may be built in any orientation by calculating compliance of the unit in all four orientations, as explained in the Single Family Residential Compliance Manual, Section 8.4.2, Multiple Orientation Alternative: No Orientation Restrictions. To do this in EnergyPro:

Input the unit plan, set the Front Orientation to due north and the Rotation to zero.

When you run [Single Family T24 Performance](#), check the Run Four Orientations box in the Calculations, Options tab. EnergyPro will run compliance calculations for the building in all four cardinal orientations.

After the calculation is complete, the results are displayed in the Results pane in the bottom-right section of the window. EnergyPro lists the Standard Building results first, followed by results for each of the four cardinal orientations.

If the unit does not comply initially in all four orientations, choose the orientation with the worst results (i.e., where the building fails by the greatest margin). Make changes to the building and recalculate until the unit complies in all four orientations. EnergyPro prints the detailed simulation results for each orientation in the Energy Use Summary section of the CF-1R.

NOTE: Do not select Four Orientations if you are performing an Existing-plus-Addition calculation.

Attic Radiant Barriers

The 2019 Standards include two optional prescriptive baseline attic designs, labeled as Option B and Option C. Option B requires both roof and ceiling insulation and requires radiant barriers in Climate Zones 2, 3, and 5-7. Option C requires insulation at the ceiling level only, assumes ducts are in conditioned space, and requires a radiant barrier in Climate Zones 2-15.

Radiant barriers must meet specific eligibility and installation criteria to be modeled by any ACM to document compliance for low-rise residential buildings. The following is an excerpt from the Reference Residential Appendices, RA4.2.1. Also refer to Section 3.4.4 of the Residential Manual for additional details.

> *"The emittance of the radiant barrier shall be less than or equal to 0.05 as tested in accordance with ASTM C1371 or ASTM E408.*
>
> *Installation shall conform to ASTM C1158 (Standard Practice for Installation and Use of Radiant Barrier Systems (RBS) in Building Construction), ASTM C727 (Standard Practice for Installation and Use of Reflective Insulation in Building Constructions), ASTM C1313 (Standard Specification for Sheet Radiant Barriers for Building Construction Applications), and ASTM C1224 (Standard Specification for Reflective Insulation for Building Applications), and the radiant barrier shall be securely installed in a permanent manner with the shiny side facing down toward the interior of the building (ceiling or attic floor). Moreover, radiant barriers shall be installed at the top chords of the roof truss/rafters in any of the following methods:*
>
> *(a) Draped over the truss/rafter (the top chords) before the upper roof decking is installed.*
>
> *(b) Spanning between the truss/rafters (top chords) and secured (stapled) to each side.*
>
> *(c) Secured (stapled) to the bottom surface of the truss/rafter (top chord). A minimum air space shall be maintained between the top surface of the radiant barrier and roof decking of not less than 1.5 inches at the center of the truss/rafter span.*
>
> *(d) Attached [laminated] directly to the underside of the roof decking. The radiant barrier shall be laminated and perforated by the manufacturer to allow moisture/vapor transfer through the roof deck.*
>
> *(e) In addition, the radiant barrier shall be installed to cover all gable end walls and other vertical surfaces in the attic.*
>
> *RA4.2.1.1 For Prescriptive Compliance: The attic shall be ventilated to:*
>
> *(a) Provide a minimum free ventilation area of not less than one square foot of vent area for each 300 ft² of attic floor area.*
>
> *(b) Provide no less than 30 percent upper vents.*
>
> *(c) Ridge vents or gable end vents are recommended to achieve the best performance. The material should be cut to allow for full airflow to the venting.*
>
> *(d) The product shall meet all requirements for California certified insulation materials [radiant barriers] of the Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation, as specified by CCR, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material.*
>
> *(e) The use of a radiant barrier shall be listed in the Special Features and Modeling Assumptions listings of the Certificate of Compliance and described in detail in the Residential ACM Manual Conform to the radiant barrier manufacturer's instructions."*

Cool Roofs

A "Cool Roof" is a roofing material with high solar reflectance and high emittance that reduces heat gain through the roof. Cool roofs are required prescriptively for some buildings under the 2022 Standards, though

there are opportunities for compliance credit when using the performance approach, if a CRRC-certified cool roof is installed that exceeds the minimum prescriptive requirements.

To model a Cool Roof, from the Roof element of the Building Tree, click on the Assembly field to open the Assembly Library and edit the cool roof-related fields. Check the CRRC-certified checkbox to enable the Aged Solar Reflectance and Thermal Emittance fields, select the roofing type from the drop-down list and enter the CRRC-certified Aged Solar Reflectance and Thermal Emittance values. You must check the CRRC-Certified Roofing checkbox or EnergyPro ignores the manually-entered data and uses the following values for non-certified roofs:

> Single Family and Multifamily Residential:
>
>> Aged Solar Reflectance = 0.1, Emittance = 0.85.
>
> Nonresidential:
>
>> Asphalt Shingles: Aged Solar Reflectance = 0.08, Emittance = 0.85
>
>> All Others: Aged Solar Reflectance = 0.10, Emittance = 0.85

If the certified Aged Solar Reflectance isn't available, use the equation from Section 110.8 of the Standards to calculate it from the CRRC initial reflectance.

Refer to Section 3.4.3 of the Single Family Residential Compliance Manual for additional information about the requirements for residential roofing products which vary depending on the climate zone and roofing material. Also refer to Section 3.2.5 and 11.3.3.8 in the Nonresidential/Multifamily Compliance Manual for details.

Building Story

The user must provide information about each building story (floor) to complete the geometric description of the building. Several of the simulation calculations use the information entered here. For example, the air flow calculations require the elevation of the top and bottom of each zone, load calculations require information about the interior volume of the space, water heating recirculation loops use the floor height data, etc.

Variable Capacity Heat Pumps

The user must provide information about each building story (floor) to complete the geometric description of the building. Several of the simulation calculations use the information entered here. For example, the air flow calculations require the elevation of the top and bottom of each zone, load calculations require information about the interior volume of the space, water heating recirculation loops use the floor height data, etc.

Ductless Heat Pumps

The 2019 Standards allow users to model ductless heat pump systems (mini-split, multi-split VRF systems) for Title 24 compliance. However, the CEC Compliance Manager simulates them as a system equivalent to the standard minimum efficiency split system A/C with default duct conditions, thus there is no compliance credit available.

These systems may also be used in LEED calculations for EA Credit 1 points. There are several sample files included with EnergyPro that demonstrate how to properly model systems offered by many manufacturers. Sample files are automatically installed in the EnergyPro 8 Projects folder during program installation.

Zonal Controls

To take credit for zonal controls in a residential building:

Create separate zones for the living and sleeping portions of the house. Each zone must have its own thermostat, and the non-closeable opening between the zones can be no greater than 40 square feet. The zones may be served by separate systems or one system with zonal controls.

In the General Tab of the Zone Element, select either Res Living or Res Sleeping for the Zone Type, as appropriate. Set the zone which includes the living spaces of the house (i.e., living room, kitchen, dining room) to *Living*. Set the zone which includes the sleeping spaces in the house (i.e., bedrooms) to *Sleeping*. Ensure the data in the Dwelling Unit tab of each zone is consistent with the Zone Type. Additionally, you must model the interior surfaces and open areas between the Living and Sleeping zones. Refer to Section 4.5.2 of the *Residential Manual* for more details regarding zonal control special modeling techniques.

Note that you may not use the zonal control credit with combined hydronic systems.

Excerpts from the guidelines in the *Residential Manual* and ACM Reference Manual for modeling zonal controls and zonally controlled systems follow.

Residential Manual, Section 4.5.2:

There are unique eligibility and installation requirements for zonal control to qualify under the Standards. The following steps must be taken for the building to show compliance with the Standards under this exceptional method:

1. ***Temperature Sensors***. *Each thermal zone, including a living zone and a sleeping zone, must have individual air temperature sensors that provide accurate temperature readings of the typical condition in that zone.*

2. ***Habitable Rooms***. *For systems using central forced air or hydronic heating each habitable room in each zone must have a source of space heating such as forced air supply registers, radiant tubing or a radiator. For systems using a combination of a central system and a gas vented fireplace or other individual conditioning units, the zone served by the individual conditioning unit can be limited to a single room. Bathrooms, laundry, halls and/or dressing rooms are not habitable rooms.*

3. ***Non-closeable Openings***. *The total non-closeable opening area (W) between adjacent living and sleeping thermal zones (i.e., halls, stairwells, and other openings) must be less than or equal to 40 ft². All remaining zonal boundary areas must be separated by permanent floor-to-ceiling walls and/or fully solid, operable doors capable of restricting free air movement when in the closed position.*

4. ***Thermostats***. *Each zone must be controlled by a central automatic dual setback thermostat that can control the conditioning equipment and maintain preset temperatures for varying time periods in each zone independent of the other. Thermostats controlling vented gas fireplace heaters that are not permanently mounted to a wall are acceptable as long as they have the dual setback capabilities.*

Other requirements specific to forced air ducted systems include the following:

1. *Each zone must be served by a return air register located entirely within the zone. Return air dampers are not required.*

2. *Supply air dampers must be manufactured and installed so that when they are closed, there is no measurable airflow at the registers.*

3. *The system must be designed to operate within the equipment manufacturer's specifications.*

4. *Air is to positively flow into, through, and out of a zone only when the zone is being conditioned. No measurable amount of supply air is to be discharged into unconditioned or unoccupied space in order to maintain proper airflow in the system.*

Although multiple thermally distinct living and/or sleeping zones may exist in a residence, the correct way to model zonal control for credit requires only two zones: one living zone and one sleeping zone. All

separate living zone components must be modeled as one single living zone; the same must be done for sleeping zones.

Zonally controlled systems must meet minimum airflow and fan efficacy requirements. Zoned systems (multiple zones served by a single air handler with motorized zone dampers), with or without bypass dampers, usually do not meet the airflow and fan efficacy requirements when less than all zones are calling. The energy penalty that results is often greater than the benefit of having zonal control, therefore zonal control is no longer simply assumed to be a "better than minimum" condition and there are special compliance requirements. Refer to Residential Appendix RA3.1.4.6 for additional details regarding the airflow and fan efficacy requirements for zonally controlled systems.

Excerpt from Section 2.4.8.4 of the Residential ACM Reference Manual:

Zonally controlled central forced-air cooling systems must be able to deliver, in every zonal control mode, an airflow to the dwelling of $\geq$ 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of $\leq$ 0.45 W/CFM. This is a HERS verified measure, complying with Residential Appendix RA3.3.

An exception allows multispeed or variable speed compressor systems, or single speed compressor systems to meet the mandatory airflow (cfm/ton) and fan efficacy (Watt/cfm) requirements by operating the system at maximum compressor capacity and system fan speed with all zones calling for conditioning, rather than in every zonal control mode.

No Setback Thermostats

Setback thermostats are a mandatory measure for most HVAC systems as explained in Section 4.5.1 of the *Residential Manual and* the Standards, Section 110.2(c). Heat pumps must have "smart" thermostats, or controls which minimize operation of the supplemental electric resistance heating when the heat pump can meet the load independently.

Title 24 allows certain types of HVAC systems to be installed without setback thermostats. The systems which do not require setback thermostats are:

- Non-central electric heaters
- Room air conditioners
- Room air conditioner heat pumps
- Gravity gas wall heaters
- Gravity floor heaters
- Gravity room heaters
- Wood Stoves
- Fireplace or decorative gas appliances

Heating and Cooling Distribution Systems

You must specify the HVAC distribution system features, including the type, location, insulation value, and the features that require field verification by an approved HERS rater. Many features of the distribution system require HERS Field Verification. Some are mandatory, some are prescriptive requirements, and others provide an opportunity for compliance credit. Refer to the Measures that Require HERS Verification topics for additional details regarding those measures.

First, indicate the type of distribution system and its location. Ducted systems may be located in the attic, crawlspace, garage, outdoors or entirely within conditioned space. If the Proposed Design has an attic, then the Standard Design also assumes an attic, and assumes the Option B attic design which includes ducts

located in the attic for single family homes. Multifamily projects assume the ducts are located in conditioned space.

- Select Crawlspace for ducts located in a crawl space or basement if the duct layout and design are shown on the plans and if all supply registers are located in the floor (or no more than two feet above the floor). If any building story has supply registers located more than two feet above the floor, you must select the Attic for that entire floor.
- If all ducts are 100% within the conditioned envelope, select Conditioned.
- If ducts are in a slab-on-grade or slab-below-grade, select Ducts in Attic with a duct R-value of 6. Other requirements apply; refer to Section 4.4.1.10 of the Residential Manual for additional details.

There are several system types that do not use ducts. For example:

- If the system has fan coils with no ducts, select Ductless with Fan.
  - For a gas wall furnace without fans, select Ductless No Fan.
  - With a hydronic radiant floor system, select Radiant Floor.
  - With hydronic baseboard or electric baseboard, select Baseboard.
  - For hydronic piping, see Hydronic Systems.
  - If there is no cooling installed, see the No Cooling topic for modeling details.

  For additional information on duct location options, refer to Section 4.4.3.2 of the Residential Compliance Manual.

Hydronic Systems

Residential Systems

Residential hydronic heating systems are typically either dedicated (providing only space heating), or combined (providing both space and water heating). Refer to Sections 4.7.1 and 4.7.2 in the Residential Manual for additional details regarding hydronic heating systems.

Combined hydronic space and water heating systems are modeled as follows:

In the Plant element, under the Domestic Hot Water tab, create a DHW System with a water heater or boiler selected from the DHW Library. Include all the standard water heating system attributes, including features of the distribution system. In the Combined Hydronic Piping section of the tab, enter the length of pipe associated with the hydronic system which is in unconditioned space, the pipe diameter, and the insulation thickness on that pipe.

Create a *New* Split FAU-A/C system in the Central System library and assign it a name. Set the Heating Tab entries to zero, and all other Central System entries to the actual conditions. EnergyPro automatically calculates the effective efficiency (AFUE or HSPF) from the water heater characteristics and pipe losses. Save the entry in the library and select that system in the General Tab of the System Element to properly document the hydronic system. In the Distribution Tab, select the heating distribution type from the drop-down list based upon the actual condition. This could be Radiant Floor if the piping is embedded in the floor, Baseboard if the system uses perimeter hot water radiators, or in some cases a Ducted system if using fan coils. In the Residential Tab, select *DHW Boiler Provides Heat* from the Hydronic Space Heating drop-down list.

Dedicated (separate) hydronic space heating systems are modeled as follows:

In Plant, Heating Hot Water Tab, select a boiler from the Boiler library and input a multiplier. In the Hydronic Heating section of the tab, enter the length of pipe associated with the hydronic system which is in unconditioned space, the pipe diameter, and the thickness of insulation on that pipe. If less than 10 feet of pipe is in unconditioned space, EnergyPro assumes there are no pipe losses.

Create a *New* HVAC system in the Central System library, assign it a name, and enter the output of the hydronic system. Enter all other Central System entries to the actual conditions. EnergyPro automatically calculates the effective efficiency (AFUE or HSPF) from the boiler characteristics and pipe losses. Save the entry in the library and select that system in the General Tab of the System Element to properly document the hydronic system. In the Distribution Tab, select the heating distribution type from the drop-down list based upon the actual condition. This could be Radiant Floor if the piping is embedded in the floor, Baseboard if the system uses perimeter hot water radiators, or in some cases a Ducted system if using fan coils. In the Residential Tab, select *Heating Boiler Provides Heat* from the Hydronic Space Heating drop-down list.

If the hydronic heating only serves a portion of the residence, you must model the hydronically-heated area under its own Plant element. If the area is also served by its own water heater, then complete the applicable data in the DHW tab also. If there is no separate water heater in this area for domestic consumption (i.e. the entire house is served by a single water heater) leave the DHW system tab(s) "Undefined". Alternatively, use a DHW multiplier of zero. You might also enter a comment in the Remarks box in the Building element noting that the hydronic area receives domestic hot water from a water heater modeled under another Plant element.

Nonresidential Systems

Combined hydronic space and water heating systems are modeled as follows:

In the Plant element, under the Heating Hot Water Tab, create a boiler or select one from the Boiler Library. Enter the Boiler pump capacity and energy use data. Do not model a domestic hot water system; the program automatically calculates the service water heating load on the boiler.   In the System element, create either a Four-Pipe Fan Coil (FPFC) if design does not call for economizers, Built-Up Single Zone (BUSZ) if the design calls for economizers, or in a heating hot water only situation; a Split DX HVAC system.

The hydronic system may also have a chilled water cooling component, in which case, also model the chiller and cooling tower (Four-Pipe Fan Coil and Built-up systems only).

No Cooling Installed

When no mechanical cooling equipment is installed, use the following modeling procedure:

In the System Element, select a central system from the library which has the desired heating output and a cooling output capacity of zero (0) Btuh. EnergyPro automatically sets the efficiency, airflow, and refrigerant charge status equal to the standard design; there is no compliance credit or penalty. (You may wish to create a system in the default Central System Library and name the cooling system "No Cooling".)

Save the entry in the library and select that system in the General Tab of the System Element to properly document the system. In the Distribution tab, if the heating system is ducted, assign the heating and cooling ducts the same location and insulation level.   If the heating system is not ducted, set the cooling duct insulation to the prescriptive value for that climate zone, and the duct location to Attic.

Attached Sunspaces and Garages

Most often, sunspaces and garages are unconditioned spaces. Like other unconditioned zones in the 2019 Standards, you need to model the space to accurately reflect the building characteristics. You must model all the exterior surfaces as well as all surfaces that separate conditioned and unconditioned space, including fenestration areas, and doors. In addition, these areas must comply with the residential lighting requirements in Section 150.0(k) of the Standards.

 A sunspace may be an indirectly conditioned space and not an unconditioned space, according to the definition in the *Standards.* If a space is indirectly conditioned, the Standards apply and you must include the floor area as part of the conditioned floor area, and include all the exterior surfaces as part of modeling the building.

Pool and Spa Equipment

Sections 110.4, 110.5, and 150.0(p) of the Standards describe the mandatory requirements for pool and spa heating equipment. All requirements are mandatory and may not be traded off or used to offset other measures for achieving compliance. The Standards include manufacturer's as well as installation requirements, including minimum thermal efficiency, switching, operating instructions, piping and other features, as detailed in the Standards and Section 5.10 of the Single Family Residential Compliance Manual.

Multifamily Residential Title 24 Compliance Modeling Topics

Modeling multifamily buildings for calculating design loads and for calculating energy compliance is a complex topic. There are basic principles and guidelines which you should consider in deciding how a building is modeled. This section presents guidelines and special techniques which may assist you in modeling multifamily residential buildings. Topics include:

- Dwelling Units
- Photovoltaic and Battery Storage Systems
- Heat Pump Water Heating
- Pool and Spa Equipment
- Measures that Require HERS Verification
- HERS Registration

Multifamily Dwelling Units

Define dwelling unit data at the Zone Element level to calculate the IAQ ventilation requirements. The Dwelling Units tab is used to document the floor area, number of bedrooms and type (and number) of appliances located in the zone. The appliance data is fixed for compliance calculations but is included in the Appliances and Miscellaneous Energy Loads.

Dwelling units are defined in Standards Section 100.1 as:

> *"DWELLING UNIT is a single unit providing complete, independent living facilities for one or more persons including access to permanent provisions for living, sleeping, eating, cooking and sanitation."*

Note that EnergyPro treats the Dwelling Unit data somewhat differently depending on the occupancy type (Single Family, Multifamily), or when compliance is documented using the Addition Alone method. Some of the calculations on the Dwelling Unit tab are overridden by the software, such as the example that follows.

Use caution when completing these values to ensure your data is consistent between the Dwelling Units tabs and Room Elements. If there is an inconsistency, the final calculation in the compliance report may be different than the on-screen results. For example, EnergyPro will always assume one dwelling unit when the building type is Single Family (new or E+A+A) irrespective of the number entered in the dwelling unit tabs. However, EnergyPro does use the "Number of Bedrooms" entries, even if the Floor Area and Number of Units are both set to zero in that unit.

Enter the Number of Bedrooms per unit to calculate the required IAQ ventilation rate. You may use the multiplier to model multiple identical dwelling units within one zone, but you may not split one dwelling unit across two zones. Dwelling units must have the same floor area and number of bedrooms to model them together. For high-rise residential projects, EnergyPro uses only the Number of Units. You need not enter the other information here.

Addition Alone: If you are modeling an Addition Alone, select "Addition" when specifying the Building Type in the Building Element, General tab. For Number of Units, enter a decimal fraction indicating the ratio of the addition area relative to the area of the entire house (existing plus addition). The calculation is as follows: Area of addition/(Area of existing + addition).

Duplexes and Townhomes: A duplex or townhome (an R-3 occupancy) must be modeled as multiple single-family buildings. Each dwelling unit will be a separate input file rather than modeling a building with multiple dwelling units.

Multifamily PV and Battery Storage Systems

The prescriptive requirements for multifamily PV and battery storage vary between lowrise (up to three habitable stories) and high-rise (four or more stories) multifamily buildings.

Newly constructed low-rise multifamily buildings are prescriptively required to install a PV system, but are not required to install battery storage, consistent with the single family requirements.

Newly constructed high-rise multifamily buildings are prescriptively required to install both a PV and battery storage system, similar to the nonresidential requirements.

Refer to Standards Section 170.2(f) for low-rise multifamily requirements, 170.2(g) for highrise PV requirements, and 170.2(h) for multifamily battery storage requirements. Also refer to Section 6.4 of the NR/MF ACM Reference Manual, and Section 11.9 of the Nonresidential/Multifamily Compliance Manual for additional information regarding multifamily PV and battery storage system requirements. _D2HLink_423928

Multifamily Heat Pump Water Heating

Heat pump water heaters are a significant component in the new all-electric baseline for water heating systems serving individual residential dwelling units. The prescriptive baseline has two options for heat pumps in most climate zones: install a high-efficiency, NEEA-rated unit OR install a minimum efficiency unit plus other measures.

NEEA, the Northwest Energy Efficiency Alliance, has created an "Advanced Water Heating Specification" and established the rating test criteria to ensure newly installed HPWHs perform adequately, especially in colder climates. The NEEA rating requires a minimum Uniform Energy Factor (UEF) equal to the ENERGY STAR performance level and includes requirements regarding noise and prioritizing heat pump use over supplemental electric resistance heating.

Systems Serving Individual Dwelling Units:

In Climate Zones 1-15, if the project includes a 240V HPWH with a NEEA Tier 3.0 rating, it meets the minimum prescriptive requirements. In Climate Zone 16, the project must also install a drain water heat recovery system.

Minimum efficiency HPWHs must also include one of the following options:

- In Climate Zones 1, 16: Install a compact hot water distribution system, and

- In Climate Zone 16: Install a drain water heat recovery system.

Under the prescriptive method, multifamily projects may also install an instantaneous gas or propane unit.

Systems Serving Multiple Dwelling Units:

The proposed water heating system may be either heat pump or gas/propane. If the proposed system is a heat pump system, there are several requirements regarding the tank temperature, recirculation loops and piping design, in addition to other features of the system.

There are also specific requirements for gas water heating systems. If the system serves more than eight dwelling units, it must have a recirculation loop.

In Climate Zones 1-9, if the total system capacity is greater than 1MMBtu/h, the equipment must have a thermal efficiency of 90 percent (additional details regarding the calculations and exceptions may be found in Section 170.2(d).

In addition, gas systems must also install a solar water heating system with a minimum solar savings fraction (SSF) equal to either:

CZ 1-9: 0.20 SSF; CZ 10-16 0.35 SSF, or

CZ 1-9: 0.15 SSF; CZ 10-16 0.30 SSF, if the system includes a drain water heat recovery system.

There are several exceptions to the prescriptive requirements. Refer to Standards Section 170.2(d) for additional information on prescriptive requirements for multifamily water heating.

Enter data for heat pump water heating equipment in the Domestic Hot Water Tab of the Plant Element.

Pool and Spa Equipment

Sections 110.4, 110.5, and 160.7(b) of the Standards describe the mandatory requirements for multifamily pool and spa heating equipment. All requirements are mandatory and may not be traded off or used to offset other measures for achieving compliance. The Standards include manufacturer's as well as installation requirements, including minimum thermal efficiency, switching, operating instructions, piping and other features, as detailed in the Standards and in Section 4.8.5 of the Nonresidential and Multifamily Compliance Manual.

Nonresidential Compliance Modeling Topics

The state's *ACM Approval Manual* (Nonresidential) requires that program documentation "…contain a chapter or section on how to model buildings for compliance and how to prepare a building input file for a compliance run". This section is intended to fulfill that purpose and explain other special topics:

Modeling Guidelines for Compliance
PV and Battery Storage Systems
Acceptance Tests
Partial Permit Applications
Inputting Zones by Thermal Characteristics and Occupancy Type
Standard HVAC System According to Proposed System Type
Modeling Like HVAC Systems Together
Unconditioned Zones
Demising Partitions
Hydronic Systems
Underground (Berm) Walls and Floors
Return Air Plenums
T-Bar Ceilings
Process Loads
Tailored and Process Ventilation
Tailored Lighting Calculations
Daylighting

Modeling Guidelines for Compliance

How To Prepare A Building Input File For A Compliance Run

There are several key points to consider in preparing a building input file for a compliance run.

Identify the project scope, and whether the permitted space (i.e., the "building" as defined by the *Standards*) is new construction, an addition, an alteration, etc. Indicate the Project Building Type in the Project Design Data tab of the Building element.

Confirm the status of the space being permitted as directly or indirectly conditioned, and/or unconditioned space as defined in the *Standards.*   Unconditioned spaces must be modeled as separate zones, as explained in Unconditioned Zones.

Determine which components of the building --envelope, indoor lighting, outdoor lighting, and/or mechanical systems--are to be modeled for compliance. Enter the Designer names or select them from the Contacts Database, under the appropriate Designer tabs in the Building element. Using a worksheet, prepare a summary of information for the envelope surfaces, Plant, Systems, and Zones which comprise the building.

Modeling Envelope Surfaces

Model all exterior roofs/ceilings, exterior walls, underground walls, exterior floors, slabs-on-grade and slabs-below-grade. Model all exterior windows, skylights and doors. Model interzone surfaces between thermally dissimilar zones (demising partitions), and model surfaces between conditioned and unconditioned zones using the Interior Surface element.

See the Building Tree for detailed descriptions of all envelope-related data inputs. Also refer to Standards Section 140.3 and the applicable Special Topics later in this section.

Exceptional Conditions

EnergyPro creates a Certificate of Compliance (NRCC-PRF-01-E) form with every performance (NR T24 Performance) report. Exceptional Conditions are listed on the PRF-01 form in Section D, following the general compliance summary information. Exceptional Conditions may require additional documentation, such as manufacturer's cut sheets.

Appropriate Zoning For Compliance Modeling

Zoning must be determined and input according to several key criteria:

Actual mechanical system zoning, if known; or,

Perimeter and interior zones, where merging thermodynamically similar zones is acceptable; and,

Occupancy types, including different lighting Area Categories and different ventilation requirements.

In general, zones served by different HVAC systems must be modeled separately; perimeter and interior zones must be modeled separately; and subzones which are different occupancy types must be modeled as separate zones. See Inputting Zones By Thermal Characteristics and Occupancy Type.

Selecting Correct Occupancy Types

In order for the program to establish the correct energy budget, each zone in the proposed building must be designated with the correct occupancy type. The occupancy selection must be defensible from the perspective of which prescriptive lighting Area Category most closely matches the lighting requirements of the zone. You must also pay attention to the possibility of special ventilation requirements in such occupancies as automobile repair shops, beauty salons, and theaters.

If you are unsure of which occupancy type to select, choose one with a prescriptive lighting allotment that is appropriate for the lighting task specified or implied. Refer to Inputting Zones By Thermal Characteristics and Occupancy Type.

How Fixed And Restricted ACM Inputs Work

When used for Title 24 compliance, the program automatically fixes or restricts certain inputs. For example, the nonresidential performance approach automatically uses fixed daily schedules for lights, equipment, people, etc., regardless of the actual schedules you have selected from the Schedule Library. In addition, the absorptivity of assemblies is restricted to between 0.20 and 0.90 even if a value outside that range is entered. All fixed and restricted inputs are described in the Nonresidential ACM Reference Manual.

Program Modeling Limitations

The program has modeling limitations when it is used as a compliance performance approach. Some of these limitations include:

Maximum # of Systems	256
Maximum # of Zones	1024
Maximum # of Rooms	1024
Maximum # of Exterior Walls	4096
Maximum # of Underground Walls	256
Maximum # of Doors	1024
Maximum # of Windows	8192

One type of cooling tower and boiler per plant, and one type of HVAC equipment per system (although you may model multiple pieces of equipment of the exact same type and size).

Nonresidential Compliance Manual

The CEC Nonresidential Compliance Manual is required reading, and must be accessible while using the program in order to maintain a current license agreement with EnergySoft and receive user support. You may also wish to obtain the Nonresidential ACM Reference Manual which describes the simulation requirements, methodologies and assumptions for all building modeling data.

PV and Battery Storage Systems

The nonresidential new construction prescriptive baseline requires many nonresidential buildings to install a photovoltaic (PV) and battery storage system. The following occupancy types are included: grocery, high-

rise multifamily, office, financial institutions, unleased tenant space, retail, school, warehouse, auditorium, convention center, hotel/motel, library, medical office building/clinic, restaurant, and theaters.

PV System Requirements:

Minimum PV system size is determined by the occupancy type (Equation 140.10-A), or may also be calculated as the total of all available solar access roof areas multiplied by 14W/sqft. Note: the Standard Design uses the smaller of the results.

Mixed Occupancy: The requirements also apply to mixed-occupancy projects when at least 80% of the building is one of the covered occupancy types. Where the building includes more than one of the covered space types, the total PV system capacity for the building is calculated by applying the equation to each of the listed space types and summing the resulting capacities for each

For PV sizing calculations, the software assumes the California flexible installation (CFI) orientation (170 degrees), standard efficiency for modules and inverters, fixed tracking, standard shading, roof tilt of 22.61 degrees (5:12 pitch), and annual solar access percentage equal to 98 percent. Refer to the PV+Batt Tab of the Building Element for information and options for calculating PV system sizing in EnergyPro.

Proposed System: To use the California Flexible Installation 1 (CFI1) simplified modeling option in the performance method, the PV array must be installed between 150 to 270 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12.

When the CFI2 option is selected in the performance calculation, the PV array must be installed between 105 and 300 degrees from true north, with all modules at the same tilt as the roof for pitches up to 7:12. Note, when selecting CFI2, the performance of the proposed system is derated by approximately 10 percent.

You must enter the actual orientation and tilt of the PV array if it doesn't meet the conditions for either CFI1 or CFI2.

Exceptions to PV System Requirements: There are several exceptions to the minimum PV system requirements, most of which allow a reduction in PV system size in cases with limited solar access.

Battery System Requirements:

The Nonresidential/Multifamily Compliance Manual, (Chapter 9.5) explains that the primary function of the battery storage system is to harmonize the onsite PV system with the grid, to maximize benefits to the grid, environment, and the occupants.

Grid harmonization: For the purpose of Building Standards, "grid harmonization" is defined as strategies and measures that harmonize customer-owned distributed energy resources assets with the grid to maximize self-utilization of PV array output, and limit grid exports to periods beneficial to the grid and the ratepayer. Grid harmonization is done by charging the battery from the PV system when there is limited electrical load at the building and the cost of electricity is low in midday, and discharging when the cost of electricity is high, usually in the late afternoon and early evening hours

Battery systems are defined by both the energy capacity and the rated power capacity. The minimum battery storage system size is also determined by the PV system size and the project occupancy type as calculated in Equations 140.10-B and 140.10-C. There are several exceptions to the requirements.

Refer to Section 140.10 in the Standards, Section 5.10 of the NR/MF ACM Reference Manual, and Chapter 9 of the Nonresidential/Multifamily Compliance Manual for additional information regarding nonresidential PV and battery storage system requirements.

Acceptance Tests

Acceptance tests are one way to help ensure that equipment, controls and systems operate as intended and as required by the Standards. The scope of the Acceptance Test requirements in the 2022 Standards continues to expand and includes additional measures spanning nearly all nonresidential end-uses.

Refer to Nonresidential Reference Appendix NA7, Nonresidential and Multifamily Compliance Manual, Section 2.2.7 and Chapter 14, and to the CEC web site for additional details regarding the acceptance testing requirements.

EnergyPro automatically identifies and lists which equipment or features in a particular project require acceptance testing and indicates which acceptance tests must be performed for each item.

Partial Permit Applications

The general rule when using the performance method is that you may model a specific building component or system for compliance (i.e., envelope, indoor lighting, outdoor lighting, and mechanical) only if that component or system is designed for and covered by the current permit application.

In alterations, partial permits are quite common. The Standards only apply to the system or feature being altered, they do not apply to the unaltered existing building. For example, if the lighting system is not being altered, the existing lighting need not meet the Standards. Refer to Section 11.4 in the Nonresidential Compliance Manual for additional details.

When No Envelope Design Is Submitted For Permit

When envelope compliance is not required, you may turn off envelope compliance calculation features as well as any envelop-specific compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, uncheck the Envelope checkbox.

When Envelope calculations are not selected, the envelope modeled in the Standard Design is the same envelope modeled for the Proposed Design. This is especially important in tenant improvement spaces in which there are no envelope changes and you are using the performance method to document compliance for the altered lighting and/or mechanical systems.

When No Lighting Design Is Submitted For Permit

When indoor and/or outdoor lighting compliance is not required, you may turn off lighting compliance calculations as well as the lighting compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, leave the Indoor and/or Outdoor Lighting checkboxes blank.

NOTE: When lighting plans are being submitted for only certain portions of the permitted space, check "(Proposed Lighting) Use Installed LPD" under the Zone Element Lighting tab for zones with plans. For zones without lighting plans submitted, check "Use Standard LPD (No Plans)".

When No Mechanical Design Is Submitted For Permit

When mechanical compliance is not required, you may turn off mechanical compliance calculations as well as the mechanical compliance forms for the project. In the Scope section of the Calculations Options for either the NR Prescriptive or NR T24 Performance module, leave the Mechanical checkbox blank.

Inputting Zones By Thermal Characteristics and Occupancy Type

One of the most important questions to answer before taking off floor areas and other information from the plans is: How many different Zones are necessary to properly model the building -- the conditioned permitted space?

To find the answer, you must first understand what is needed to capture the effect of different thermal zones within a system or within a building as a whole.

Rule 1a: If the actual system(s) and zoning of the building is known at the time of the performance calculation, use the actual zoning and system(s). This is the most accurate and straightforward approach, and should be used whenever possible and practical. If the building has twenty thermostats or less, you must model one zone for each independent thermostat. Any area that is considered one zone must maintain a well-balanced distribution of heating and cooling.

Rule 1b: If the building has more than twenty thermostatically controlled zones, and the zoning of the building is too convoluted and/or cannot be modeled as-is, you may make some simplifying assumptions in which you merge thermodynamically similar zones within the same system, or within a group of identical systems (e.g., packaged units) all serving thermodynamically similar zones. Thermodynamically similar zones must be able to use a single thermostat or HVAC-controlling device or sensor to maintain physical comfort. Typically, physical zones which have the same or similar glazing orientation(s), the same or similar glazing area to floor area ratio and the same occupancy types will be thermodynamically similar since, for example, they experience their peak cooling loads at the same hour.

The methods of combining thermal zones shall be consistent with the definition for Zone, Space Conditioning in Section 100.1(b) of the Standards, which states that a space conditioning zone "is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in 140.4(b)3 or 150.0(h), as applicable, can be maintained throughout the zone by a single controlling device."

An example of similar zones are central core areas on multiple floors of a multi-story building. An example of dissimilar zones is a perimeter area on one facade of a building, part of which includes a large amount of glazing, and part of which has no glazing. If these areas are in fact independently controlled, they should be treated as two zones even though they are on the same floor and facing the same orientation.

Rule 1c: If no reliable information about the actual system(s) and zoning of the building is known, the building shall be considered to have 12.5 feet (3.81 meter) perimeter zones and a central core zone that is greater than 15 feet (4.6 meters) from the exterior walls of the building. Any building or separate permitted space smaller than 2,500 square feet (232.3 square meters) in conditioned floor area may be modeled as having only a single HVAC zone.

For buildings that are larger than 2,500 square feet, the 2008 Nonresidential ACM manual outlines the procedure for determining the perimeter zone area as follows.

1. Determine the ratio (R) of the floor's total conditioned area to the gross exterior wall area associated with the conditioned space.

2. For each combination of occupancy type and exterior wall orientation create a perimeter zone. The floor area of each perimeter zone shall be the gross exterior wall area of the zone times R or 1.25, whichever is less.

3. Model the exterior space adjacent to each wall orientation as a separate exterior zone. Spaces adjacent to walls which are within 45 degrees of each orientation shall be included in the zone belonging to that orientation.

4. For cases where R is greater than 1.25, create an interior zone for each occupancy type. For each occupancy type, the floor area of the interior zone shall be the total area less the floor area of the perimeter zones created in paragraphs 2 and 3 above.

5. Prorate the roof area and the floor area among the zones according to the floor area of each zone. Prorate the roof and floor areas among the perimeter zones created in paragraphs 2 and 3 above according to the floor area of each exterior zone.

6. Assign skylights to interior zones. If the skylight area is larger than the roof area of the interior zone, then the skylight area in the interior zone must be equal to the roof area in the interior zone and the user must prorate the remaining skylight area among the perimeter zones based on the floor area.

7. If the area of the zone is less than 300 ft² (27.9 m²), combine it with its adjacent zone of the same occupancy type and zone type (interior or exterior).

8. Courtyards are considered outside or ambient air. Walls, floors, and roofs separating conditioned spaces from courtyards are exterior walls, floors, and roofs. Create an exterior zone for each wall orientation separating the conditioned space from the courtyard. The user shall not combine these exterior zones with other exterior zones even if their exterior walls have the same orientation.

9. Model spaces adjacent to demising walls as interior zones.

10. Ignore all interior walls and model partitions separating thermal zones as air walls with U-factor of 1.0 Btu/h-ft$_2$-°F.

If a building has more than one story, the core zone of the top floor should be a separate zone from the core areas of the middle and ground floors. Likewise, the core area of the ground floor should be a zone separate from the middle or top floor and an exterior roof/ceiling.

Since the California Energy Commission considers a larger number of modeled HVAC zones to be a more accurate representation, local enforcement agencies may at their own discretion require the permit applicant to model additional HVAC zones up to the limits of the ACM capabilities.

NOTE: The standard design which sets the energy budget for the building uses exactly the same zoning and interzone surfaces as the proposed design.

Rule 2: If each zone designated according to Rules 1a and 1b has more than one occupancy type, subdivide the zones further according to lighting area categories and special ventilation requirements.

With the exceptions of tailored lighting allotment, tailored ventilation, and process loads described below, the program normally uses the occupancy type selected to internally fix specific modeling assumptions in the standard design to calculate the energy budget, and in the proposed design to calculate energy use. These modeling assumptions are as follows:

- Square feet per occupant
- Sensible heat per occupant
- Latent heat per occupant
- Receptacle load in Watts per square foot
- Service hot water in Btuh per hour per occupant
- Lighting Watts per square foot
- Cfm per occupant

The general rules for dividing the building into Zones are as follows:

If more than 10% of a Zone in the building does not have the same "primary lighting function" (as explained in Chapter 5 of the Nonresidential Manual, and in Mixed Occupancy), you must:

Divide the Zone into smaller zones, each with its own proper occupancy type, which accurately models either the different lighting Area Categories shown in Table 140.6-C of the Standards and/or the ventilation categories shown in Table 120.1-A of the Standards*;* or

For those instances when a thermal zone contains more than one space, the software shall either model the lighting separate for each space and sum energy consumption and heat gain for each time step of the analysis or it must incorporate some procedure to sum inputs or calculate weighted averages such that the lighting power used at the thermal zone level is equal to the combination of lighting power for each of the spaces contained in the thermal zone.

The main point is that you must select occupancy type correctly since occupancy, in conjunction with the tailored lighting allotment, tailored ventilation, and process loads, set the energy budget for the building. Be sure that the building is divided into zones which properly set an appropriate energy budget for lighting and ventilation in the standard design.

Any local enforcement agency may, at its own discretion, demand that the permit applicant provide special documentation or justification as to the reasonableness of the way in which the building has been zoned for the performance compliance calculation.

Standard HVAC System According To Proposed System Type

SECTION TO BE UPDATED

Based on the proposed HVAC system entered, the program chooses a standard default system for the standard design which determines the annual energy budget. Table 2 (below) from the 2019 Nonresidential ACM Reference Manual lists the mechanical system types from which the software selects a system for the standard design. Refer to the Nonresidential ACM Manual for detailed information on the standard system type and characteristics assumed for a variety of proposed system types.

Modeling Like HVAC Systems Together

You may model like systems together as one system provided the following conditions are met:

1. The zones served by the individual units meet the requirements of thermal zones as described in Inputting Zones by Thermal Characteristics and Occupancy Type; and

2. The equipment is all of the same category. Multiple units of the same type must fall into one of the specific categories contained within the following pop-up listings:

   Cooling Equipment

   Heating Equipment

   Fan Systems

   Water Heaters

Unconditioned Zones

The Standards require that you model unconditioned zones including attached garages or basements, to accurately reflect the thermal conditions impacting the building. In residential occupancies, EnergyPro will create and model the unconditioned attic. You do not need to create a zone for the attic in your model, but you must model the Interior Surfaces adjacent to it.

In addition, lighting in both residential and nonresidential unconditioned zones must meet the Standards requirements.

To model an unconditioned zone:

1. Create a Zone within the System which shares the most heat transfer to and from the conditioned space. In the program, give it a name (e.g., "Warehouse" or "Garage") and set the Zone type to "Unconditioned", or to "Res Garage" if modeling a residential attached garage.

2. Select the appropriate Occupancy from the drop-down list.

3. Create a Room within the Zone Element and complete the entries.

4. Set the Desired Winter Temperature to an appropriate actual winter temperature (e.g., 50°F or 10.0°C) and the Desired Summer Temperature to an appropriate actual summer temperature (e.g., 90°F or 32.2°C). Do not leave the settings for the unconditioned space at the same settings as a conditioned space.

5. Input the major exterior surfaces of the unconditioned zone, such as roof and exterior walls. It may not be necessary to model relatively small areas of glazing.

6. Create demising partitions in the adjacent conditioned zones to model all surfaces (roof, walls, floor) between conditioned Zones and unconditioned Zones using the Interior Surface element.

NOTE: Include Demising Partitions as part of the adjacent conditioned space, not part of the unconditioned space.

Demising Partitions

To link an unconditioned space to a conditioned space, you must model an Unconditioned Space (Zone) before you create Demising Partitions for the conditioned space, so that the name (e.g., Warehouse) will appear in the Adjacent To list. Demising Partitions do not have an azimuth or true exterior orientation; instead they are linked to enclosed, unconditioned spaces.

A demising partition is defined in the *Standards* as "a wall, fenestration, floor, or ceiling that separates conditioned space from enclosed unconditioned space". Demising partitions may be modeled using the Interior Surface element within the appropriate conditioned space. (The Interior Surface element has a default tilt of 90 degrees, i.e., a wall. You must select the appropriate assembly and change the tilt for ceilings and floors.) Demising partitions also separate return air plenums from conditioned spaces.

Model demising partitions as follows:

First create one or more Unconditioned Zone(s).

Then, in the adjacent conditioned space(s), use the Interior Surface element to create a demising ceiling, wall, or floor. Name the partition to identify it (e.g., "Wall to Warehouse") and input the area and surface type. Next, select the assembly from the library, and enter the floor elevation. Click on the Select button to choose the adjacent space from the list.

NOTE: Model a demising partition only from within a conditioned zone. Do not, for example, model a demising wall in an office zone to an unconditioned warehouse zone, and also model the same demising wall in the warehouse linked back to the office.

Underground Walls and Floors (Nonresidential)

Model nonresidential underground (berm) walls as follows:

- Insert an Underground Wall element and enter the name and area. Select a Wall assembly from the Assembly Library. See Joint Appendix JA4 for additional information regarding wall construction assemblies, and JA4.1.4 for information about insulation on either the interior or exterior of mass walls.

- Enter the depth (in inches) that the wall extends below grade.

Use the same method to model nonresidential Underground Floors with the Underground Floor element.

All underground walls and floors are considered compliance neutral. There is no credit or penalty associated with underground elements.

In nonresidential load calculations, heat loss for underground assemblies is calculated by multiplying the U-Factor by the area. (Heat loss for slab-on-grade elements is calculated using slab edge loss.)

Refer to the topic Underground Walls, Floors, and Conditioned Spaces (Residential) for modeling details in low-rise residential calculations.

Return Air Plenums

A return air plenum is an unoccupied space within the insulated building envelope through which air flows back to the space conditioning system from the space(s). The return air temperature is usually within a few degrees of the conditioned space temperature, and is considered indirectly conditioned space. Model return air plenums as part of the adjacent conditioned space. Model the correct geometry of the Zone, including its area, height, adjacency to other Zones, and any exterior surfaces. Set the equipment, lighting and occupant loads to zero.

T-Bar Ceilings

SECTION TO BE UPDATED

Placing insulation directly over suspended ceilings is not permitted as a means of compliance, except for in limited applications. The following excerpt from Section 120.7(a)3 of the Standards describes the conditions under which placing insulation over suspended ceilings is allowed for Title 24 compliance.

> *"**EXCEPTION to Section 120.7(a)3:** When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations."*

Refer to Section 3.2.4 of the Nonresidential Compliance Manual for additional information regarding insulating a ceiling with removable panels.

Process Loads

SECTION TO BE UPDATED

The 2022 Standards include both mandatory and prescriptive requirements for several "Covered Process" activities that commonly occur within nonresidential buildings, including: Refrigerated Warehouses, Commercial Refrigeration, Enclosed Parking Garages, Process Boilers, Compressed Air Systems, Elevators, Escalators and Moving Walkways, Computer Rooms, Commercial Kitchens, and Laboratory Exhaust Systems.

EnergyPro version 8 includes a Process module to assist you in completing the required NR Prescriptive compliance documentation for all covered processes. Enter the prescriptive process data in the Forms Tab of the Building Element.

Input process loads (isensible and/or latent process loads) in each Zone with the Room element, under the Receptacle/Process tab. They are included in the NR Loads calculation for sizing mechanical equipment and are also modeled in the NR T24 Performance compliance runs in both the Standard Design and the Proposed Design.

Process loads are compliance-neutral and are modeled identically in the Standard and Proposed Designs, they are neither an energy penalty nor a credit. For any particular occupancy, subtract the normal equipment load from the total process load to determine the (net) sensible process load input into the program.

Tailored and Process Ventilation

SECTION TO BE UPDATED

The *Standards* require a minimum mechanical ventilation rate to be provided in all conditioned zones when natural ventilation [as defined in Section 120.1(b)1] cannot be met. Specifically, the *Standards* require outdoor air to be provided in accordance with Table No. 120.1-A of the Standards, or 15 cfm (7.1 L/s) per person times the number of occupants, whichever is larger. The number of occupants shall be the number of fixed seats in occupancies which include fixed seating, or an occupant density no less than one-half the occupant density assumed for exiting purposes in Chapter 33 of the UBC, times the area of the zone.

Table 4-12 lists input values to use for ventilation for a variety of nonresidential occupancies.

As explained in the Zone Element, Mechanical tab, CEC *Standards* set the ventilation for the NR T24 Performance calculation and set Occupant Density and Ventilation (cfm per Occupant) to the values specified in the NR Loads calculation. When Vent Type is set to Tailored, the program uses the actual Occupant Density and Ventilation (cfm per Occupant) in both NR Loads and NR T24 Performance compliance calculations. You may be required to demonstrate justification for tailored ventilation rates by the local enforcement agency.

Process ventilation, to the extent that it requires the heating and cooling of outside air to remove fumes or other special contaminants, may be included in the total ventilation rate.

Process ventilation and the fan power associated with it may be ignored in compliance calculations because the *Standards* exempt the energy use of some process fans (though others are covered, see Standards Section 140.9 Covered Processes for additional details). Adjust the fan power for fans which serve both process load and provide space conditioning using the equation in Standards, Section 140.4(c).

Exhaust Fans

Exhaust fans must be modeled for compliance calculations, including exhaust fans in kitchens, conference rooms, workrooms, computer rooms and storerooms. Exhaust fans that are manually controlled (such as bathroom fans) may not operate at design conditions and therefore shall **not** be included in the fan system power demand calculations.

Create or modify exhaust fans in the Zone Element, Mechanical tab.

Nonresidential Fenestration

Manufactured   Site-Built   Field-Fabricated   NFRC CMA Program   Mixed Types

SECTION TO BE UPDATED

Title 24 requires that nonresidential fenestration products be certified to comply with the mandatory requirements in Section 110.6 of the Standards. The requirements include maximum allowed air leakage, methods for calculating the U-Factor and SHGC, labeling, and acceptance requirements.

Specific requirements vary according to the specific fenestration product type. The definition of each type, from Section 100.1 of the Standards, is shown below.

> *"**MANUFACTURED or KNOCKED DOWN PRODUCT** is a fenestration product constructed of materials which are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. Knocked down or partially assembled products may be sold as a fenestration product when provided with temporary and permanent labels as described in Section 10-111; or as a site-built fenestration product when not provided with temporary and permanent labels as described in Section 10-111.*

> ***SITE-BUI**LT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units, that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls, and atrium roof systems.*

> ***FIELD-FABRICATED** is a fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product. Field fabricated does not include site-built fenestration."*

Manufactured and site-built fenestration products must have a temporary label, and those that are rated using the NFRC Rating Procedure (NFRC 100 for U-Factors, and NFRC 200 for SHGC) must also have a permanent label (or an NFRC label certificate).

Manufactured (Factory-Assembled) Fenestration Products

If manufactured fenestration products are not rated and labeled using the NFRC Rating Procedure, they must use the default values for U-Factor from Table 110.6-A, and for SHGC from Table 110.6-B of the Standards. See Sections 10-111 and 110.6 of the Standards, and Section 3.1.4 of the Nonresidential Manual for additional information regarding mandatory requirements for fenestration products.

Site-Built Fenestration Products (and Skylights)

This section describes the two methods for documenting thermal performance (U-Factor, SHGC) for site-built fenestration products. Site-built fenestration must have either a NFRC Label Certificate, use the default values listed above, or use the alternative calculation in NA6. The total site-built fenestration area includes windows, non-opaque doors, and skylights.

Before an occupancy permit is granted site-built fenestration products shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for each product installed and be readily accessible at the project location.

Projects with less than or equal to 200 square feet of site-built fenestration:

> If the values are NFRC-certified, you may use the certified values for compliance purposes. Otherwise, you must either use the CEC default values in Section 110.6 of the Standards or the values resulting from the alternate default equations for calculating fenestration thermal performance from Reference Appendix NA6. Refer to the Appendix for additional information regarding the compliance-related responsibilities of

energy consultants, designers, architects, builders, installers, and enforcement agencies when using the procedures in NA6.

Projects with more than 200 square feet of site-built fenestration:

Fenestration products in these projects must either have a NFRC label certificate or use the default values in Section 110.6 of the Standards. NFRC label certificates can substitute for the temporary and/or permanent label for site-built fenestration products.

NFRC Component Modeling Approach (CMA) Product Certification Program

The following text is an excerpt of Section 3.3.2 of the Nonresidential Manual:

"NFRC has developed a performance base calculation, the component modeling approach (CMA), to make the rating process quick and simple. This serves as an energy ratings certification program for fenestration products used in nonresidential projects. The CMA allows users to assemble fenestration products in a virtual environment. CMA draws data for NFRC-approved components from online libraries choosing from preapproved glazing, frame, and spacer components. CMA users are able to obtain preliminary ratings for various configurations of their designs. CMA is a fair, accurate, and credible method based on NFRC 100 and 200 program documents, which are verified by third-party rating procedures. This tool helps users to:

1. Design energy-efficient windows, curtain wall systems, and skylights for high-performance building projects.

2. Determine whether a product meets the specifications for a project and local/state building energy codes.

3. Model different fenestration designs to compare energy performance.

Once the user is satisfied with the product, they create a bid report containing the data for all fenestration products to be reviewed. The windows are then built, either on-site or in a factory. The final products are reviewed and are rated by an NFRC-approved calculation entity (ACE) and a license agreement is signed with NFRC. Then the NFRC issues a CMA label certificate for the project. This label certificate is a document that lists the certified fenestration ratings at the NFRC standard testing size for the entire building project. Once approved, the CMA label certificate is available online immediately. This certificate serves as code compliance documentation for fenestration energy performance, and the certified products may be applied to future projects without repeating the certification process.

***Benefits of CMA.** CMA provides facility managers, specifiers, building owners, and design teams with a simple method for designing and certifying the energy performance of fenestration systems for their buildings without having to test every possible variation of glazing and framing. This is significantly less expensive than building sample wall sections and testing them in a large test enclosure. There are several additional advantages gained by using the CMA:*

1. CMA's online tool has the ability to output a file with values for use in building energy analysis software programs.

2. The program can export detailed information for angular-dependent SHGC and VT values, seamlessly transferring the data to the analytical software.

3. A 2010 study[1] conducted in California demonstrated that fenestration modeled with the CMA program can provide an increase in compliance margins by as much as 11.7 percent over the Energy Standard's default calculation methods.

4. *CMA can help demonstrate above-code performance, which is useful for environmental rating programs such as Leadership in Energy and Environmental Design (LEED™) or local green building programs.*

   Use of the CMA can lead to a more efficient building and enable cost savings due to more accurate fenestration performances and potential energy benefits from above-code utility incentives. Details are available at www.NFRC.org."

Note that the Bid Report generated by the NFRC's CMA software contains non-certified performance data. This report IS NOT an NFRC-Approved Label Certificate. NFRC must review and approve the calculations prior to issuing the Approved Label Certificate. Refer to the NFRC web-site at http://www.nfrc.org or Section 3.3.2 of the Nonresidential Manual for additional information about the CMA program and obtaining a label certificate.

Field-Fabricated Fenestration

Field-fabricated fenestration and field fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance using default U-factors from Standards Table 110.6-A and default SHGC values from Standards Table 110.6-B. No labeling is required for field-fabricated fenestration products.

Mixed Fenestration Types

If mixed fenestration is included in the compliance analysis, then the compliance submittal must demonstrate which are certified fenestration products and which are non-certified fenestration or site-assembled fenestration products. The manufacturer's documentation and calculations for each product must be included in the submittal, and either the ENV-1C or NRCC-PERF-1 form must be included on the building plans.

Duct Sealing in Nonresidential Occupancies

SECTION TO BE UPDATED

The prescriptive requirements for some nonresidential HVAC duct systems include duct sealing and HERS testing and verification of leakage. The prescriptive requirement applies when:

- The system is constant volume, single zone AND

- It serves less than 5,000 sqft of conditioned space, AND

- In a space directly under a roof that

  - Has a U-factor greater than the U-factor of the ceiling, or if the roof does not meet the requirements of Section 140.3(a)1B, OR

  - Has fixed vents or openings to the outside or unconditioned spaces;

The standard design for systems with the characteristics above assumes duct leakage is 6% of total fan flow. You may claim compliance credit for reduced duct leakage if the leakage is diagnostically measured and verified by a HERS rater to be less than or equal to 6% of fan flow.

The leakage requirements apply to new duct systems, new ducts on existing systems, and to existing ducts on existing systems that are being repaired or replaced. In addition, if the requirements apply when an existing HVAC system is repaired or replaced.

If the new ducts are an extension of an existing duct system the combined system (new and existing ducts) must meet:

1. A leakage rate of $\leq$ 15 percent of fan flow, or

2. All accessible leaks shall be sealed and verified through a visual inspection by a certified HERS rater.

Refer to Sections 140.4(l) and 141.0(b)2D of the Standards, Section 4.4.2 of the Nonresidential Manual, and to Reference Nonresidential Appendix NA1 and NA2 for additional information regarding nonresidential duct leakage requirements.

NOTE: One can avoid sealing the ducts by insulating the roof and sealing the attic vents as part of a larger remodel, thereby creating a conditioned space within which the ducts are located, and no longer meets the criteria of §140.4(l).

Tailored Lighting Calculations

SECTION TO BE UPDATED

Use **EnergyPro** to quickly and easily document compliance using the Tailored Method. Based on your task and activity selections and other descriptive characteristics, **EnergyPro** automatically calculates the maximum Allowed Lighting Power as well as the Proposed design LPD. A main concept of the prescriptive lighting approach is that the permit applicant has the option of establishing a lighting allotment (or allowable lighting power density) for the conditioned permitted space by completing forms which document lighting needs *tailored* to the specific lighting requirements of the building or area.

The Tailored Method is one of three Prescriptive methods for determining the Allowed Lighting Power for a project; the others are Complete Building and Area Category Method. Because the Tailored Method is based on task activities, this method requires the most detail on the plans, and in some cases, requires documentation of the actual lighting tasks.

An important consideration when using the Tailored Method is described in Section 5.7.3 of the Nonresidential Compliance Manual:

> *"The Tailored Method is a lighting compliance approach which establishes an allowed lighting power budget on a room-by-room or area-by-area basis. In addition to providing a lighting power budget for general illumination, this compliance approach provides additional lighting power budgets for illuminating wall displays, floor displays, task lighting, and ornamental/special effects lighting.*

> *These additional layers of lighting power have been informally referred to as "use-it or lose-it" lighting power allowances because these additional allowances cannot be traded-off to other areas or applications. If a lighting design does not include these additional layers of lighting power, the total lighting power budget using the Tailored Method may be less than if the Area Category Method or Whole Building Method of compliance is used."*

Using EnergyPro to Calculate Prescriptive Tailored Lighting Compliance

Specify the Occupancy Type and Lighting Status in the General Tab of the Zone Element. Select the Standard and Proposed Design calculation options you wish to use for the project in the Zone, Lighting Tab. In the Room Element, General Tab, enter the floor area of the room. In the Lighting Tab, enter the task height and mounting height for the general room lighting fixtures.

The Room Dimension, task height and mounting height are used by the program to calculate the RCR. If the room is rectangular, enter the room length and width. If not, enter the perimeter. If you enter a perimeter value, the length and width values will be overridden. If the mounting height is equal to or greater than 15 feet (4.6 meters), **EnergyPro** automatically applies the appropriate Mounting Height Multiplier to the assigned LPD value.

Add a Lighting Task Element and for each task in the room, specify the task type (wall display, very valuable merchandise, etc.) and the other data relevant to the specific task. Then, Add as many Lighting Elements as necessary to define all light fixtures dedicated to that task.

In the appropriate NR Calculations Options, check the Indoor Lighting checkbox to include Indoor Lighting in the simulation scope.

Refer to Section 140.6 of the Standards and 5.7 of the Nonresidential Manual for additional information about tailored lighting calculations. Table 140.6-D in the Standards lists the lighting power allowances for general, display, and ornamental lighting using the Tailored Method.

Title 24 Daylighting Requirements

SECTION TO BE UPDATED

Nearly all nonresidential occupancies that have adequate access to daylight, either through skylighting or vertical fenestration (in primary and/or secondary daylit zones), are required to employ mandatory daylighting strategies.

Section 130.1(d) of the Standards defines daylit zones as follows:

> *"SKYLIT DAYLIT ZONE is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than the following: A permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists.*

> *For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the skylit daylit zone plan area shall be rectangular, and for a circular skylight the skylit daylit zone plan area shall be circular.*

> *B.   PRIMARY SIDELIT DAYLIT ZONE is the area on a plan directly adjacent to each vertical glazing, one window head height deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.*

> *C.   SECONDARY SIDELIT DAYLIT ZONE is the area on a plan directly adjacent to each vertical glazing, two window head heights deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.*

> ***Note****: Modular furniture walls shall not be considered a permanent obstruction."*

Modeling Daylit Zones

In the Central System Element, check the checkbox indicating the space must meet the mandatory daylighting requirements (Space > 5,000 sqft and Ceiling Height >15 feet…).

In the Lighting Tab of the Room Element, describe the activity type and the room features. You must enter Room Dimensions and the Sidelit and/or Skylit Areas, as applicable. EnergyPro automatically calculates the Room Cavity Ratio and Effective Aperture for each area.

Finally, in the Lighting Element, enter the lighting system data and the type of control, e.g., Dimming with Occ Sensor.

If your project will claim compliance credit for the controls in both the primary and secondary daylit zones, you may wish to model a second room for the secondary daylit zone.

Large, Enclosed Spaces

The Standards require that "large, enclosed spaces" in nonresidential buildings located in Climate Zones 2 - 15 that meet the following characteristics locate at least 75% of the area of the space within a "daylit zone". Daylighting may be provided via skylights, vertical fenestration, or both. The requirement applies to the following spaces:

- Larger than 5,000 square feet and

- Located directly under a roof, and

- Ceiling height greater than 15 feet, and

- LPD equal to or greater than 0.5 W/sqft.

In addition, the general lighting in the daylit area must be controlled to automatically respond to changes in the natural daylight available.

Refer to Sections 130.1(d) and 140.3(c) of the Standards and Sections 5.4.4 and 5.5.2 in the Nonresidential Manual for details regarding the daylighting requirements and how to calculate the primary and secondary daylighting zones.

Mandatory Measures

SECTION TO BE UPDATED

Specific mandatory features must be installed in all new buildings, additions, and alterations. These measures are required regardless of which method is used to demonstrate compliance. Mandatory measures may be superseded by other more stringent requirements in the prescriptive or performance method.

EnergyPro allows you to print a Mandatory Measures Form for residential buildings (Form MF-1R) for each project. For an explanation of the low-rise residential mandatory measures, refer to the relevant sections of the Residential Compliance Manual.

EnergyPro now includes a Nonresidential Mandatory Measures module that assists in completing the required documentation for nonresidential mandatory measures. Select the Forms Tab in the Building Element to access entries for mandatory measure forms. For an explanation of the nonresidential mandatory measures, refer to the relevant sections of the *Nonresidential Compliance Manual*.

Additions

Additions are common construction projects that are considered new construction under Title 24. As defined in Section 100.1(b) in the Standards, an addition is "any change to a building that increases conditioned floor area and conditioned volume. See also "newly conditioned space." Addition is also any change that increases the floor area or volume of an unconditioned building of an occupancy group or type regulated by Part 6. Addition is also any change that increases the illuminated area of an outdoor lighting application regulated by Part 6".

Refer to Chapter 9 of the Residential Manual for a discussion of low-rise residential additions. The Nonresidential Manual contains a general summary of the addition requirements in Section 1.7.14, and more specific information in each of the relevant chapters.

You may use any one of three options to document compliance of an addition:
- Addition Alone: Demonstrate that the addition alone meets the energy budget for new construction;
- Existing Plus Addition Plus Alteration: Demonstrate that the existing building plus the addition and/or alteration meets the energy budget by using the same or less energy than the existing building plus an addition that meets the current standards energy budget for new construction (with HERS verification).

- Whole Building: Demonstrate that the whole building, including the addition complies with the current standards.

Because it is the most stringent, the last option is rarely used. The first option is the most straightforward approach when the addition is able to comply with that approach and is especially recommended in nonresidential buildings. Although it is the most lengthy to calculate and document, the second alternative provides the most flexibility in showing compliance of the addition. It's also a good option when the project involved upgrades (alterations) to the existing home. **EnergyPro** accommodates any of these compliance options for additions.

Analysis of Addition Alone

Any addition--that is, the sum of all newly conditioned spaces and associated new exterior walls, ceilings, and floors within the building--may be shown to meet the energy budget as a separate entity. This procedure does not involve the existing structure and may be performed using the Res T24 Performance calculation for low-rise residential buildings, or either of the NR T24 Performance or NR T24 Prescriptive calculations for nonresidential buildings.

The rules and overall approach for analyzing an addition alone are the same as for showing compliance of any new building:

1. Enter all the building and system characteristics and meet the appropriate energy budget.

2. Use the program exactly as you would for a new building, but select Addition in the Project Design Data tab of the Building Element, and enter the existing floor area and number of existing bedrooms. EnergyPro will automatically calculate the fraction of the entire building attributable to the addition.

3. In the Project Title tab, name the project to show that it is only the Addition you are modeling, e.g., Wu Residence, Addition Only.

Analyzing additions alone works well for relatively large additions with moderate amounts of glazing. It may be difficult to achieve compliance in this way with small additions, because they tend to have a higher glazing-to-floor area ratio than an entire residence, which boosts the energy consumption per square foot. If an addition alone does not comply with the Standards, improvements to the Existing building may be necessary in order for the addition to comply as explained in the Existing-Plus-Addition-Plus-Alteration approach. The Addition Alone method cannot be used when alterations to the existing building are required to compensate for failure of an addition to comply alone or when alterations to the water heating system are proposed. In these events, use either the Whole Building or the Existing + Addition + Alteration approach.

Existing-Plus-Addition-Plus-Alteration (E+A+A) Analysis

Probably the most flexible method for showing compliance of an addition with the Standards is to consider the existing building along with the addition and any alterations. By comparing building energy consumption before and after the addition, you may take credit for improvements to the efficiency measures in the existing building under certain conditions.

Residential Projects: When using the residential prescriptive approach, each altered or added component must meet or exceed the requirements of Standards Section §150.2(a)1 for additions, or 150.2(b)1 for alterations. Alteration projects may only use the E+A+A (performance) approach if two or more components are altered. If you are altering a single component only, e.g., replacing windows, you must use the prescriptive approach.

In 2013, the CEC revised the E+A+A requirements to provide credit for projects that include independent field verification of the existing conditions. There are two Standard Design baselines for E+A+A projects: Without Third Party Verification of Existing Conditions, and With Verification. Refer to Standards Table 150.2-C for a list of the standard design condition for each of the baselines.

If there is no HERS verification of the existing conditions PRIOR to demolition, the Standard Design creates the energy budget using the values from the table. Thus, there is a high possibility that many existing (and altered) features will be subject to a compliance penalty.

If the existing conditions are verified by a HERS rater, the altered components must meet the prescriptive alteration requirements to obtain compliance credit for the improvement. In this case, the Standard Design uses the existing condition for many features to calculate the energy budget. Baselines for windows vary depending on the energy performance of the proposed new windows (if the proposed windows are more efficient than the threshold, the baseline is existing; if less efficient, the baseline uses the threshold values).

Refer to Standards Section 150.2 and Table 150.2-C, and Section 9.4 in the Residential Manual for additional details regarding additions and alterations.

Nonresidential Projects: The proposed energy budget is calculated based on existing building features that remain unaltered, and all alterations (actual values of the proposed alterations), plus the proposed addition. The standard (allowed) budget is calculated based on the existing building features that remain unaltered, and all proposed alterations modeled to meet the requirements of §141.0(b) (these are generally mandatory or prescriptive requirements for mechanical, envelope, and lighting systems), plus the addition modeled to meet the requirements of §141.0(a). Refer to Sections 1.7.13 and 1.7.14 of the Nonresidential Manual for additional details regarding additions and alterations generally, and to the relevant chapter for information about a specific component or end use.

Functionally, residential and nonresidential additions use essentially the same process to show compliance with this approach. The following example demonstrates the procedure for a residential building using Res T24 Performance. It also applies to a nonresidential occupancy with NR T24 Performance.

You may view a sample EnergyPro file of the existing plus addition plus alteration method. From the File menu, open the Existing+Alteration+Addition.bld file located in the Projects folder. The following two diagrams show the existing house and the house as it will be permitted.

Figure A. Existing House
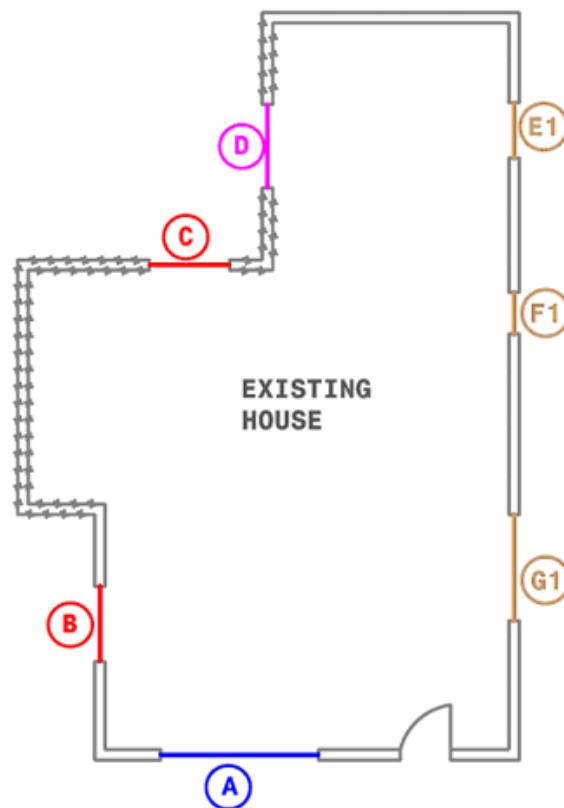
Existing House

→→ (E)WALL TO DEMO

A   **Existing Window to Remain**

B/C   **Existing Windows to be Remove**

D   **Existing Window to be Relocated**

E1/F1/G1   **Existing Windows to be Replaced**

A single model will contain all of the information, meaning that all of the information for the existing house including that which will be altered, as well as the Addition information. Do not model features which have been removed. Each Building Tree element (Room, Window, Wall, HVAC, DHW, etc..) will include a designation of the element Type that properly explains the role the element is playing in the calculation.

Figure B. Existing House, the Addition, and the Alterations

ADDITION

EXISTING HOUSE
PLUS ALTERATIONS
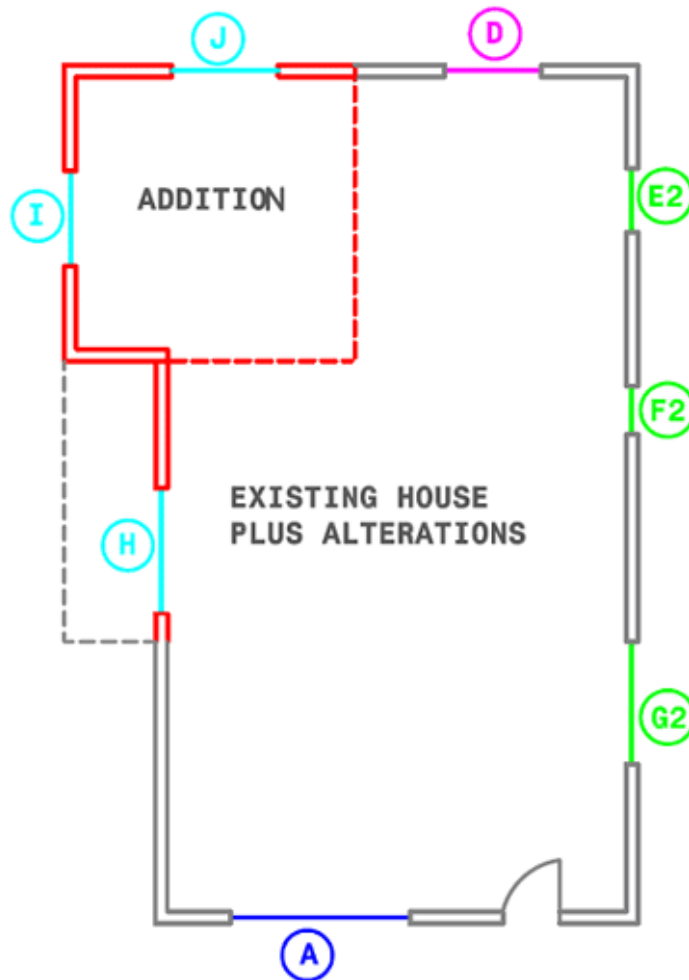
Existing + Alterations + Addition

— New Wall

A   Existing Window (Unchanged)

D   Relocated Existing Window

E2/F2/G2   Replacement Windows

H/I/J   New Windows

1. Compile complete information on the existing building before the remodel and information on the addition/alteration. If possible, encourage the owner to obtain HERS verification of the existing conditions, in order to be eligible to use the existing conditions in the baseline calculation.

2. Enter all the building characteristics, making sure that you:

    Select Exist+Addition/Alteration as the Building Type in the Project Design Data tab.

    Name each Plant, System, Zone, Room , Room Components (when applicable) depicting the status of that item, i.e. for a wall that will be altered: "Front Wall: To Remain". Figure C below is an example of a typical structure and naming convention for the project:

Figure C: EnergyPro Building Tree Example
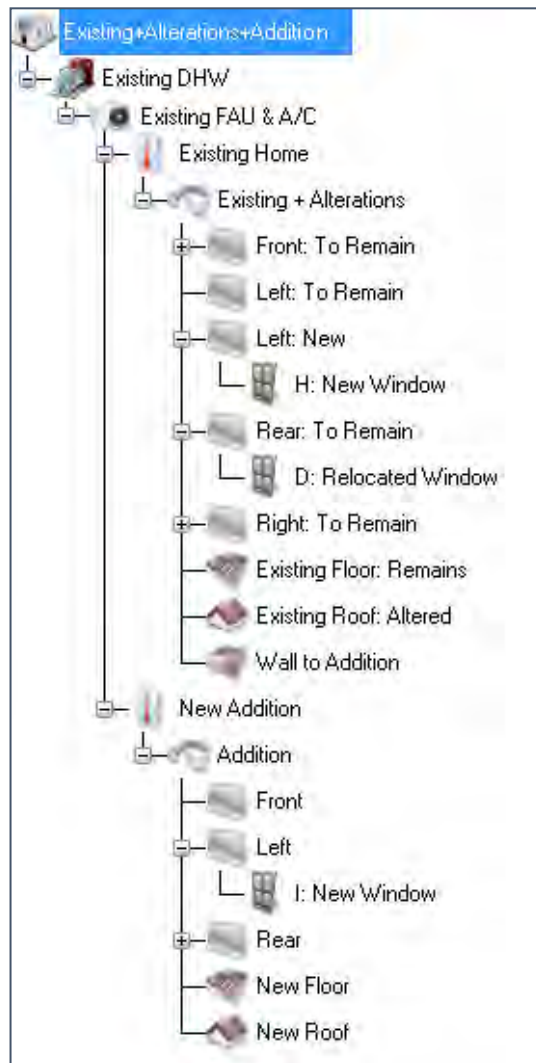
Each Building Tree component includes a field that requires you to specify the type of component or project: Existing, New, or Altered. Figure D below shows an example of a roof component that will be altered as part of the project.

Figure D. Altered Roof Type Example

When you select Altered, you must enter or select the existing component as it is prior to the alteration from the appropriate library. Then, enter or select the component as it will exist after the alteration. In this case, the existing roof uses the actual existing condition (R-19 insulation) because it was verified by a HERS rater, and a new R-38 roof. To obtain full compliance credit for the upgrade, you must check the appropriate checkboxes in the Residential Tab of the Building element to document HERS verification of the existing conditions.

3. Calculate the energy performance of the building—for low-rise residential buildings, the Res T24 Performance Proposed Total— the NR T24 Performance Proposed Total for nonresidential performance calculations. Be sure to select both the Standard and Proposed runs for the building in the Calculation Options.

NOTE: When using this compliance approach, it is important to account for all changes in all walls, floors, roofs and glazing which are altered, or added to the existing building as part of the remodel. Wall, roof and floor areas become critical in this context, because credit may be gained by insulating previously uninsulated parts of the building envelope, provided the existing conditions are verified by a HERS rater.

Mixed Occupancy Buildings

SECTION TO BE UPDATED

There are several ways to handle mixed occupancy buildings depending upon the occupancies involved, the relative areas of each occupancy, and how compliance is to be demonstrated.

As explained in Section 100.0(f), the *Standards* state that "when a building is designed and constructed for more than one type of occupancy, the zone for each occupancy shall meet the provisions of Title 24, Part 6 applicable to that occupancy."

Generally speaking, you must demonstrate compliance of each occupancy separately. For example, in a two-story building with 10,000 ft² (929 m²) of nonresidential space and a 2,500 ft² (139.4 m²) dwelling unit, the documentation for the low-rise residential occupancy portion of the building would be totally separate from the nonresidential reports even if the building is entered within the program as one entity with different zones and HVAC systems. Perhaps the clearest way to execute this using the program would be to print out two complete reports, each one for the applicable occupancy or occupancies within the same building. The title information should be clear to those reviewing the calculations.

There are two exceptions in the *Standards* to Section 100.0(f):

EXCEPTION 1 to Section 100.0(f): If one occupancy constitutes at least 80 percent of the conditioned floor area of the building, the entire building envelope, HVAC, and water heating may be designed to comply with the provisions of Part 6 applicable to that occupancy, provided that the applicable lighting requirements in Sections 140.6 through 140.8 or 150.0(k) are met for each occupancy and space and mandatory measures in Sections 110.0 through 130.5, and 150.0 are met for each occupancy and space.

EXCEPTION 2 to Section 100.0(f): If one occupancy constitutes at least 90 percent of the combined conditioned plus unconditioned floor area of the building, the entire building indoor lighting may be designed to comply with only the lighting provisions of Part 6 applicable to that occupancy."

See the Nonresidential Manual for further information on mixed occupancy nonresidential buildings.

Mechanical Systems

SECTION TO BE UPDATED

EnergyPro can analyze a wide range of HVAC system types. Systems may have a number of different components which are input in different parts of the program. Mechanical system components are defined in the Central System, Zonal, Chillers, Towers, and Boiler Libraries. They are brought into specific building description files in various elements of the Building Tree.

Related Topics:

Central Systems

Variable Capacity Heat Pumps

Default Mechanical Systems

Zonal Systems

Chillers and Cooling Towers

Space Heating Boilers

HVAC Distribution Systems

Case Studies

Central Systems

Every mechanical system modeled in **EnergyPro** needs at least one central system component. These include simple furnaces and air conditioners, as well as certain central components of more complex systems such as built-up VAV systems or hydronic heat pumps.

Central systems are defined in the Central System Library and are brought into specific building description files in the System Element.

Each central system may include both heating and cooling equipment. Some mechanical systems, particularly those used in low-rise residential buildings, may be completely defined as central systems. Examples include typical gas furnaces and air conditioners. Such systems do not require any other Library inputs. Other more complex systems such as built-up mechanical systems, also require inputs at the Plant level to define the chiller, tower, and boiler characteristics, and the Zone level for zonal systems.

Variable Capacity Heat Pumps

SECTION TO BE UPDATED

In December, 2019 the CEC approved a performance compliance option for variable capacity heat pumps. The compliance option provides credit for savings in cooling energy, heating energy and fan system energy use. The compliance credit applies to the following system types:

- Ducted mini and multi split VCHP systems with low-static indoor units (low-static as defined by 10 CFR Parts 429 and 430, Docket No. EERE–2016–BT–TP–0029, Federal Register Vol. 82, No. 3, January 5, 2017)

- Mini and multi-split VCHP systems with ductless indoor units

    Ductless indoor units are those that meet the following criteria:

    o The unit meets the AHRI 210/240-2017 definition of a non-ducted indoor unit: "An Indoor Unit designed to be permanently installed, mounted to/in ceilings and/or room walls, and/or to floors, and that directly heats or cools air within the conditioned space."

    o The unit is installed with no connection to any external ductwork.

Modeling a Variable Capacity Heat Pump (VCHP) System

When modeling a VCHP system, first specify a heat pump in the Central Library. The system heating and cooling capacities are reported on the CF-1R, but the system efficiencies are ignored for the calculations because compliance credit for VCHP systems is fixed relative to a standard heat pump system. Enter the VCHP system characteristics in the Residential Tab of the System Element.

The following excerpt from the CEC Staff Report provides a summary of the credit, system eligibility and field verification requirements for qualified VCHP systems.

General Description of the Algorithm Approach:

- *Credit for cooling 5 percent as compared to a single speed SEER 14 / EER 11.7 system*

- *Credit for heating 12 percent as compared to a single speed HSPF 8.2 system*

- *Also assume additional energy use for ducted systems due to continuous fan operation equal to 50 W per ton of nominal cooling capacity. This additional fan energy use will be incurred during each hour where there is no cooling load during cooling season, or heating load during heating season unless the system is from a manufacturer who has certified to the Energy Commission that the applicable combination of outdoor unit and indoor unit(s) does not operate the indoor fan(s) continuously by default.*

Eligibility Requirements:

1. *The performance compliance credit is applicable only to these system types:*

    - *Ducted mini and multi split VCHP systems with low-static indoor units (low-static as defined by 10 CFR Parts 429 and 430, Docket No. EERE–2016–BT–TP–0029, Federal Register Vol. 82, No. 3, January 5, 2017)*

    - *Mini and multi-split VCHP systems with ductless indoor units*

2. *Dwelling units shall be provided with heating and cooling supply airflow in each habitable room by use of a ductless VCHP indoor unit located in the room, or by use of ducts connected directly to the supply air outlet of a ducted VCHP indoor unit. Transfer fans do not meet this requirement.*

3. *All ducts, ducted indoor units, and ductless indoor units must be located entirely in conditioned space.*

4. *New ducted systems shall provide a minimum of 350 cfm/ton of nominal cooling capacity (300 cfm/ton for altered systems complying with refrigerant charge verification).*

5. *All VCHP indoor units serving zones larger than 150 square feet shall be controlled by external wall mounted thermostats located within the zone served.*

6. *The manufacturer of ducted indoor units shall certify to the Energy Commission that the system is a VCHP that meets the definition of a low-static system as defined in the new DOE rule adopted January 5, 2017. The manufacturer's model number(s) shall be included in listings of certified-to-the-Energy Commission low-static pressure VCHP systems which will be published on the Energy Commission's website*

7. *The manufacturer may certify to the Energy Commission that their ducted indoor unit + outdoor unit combination does not operate the fan continuously by default. This certification is required in order to receive credit for non-continuous fan operation.*

8. *Air filter sizing shall be required for all ducted systems, regardless of duct length. The maximum allowable clean filter pressure drop for the required MERV 13 air filters shall be 0.1 inch wc..*

9. *It must be possible for a HERS Rater to view the manufacturer indoor unit and outdoor unit make/model/serial number in the field-installed unit in order to comply with the required field verifications.*

Field Verification Requirements

1. *The installed system must have refrigerant charge verified by a HERS Rater according to applicable procedures in RA3.2, as specified in Title 24, Part 6 Standards Sections 150.1(c)7A and 150.2(b)1Fii, or 150.2(b)1Fiii.*

2. *Ducted indoor units shall be HERS verified to meet the Verified Low Leakage Ducts in Conditioned Space requirements according to the procedure in RA3.1.4.3.8.*

3. *Ductless systems shall be HERS verified to visually confirm ductless indoor units are located entirely in conditioned space.*

4. *HERS Rater shall confirm all habitable rooms are provided with conditioned airflow.*

5. *HERS Rater shall confirm zones greater than 150 ft2 have a wall mounted thermostat.*

6. *HERS verification shall confirm that the manufacturer's model number of installed ducted units are included in listings of certified low-static pressure VCHP systems published on the Energy Commission's website.*

7. *If non-continuous fan operation is claimed for credit in CBECC-Res, HERS verification shall confirm that the installed system's indoor unit + outdoor unit combination is certified to the Energy Commission and listed on the Energy Commission website as a type that does not operate the fan continuously by default. Additionally, HERS field verification of the installed system operation shall confirm that the installed system's indoor unit fan does not run continuously when the system is not calling for conditioning.*

8. *Each new ducted indoor unit must have airflow verified by a HERS Rater to confirm the airflow at full capacity in cooling mode is equal to or greater than 350 cfm/ton of nominal cooling capacity of the indoor unit. 300 cfm/ton shall be verified for altered systems if required for compliance with the refrigerant charge verification procedure.*

9. *HERS verification shall confirm the air filter sizing is correct, and confirm the installed air filter label specifies performance that meets a clean filter pressure drop less than or equal to 0.1 inch wc. at the design airflow rate.*

CEC Staff Report: Variable Capacity Heat Pump Performance Compliance Option, September 2019,CEC-400-2019-012

When to Use and How to Create Default Mechanical Systems

There are times when you may want to use the NR T24 Performance/DOE calculation but want to model a default or minimum efficiency mechanical system. For example, when you model only a part of a building (e.g., a tenant space) which is served by a central boiler, central chiller and/or central cooling tower, you can create a default HVAC system for the proposed building.

Default HVAC System

To model a default HVAC system, simply set the HVAC input of the System element to "Undefined". EnergyPro will automatically define a standard efficiency default system for both the standard and proposed designs.

For projects where a built-up system is the appropriate system type, you may use an alternative method to force the program to model the system type you select. In the Central System Library, Heating Tab, select the System Type from the drop-down list. Set all heating and cooling entries to zero. You may model the actual fan characteristics (if known) or model a fan power index equal to 0.365 Watts/cfm, which will be used for both the standard and proposed systems. Be sure to model sufficient supply air to meet the minimum ventilation requirements. NR T24 Performance will automatically define the type of system specified for both the standard and proposed designs.

Default Chiller

To model a default Chiller, simply set the Chiller input of the Plant element to "Undefined". NR T24 Performance will automatically define a chiller for both the standard and proposed designs.

Default Central Cooling Tower

To model a default Cooling Tower, simply set the Cooling Tower input of the Plant element to "Undefined". NR T24 Performance will automatically define a cooling tower for both the standard and proposed designs.

Default Zonal Systems

When modeling a default built-up mechanical system with VAV boxes, reheating, or recooling, you must create default zonal conditions as well.

1. In the Zonal System Library, create, for example, a default VAV box (e.g., Std 30% VAV Box/Reheat). Set the Minimum Airflow Ratio to the appropriate value (e.g., 0.30), and indicate the presence or absence of a Reheat Coil depending on the default condition.

2. Save the Zonal system, and select it in the Zone element under the Mechanical tab, Zonal System Data.

Default Boiler

To model a default Boiler, simply set the Heating Boiler input of the Plant element, Heating Hot Water Tab to "Undefined". NR T24 Performance will automatically define a boiler for both the standard and proposed designs.

Zonal Systems

Zonal systems include different kinds of VAV (variable air volume) or variable refrigerant volume boxes. Zonal systems are defined in the Zonal System Library and are input in the Zone element(s) under the Mechanical tab.

Each zone may have up to 99 identical terminal units such as VAV boxes.

Chillers and Cooling Towers

Chillers and cooling towers are components of more complex systems, such as built-up VAV systems. They are generally found in larger nonresidential and high-rise residential construction. Chillers and cooling towers are defined in the Plant Library and are incorporated into the overall building description using the Chilled Water tab in the Plant element.

Default Built-Up Systems with VAV Boxes, Reheating, or Recooling

When modeling a default existing or expected built-up system, you must model relevant zonal system characteristics as explained in Default Mechanical Systems: Default Zonal Systems.

Each building can have four chiller types and one type of cooling tower, but there can be multiple identical units of each. Primary and secondary pump information and chiller EMS control data are also entered in the Plant Element.

Space Heating Boilers

Boilers may be used for space heating in both residential and nonresidential buildings. Define boilers in the Boiler Library, and then you may select the equipment in the Heating Hot Water Tab in the Plant element.

Each building may have only one type of boiler, although there may be more than one identical unit. The exception to this may be residential buildings with combined hydronic systems. They may have more than one boiler and/or water heater serving a single building.

Distribution Systems

The ducts and other distribution systems for mechanical systems can be input in the System element for each HVAC system. These inputs are most often used for low-rise residential compliance calculations, although distribution system type and any duct R-values are also documented in nonresidential compliance calculations when more than 25% of the ducts are located in unconditioned space or outdoors. For other nonresidential compliance calculations, the program makes certain fixed assumptions based on the HVAC system type.

Case Studies

SECTION TO BE UPDATED

This section presents several different mechanical systems and explains how to input them in **EnergyPro**. They are:

- Gas Furnace
- Packaged Furnace/AC with Exhaust Fans
- Packaged VAV without Reheat
- Built-up VAV with Reheat

These case studies are intended to demonstrate the general approaches used to input some different mechanical systems. Use them as guidelines for defining your own systems, understanding that each project will have somewhat different requirements.

Case Study 1: Gas Furnace

A residential building in Climate Zone 6 has a typical gas furnace with R-6 ducts in the attic and a setback thermostat. There is no cooling. How is this input?

Answer:

1. Define and save the furnace in the Central System Library, or confirm that the desired unit is already in the Library. You can use the CEC Appliance Efficiency Database to import equipment from the approved CEC lists. Return to the Building Tree.

2. In the General Tab of the System element, give the system a name (e.g., Whole House System), select the HVAC unit from the Central System Library, and enter the number of identical units in the Multiplier field, if more than one. The remainder of the inputs on this tab are default values for residences.

3. In the Distribution Tab, select the distribution type and duct location (default is Attic), the R-Value of the insulation (min R-6), and check the Sealed Ducts with Leakage Verified checkbox (this is a mandatory requirement, and requires HERS field verification). Since there is no cooling, you can ignore the cooling system inputs. Leave them set at default values.

4. In the Residential Tab, select Setback for the thermostat.

5. For Title 24 compliance, the operating schedule is set automatically. If the system isn't being modeled for compliance purposes, set the schedule in the Zone Element, Schedules tab.

This completes the mechanical system inputs for a typical gas furnace.

Case Study 2: Packaged Furnace/AC with Exhaust Fans

A small office building (approximately 2,500 sqft) is served by one packaged rooftop furnace/air conditioner with R-4.2 ducts located in the attic. Insulation is at the roof level, so the ductwork is located within indirectly conditioned space. The building also has two 400 cfm (188.8 L/s) bathroom exhaust fans. What inputs are required?

Answer:

1. Create and save (or import from the CEC Appliance Efficiency Database) the specified packaged unit in the Central System Library, or confirm that the desired unit is already there.

2. The building has been defined as having a single zone. Under the Schedules tab of the Zone element, select CA Daytime Fans for the Fan Schedule (you may leave this Undefined if modeling for Title 24 compliance as the input is fixed in compliance calculations).

3. Define a 400 cfm (188.8 L/s) exhaust fan in the Exhaust Fan tab of the Room Element. If you are defining all the envelope elements within one Room Element of the Building Tree, enter a multiplier of 2. If you will be further dividing the building for analysis, set the multiplier to 1 and enter the second exhaust fan in the appropriate Room.

4. Open the System Element, General Tab and Name the System, e.g., Office System. Select the packaged unit you created in the Central System Library, and enter a system Multiplier of 1. In the Distribution Tab, enter the duct location, and insulation value.

No other inputs are needed to describe this system.

NOTE: Both the heating and cooling components of the system are combined into one Central System Library entry. It is not possible to have more than one type of Central System in an HVAC System, unless multiple different units have been averaged into one Central System Library entry.

Case Study 3: Packaged VAV without Reheat

A one-story, 5,600 ft² (520.2 m²) office building has a packaged VAV (variable air volume) system with no reheat at the VAV boxes. Both heating and cooling are supplied by the packaged unit. How is this system modeled for compliance? Can the building be modeled as one large zone, or must it be divided into separate zones?

Answer:

1. Any building served by a VAV system must be divided into separate zones that correspond to thermodynamically similar parts of the building. Typical minimum zoning for a one-story, rectangular building, if the actual zoning isn't known, is to have separate perimeter zones for each orientation, plus a central core zone. Multi-story buildings often require additional zones to account for the roof and floor conditions. Refer to the Inputting Zones by Thermal Characteristics and Occupancy Type topic for additional details regarding zoning.

    The first step in defining this system is to divide the building into appropriate thermal zones which will be input as separate Zone Elements under one System Element. Before starting the input in the System and Zone elements, create the equipment in the Central and Zonal System Libraries.

2. In the Central System Library, create a Packaged VAV system that matches the one specified for the building. Since there is no reheat, None for Reheat Coils. Once all the system inputs are complete, save the equipment to the Central System Library and return to the Building Tree.

3. In the Zonal System Library, create all the different types of VAV boxes used in the building. Remember that each zone can use only one type of zonal system. Since there is no terminal reheat in the building, do not check the Reheat Coil checkbox. Save each VAV box to the Library, and return to the Building Tree.

4. In the System Element, name the System and select the equipment you created in the Central System Library, and input other relevant information.

5. The next step is to load the VAV boxes into each Zone.   Name each Zone Element and select VAV boxes and multipliers as appropriate. Check that the proper values for Supply ACH (air changes per hour) and Outside ACH have been entered and that the desired schedules have been selected.

This completes the definition of this mechanical system.

Case Study 4: Built-Up VAV with Reheat

A ten-story, 56,000 ft² (5,202.4 m²) office building has a built-up VAV system with hot water reheat coils in the perimeter zones. There are five air handling units, one each for the north, south, east and west perimeter zones, and one for all interior zones. A chiller provides cooling for the whole building, and a boiler supplies all reheat at the zones. There is no other space heating other than the reheat. How is this system modeled for compliance?

Answer:

1. In many respects, the inputs for this built-up VAV system are similar to those for the packaged VAV system defined in Case Study 3. The building must still be divided into zones that correspond to thermally distinct zones. In this case, there are fifteen zones: four perimeter zones and a core zone for the ground floor, a similar five zones for the top floor, and another five zones for the combined interior floors (levels 2 through 9).

2. In the Central System Library, create a built-up VAV system corresponding to each separate air handling unit proposed for the building. The Cooling Output for each unit should equal the rated output of its cooling coil. This example has hot water reheat, so select Hot Water for the Reheat Coils.

Since there is no central heating, under the Heating tab set Heating Type to None and Total Output to zero (0), and select the coil control type from the drop-down list.

Once all the Systems are in the Central Library, open the Zonal Library.

1. In the Zonal System Library, create all the different types of VAV boxes used in the building. Since this example includes reheat in the perimeter zones, check the Reheat Coil checkbox for the boxes to serve the perimeter, and clear it for those serving the core. Save each VAV box to the Library, and return to the Building Tree.

2. Next, open the Chiller Library, and define the Chiller to be used in the building. Then, in the Boiler Library, create the Boiler which will supply hot water to the reheat coils.

This wraps up the Library inputs required for this mechanical system, so return to the Building Tree.

1. Open the Plant Element, and under the Heating Hot Water Tab select the boiler just saved in the Boiler Library. Set the Multiplier to 1.   If the service hot water for the building is supplied by the Heating Boiler, leave the DHW System set to Undefined.

2. Continuing in the Plant Element, under the Chilled Water tab, click on the chiller graphic to select the chiller you just saved in the Chiller Library and define the primary chilled water pump characteristics. Set the Multiplier to 1. Enter the Secondary Pump characteristics here as well.

3. In the System Element, select the Central System equipment you defined in the Central System Library. Place each Zone Element under the appropriate System Element in the Building Tree.

4. Now load the VAV boxes into each Zone element as explained in Case Study 3.

Appendices

Appendix 1: CEC Official Notice of EnergyPro v9 Approval

EnergyPro version 9, developed by EnergySoft, LLC, is a software program which may be used for demonstrating compliance with the 2022 Title 24, Part 6 (*Building Energy Efficiency Standards),* effective January 1, 2023.

Single Family Residential Compliance: EnergyPro version 9.0 was approved by the CEC on December 14, 2022. The single family residential standards apply to single family dwellings. Hotels, motels, multifamily residential and nonresidential buildings are outside the scope of the single family residential standards.

EnergyPro version 9.0 includes the CBECC-Res version 2022.2.0 compliance manager, approved by the Commission on October 12, 2022

Nonresidential and Multifamily Compliance: EnergyPro version 9.0 was approved by the CEC on December 14, 2022.

EnergyPro's NR/MF T24 Performance module uses the CEC's CBECC version 2022.2.0 compliance manager, approved by the Commission on October 12, 2022.

The approval notices are located on the CEC site at the following URL:

https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency-1

Appendix 2: Form CF1R-PRF-01-E Sample – New Construction (Page 1)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T20:46:21-08:00

Input File Name: Single Family Sample-mb.ribd22x

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GENERAL INFORMATION

01	Project Name	Residential Example
02	Run Title	Title 24 Analysis
03	Project Location	7188 Pleasant Way

04	City	San Bernardino	05	Standards Version	2022
06	Zip code	90000	07	Software Version	EnergyPro 9.0
08	Climate Zone	10	09	Front Orientation (deg/ Cardinal)	90
10	Building Type	Single family	11	Number of Dwelling Units	1
12	Project Scope	Newly Constructed	13	Number of Bedrooms	3
14	Addition Cond. Floor Area (ft²)	0	15	Number of Stories	2
16	Existing Cond. Floor Area (ft²)	n/a	17	Fenestration Average U-factor	0.28
18	Total Cond. Floor Area (ft²)	2000	19	Glazing Percentage (%)	19.50%
20	ADU Bedroom Count	n/a			

COMPLIANCE RESULTS

01	Building Complies with Computer Performance
02	This building incorporates features that require field testing and/or verification by a certified HERS rater under the supervision of a CEC-approved HERS provider.
03	This building incorporates one or more Special Features shown below

Registration Number:

Registration Date/Time:

HERS Provider:

CA Building Energy Efficiency Standards - 2022 Residential Compliance

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 2)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T20:46:21-08:00

Input File Name: Single Family Sample-mb.ribd22x

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ENERGY DESIGN RATINGS

	Energy Design Ratings			Compliance Margins		
	Source Energy (EDR1)	Efficiency[1] EDR (EDR2efficiency)	Total[2] EDR (EDR2total)	Source Energy (EDR1)	Efficiency[1] EDR (EDR2efficiency)	Total[2] EDR (EDR2total)
Standard Design	36.3	38.7	27.2			
Proposed Design	32.6	33.3	21.6	3.7	5.4	5.6

RESULT[3]: PASS

[1]Efficiency EDR includes improvements like a better building envelope and more efficient equipment

[2]Total EDR includes efficiency and demand response measures such as photovoltaic (PV) system and batteries

[3]Building complies when source energy, efficiency and total compliance margins are greater than or equal to zero and unmet load hour limits are not exceeded

- Standard Design PV Capacity: 2.90 kWdc

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 3)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example **Calculation Date/Time:** 2022-12-10T20:46:21-08:00 (Page 3 of 14)

Calculation Description: Title 24 Analysis **Input File Name:** Single Family Sample-mb.ribd22x

ENERGY USE SUMMARY

Energy Use	Standard Design Source Energy (EDR1) (kBtu/ft^2 -yr)	Standard Design TDV Energy (EDR2) (kTDV/ft^2 -yr)	Proposed Design Source Energy (EDR1) (kBtu/ft^2 -yr)	Proposed Design TDV Energy (EDR2) (kTDV/ft^2 -yr)	Compliance Margin (EDR1)	Compliance Margin (EDR2)
Space Heating	2.45	10.95	2.44	10.97	0.01	-0.02
Space Cooling	0.93	22.62	0.84	21.73	0.09	0.89
IAQ Ventilation	0.34	3.56	0.34	3.56	0	0
Water Heating	1.17	12.26	2.94	12.73	-1.77	-0.47
Self Utilization/Flexibility Credit				-6.42		6.42
Efficiency Compliance Total	4.89	49.39	6.56	42.57	-1.67	6.82
Photovoltaics	-1.66	-46.34	-1.62	-49.1		
Battery			-2.73	-2.93		
Flexibility						
Indoor Lighting	0.75	7.29	0.75	7.29		
Appl. & Cooking	3.02	20.65	3.02	20.67		
Plug Loads	2.74	27.98	2.74	27.98		
Outdoor Lighting	0.19	1.68	0.19	1.68		
TOTAL COMPLIANCE	9.93	60.65	8.91	48.16		

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 4)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example	Calculation Date/Time: 2022-12-10T20:46:21-08:00	(Page 4 of 14)
Calculation Description: Title 24 Analysis	Input File Name: Single Family Sample-mb.ribd22x	

ENERGY USE INTENSITY

	Standard Design (kBtu/ft² - yr)	Proposed Design (kBtu/ft² - yr)	Compliance Margin (kBtu/ft² - yr)	Margin Percentage
Gross EUI[1]	14.84	16.84	-2	-13.48
Net EUI[2]	6.42	8.64	-2.22	-34.58

Notes
1. Gross EUI is Energy Use Total (not including PV) / Total Building Area.
2. Net EUI is Energy Use Total (including PV) / Total Building Area.

REQUIRED PV SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
DC System Size (kWdc)	Exception	Module Type	Array Type	Power Electronics	CFI	Azimuth (deg)	Tilt Input	Array Angle (deg)	Tilt: (x in 12)	Inverter Eff. (%)	Annual Solar Access (%)
1	NA	Standard (14-17%)	Fixed	none	false	90	Degrees	22	4.85	96	100
1	NA	Standard (14-17%)	Fixed	none	false	180	Degrees	22	4.85	96	100
1	NA	Standard (14-17%)	Fixed	none	false	270	Degrees	22	4.85	96	100

BATTERY SYSTEMS

01	02	03	04	05	06	07
		Charging		Discharging		
Control	Capacity (kWh)	Charging Efficiency	Charging Rate (kW)	Discharging Efficiency	Discharging Rate (kW)	Round Trip Efficiency
Basic	12	0.95	n/a	0.95	n/a	0.9

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 5)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example	**Calculation Date/Time:** 2022-12-10T20:46:21-08:00	(Page 5 of 14)
Calculation Description: Title 24 Analysis	**Input File Name:** Single Family Sample-mb.ribd22x	

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- Battery System: 12 kWh (Self Utilization Credit taken)
- Insulation below roof deck
- Non-standard duct location (any location other than attic)

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building tables below. Registered CF2Rs and CF3Rs are required to be completed in the HERS Registry.

- Indoor air quality ventilation
- Kitchen range hood
- Minimum Airflow
- Verified EER/EER2
- Verified SEER/SEER2
- Verified Refrigerant Charge
- Fan Efficacy Watts/CFM
- Duct leakage testing
- Ducts located entirely in conditioned space confirmed by duct leakage testing
- Compact distribution system expanded credit
- Drain water heat recovery system

BUILDING - FEATURES INFORMATION

01	02	03	04	05	06	07
Project Name	Conditioned Floor Area (ft²)	Number of Dwelling Units	Number of Bedrooms	Number of Zones	Number of Ventilation Cooling Systems	Number of Water Heating Systems
Residential Example	2000	1	3	2	0	1

ZONE INFORMATION

01	02	03	04	05	06	07
Zone Name	Zone Type	HVAC System Name	Zone Floor Area (ft²)	Avg. Ceiling Height	Water Heating System 1	Status
1st Floor Zone	Conditioned	Res HVAC1	1200	8	DHW Sys 1	New
2nd Floor Zone	Conditioned	Res HVAC1	800	8	DHW Sys 1	New

Registration Number:	Registration Date/Time:	HERS Provider:
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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 6)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T20:46:21-08:00

Input File Name: Single Family Sample-mb.ribd22x

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OPAQUE SURFACES

01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft²)	Window and Door Area (ft2)	Tilt (deg)
Front Wall	1st Floor Zone	R-21 Wall w/R-2	0	Right	320	81	90
Left Wall	1st Floor Zone	R-21 Wall w/R-2	90	Front	240	40	90
Back Wall	1st Floor Zone	R-21 Wall w/R-2	180	Left	320	88.7	90
Right Wall	1st Floor Zone	R-21 Wall w/R-2	270	Back	240	32	90
Front Wall 2	2nd Floor Zone	R-21 Wall w/R-2	0	Right	320	60	90
Left Wall 2	2nd Floor Zone	R-21 Wall w/R-2	90	Front	240	24	90
BackWall	2nd Floor Zone	R-21 Wall w/R-2	180	Left	320	70	90
Right Wall 2	2nd Floor Zone	R-21 Wall w/R-2	270	Back	240	32	90
Wall to Garage	1st Floor Zone>>__Garage__	R-13 Wall	n/a	n/a	100	20	n/a
R-38 Roof	1st Floor Zone	R-38 HP Attic	n/a	n/a	500	n/a	n/a
R-38 Roof 2	2nd Floor Zone	R-38 HP Attic	n/a	n/a	800	n/a	n/a
GarageRoof	__Garage__	R-30 Roof Attic	n/a	n/a	340	n/a	n/a
Interior Floor	2nd Floor Zone	R-0 Floor No Crawlspace	n/a	n/a	700	n/a	n/a
Floor over Garage	2nd Floor Zone	R-19 Floor No Crawlspace	n/a	n/a	100	n/a	n/a
GarageWallFront	__Garage__	Garage Ext Wall	0	Right	180	128	90
GarageWallLeft	__Garage__	Garage Ext Wall	90	Front	198	0	90
GarageWallRight	__Garage__	Garage Ext Wall	270	Back	108	0	90

ATTIC

01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic __Garage__	Attic Garage Roof Cons	Ventilated	4	0.1	0.85	Yes	No
Attic 1st Floor Zone	Attic Roof1st Floor Zone	Ventilated	4	0.1	0.85	No	No

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 7)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T20:46:21-08:00

Input File Name: Single Family Sample-mb.ribd22x

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ATTIC

01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic 2nd Floor Zone	Attic Roof2nd Floor Zone	Ventilated	4	0.1	0.85	No	No

FENESTRATION / GLAZING

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Name	Type	Surface	Orientation	Azimuth	Width (ft)	Height (ft)	Mult.	Area (ft^2)	U-factor	U-factor Source	SHGC	SHGC Source	Exterior Shading
Front Windows	Window	Front Wall	Right	0			1	60	0.28	NFRC	0.2	NFRC	Bug Screen
Left Windows	Window	Left Wall	Front	90			1	40	0.28	NFRC	0.2	NFRC	Bug Screen
Back Windows	Window	Back Wall	Left	180			1	72	0.28	NFRC	0.2	NFRC	Bug Screen
Right Windows	Window	Right Wall	Back	270			1	32	0.28	NFRC	0.2	NFRC	Bug Screen
Front Windows 2	Window	Front Wall 2	Right	0			1	60	0.28	NFRC	0.2	NFRC	Bug Screen
Left Windows 2	Window	Left Wall 2	Front	90			1	24	0.28	NFRC	0.2	NFRC	Bug Screen
Back Windows 2	Window	BackWall	Left	180			1	70	0.28	NFRC	0.2	NFRC	Bug Screen
Right Windows 2	Window	Right Wall 2	Back	270			1	32	0.28	NFRC	0.2	NFRC	Bug Screen

OPAQUE DOORS

01	02	03	04
Name	Side of Building	Area (ft^2)	U-factor
Entry Door	Front Wall	21	0.2
Back Door	Back Wall	16.7	0.2
Door	Wall to Garage	20	0.2

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 8)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example
Calculation Description: Title 24 Analysis

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OPAQUE DOORS

01	02	03	04
Name	Side of Building	Area (ft²)	U-factor
GarageCarDoorFront	GarageWallFront	128	0.7

SLAB FLOORS

01	02	03	04	05	06	07	08
Name	Zone	Area (ft²)	Perimeter (ft)	Edge Insul. R-value and Depth	Edge Insul. R-value and Depth	Carpeted Fraction	Heated
Slab-on-Grade	1st Floor Zone	1200	160	none	0	80%	No
GarageSlab	__Garage__	440	54	none	0	0%	No

OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
Garage Ext Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-0	None / None	0.361	Inside Finish: Gypsum Board Cavity / Frame: no insul. / 2x4 Exterior Finish: 3 Coat Stucco
R-21 Wall w/R-2	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O. C.	R-21	None / None	0.058	Inside Finish: Gypsum Board Cavity / Frame: R-21 / 2x6 Sheathing / Insulation: R-2 Sheathing Exterior Finish: 3 Coat Stucco
R-13 Wall	Interior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-13	None / None	0.092	Inside Finish: Gypsum Board Cavity / Frame: R-13 / 2x4 Other Side Finish: Gypsum Board
Attic Garage Roof Cons	Attic Roofs	Wood Framed Ceiling	2x8 @ 24 in. O. C.	R-0	None / None	0.638	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: no insul. / 2x8

Registration Number:
Registration Date/Time:
HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 9)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

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Input File Name: Single Family Sample-mb.ribd22x

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OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
Attic Roof1st Floor Zone	Attic Roofs	Wood Framed Ceiling	2x6 @ 24 in. O. C.	R-19	None / None	0.055	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x6
Attic Roof2nd Floor Zone	Attic Roofs	Wood Framed Ceiling	2x6 @ 24 in. O. C.	R-19	None / None	0.055	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x6
R-30 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-30	None / None	0.032	Over Ceiling Joists: R-20.9 insul. Cavity / Frame: R-9.1 / 2x4 Inside Finish: Gypsum Board
R-38 HP Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-38	None / None	0.025	Over Ceiling Joists: R-28.9 insul. Cavity / Frame: R-9.1 / 2x4 Inside Finish: Gypsum Board
R-0 Floor No Crawlspace	Interior Floors	Wood Framed Floor	2x12 @ 16 in. O. C.	R-0	None / None	0.196	Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: no insul. / 2x12 Ceiling Below Finish: Gypsum Board
R-19 Floor No Crawlspace	Interior Floors	Wood Framed Floor	2x10 @ 16 in. O. C.	R-19	None / None	0.045	Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x10 Ceiling Below Finish: Gypsum Board

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 10)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

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BUILDING ENVELOPE - HERS VERIFICATION

01	02	03	04	05
Quality Insulation Installation (QII)	High R-value Spray Foam Insulation	Building Envelope Air Leakage	CFM50	CFM50
Not Required	Not Required	N/A	n/a	n/a

WATER HEATING SYSTEMS

01	02	03	04	05	06	07	08	09
Name	System Type	Distribution Type	Water Heater Name	Number of Units	Solar Heating System	Compact Distribution	HERS Verification	Water Heater Name (#)
DHW Sys 1	DHW	Standard	DHW Heater 1	1	n/a	Expanded	DHW Sys 1-hers-dhw	DHW Heater 1 (1)

WATER HEATERS

01	02	03	04	05	06	07	08	09	10	11	12	13
Name	Heating Element Type	Tank Type	# of Units	Tank Vol. (gal)	Heating Efficiency Type	Efficiency	Rated Input Type	Input Rating or Pilot	Tank Insulation R-value (Int/Ext)	Standby Loss or Recovery Eff	1st Hr. Rating or Flow Rate	Tank Location
DHW Heater 1	Gas	Consumer Instantaneous	1	0	UEF	0.97	Btu/Hr	200000	0	n/a		

WATER HEATING - COMPACT DISTRIBUTION

01	02	03	04	05	06	07
Dwelling Unit type	Water Heating System Name	Master Bath distance of furthest fixture to Water Heater (ft)	Kitchen distance of furthest fixture to Water Heater (ft)	Furthest Third furthest fixture to Water Heater (ft)	Compactness Factor	HERS Verification
Dwelling	DHW Sys 1	n/a	n/a	n/a	0.6	Expanded Credit

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 11)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example
Calculation Description: Title 24 Analysis

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WATER HEATING - DRAIN WATER HEAT RECOVERY

01	02	03	04	05	06
Dwelling Unit type	DHW System and DWHR Names	Installation Configuration	Shower Drains	Shower Drain Water Heat Recovery Efficiency (%)	HERS Verification
Dwelling	DHW Sys 1 - 1 - DWHR-1	Equal Flow	2	43	Required

WATER HEATING - HERS VERIFICATION

01	02	03	04	05	06	07
Name	Pipe Insulation	Parallel Piping	Compact Distribution	Compact Distribution Type	Recirculation Control	Shower Drain Water Heat Recovery
DHW Sys 1 - 1/1	Not Required	Not Required	Required	Expanded	Not Required	Required

SPACE CONDITIONING SYSTEMS

01	02	03	04	05	06	07	08	09
Name	System Type	Heating Unit Name	Heating Equipment Count	Cooling Unit Name	Cooling Equipment Count	Fan Name	Distribution Name	Required Thermostat Type
Res HVAC1	Heating and cooling system other	Heating Component 1	1	Cooling Component 1	1	HVAC Fan 1	Air Distribution System 1	Setback

HVAC - HEATING UNIT TYPES

01	02	03	04
Name	System Type	Number of Units	Heating Efficiency
Heating Component 1	Central gas furnace	1	AFUE-96

Registration Number:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 12)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example   Calculation Date/Time: 2022-12-10T20:46:21-08:00   (Page 12 of 14)

Calculation Description: Title 24 Analysis   Input File Name: Single Family Sample-mb.ribd22x

HVAC - COOLING UNIT TYPES

01	02	03	04	05	06	07	08	09
Name	System Type	Number of Units	Efficiency Metric	Efficiency EER/EER2/CEER	Efficiency SEER/SEER2	Zonally Controlled	Mulit-speed Compressor	HERS Verification
Cooling Component 1	Central split AC	1	EER2/SEER2	12.2	15	Not Zonal	Single Speed	Cooling Component 1-hers-cool

HVAC COOLING - HERS VERIFICATION

01	02	03	04	05	06
Name	Verified Airflow	Airflow Target	Verified EER/EER2	Verified SEERSEER2	Verified Refrigerant Charge
Cooling Component 1-hers-cool	Required	350	Not Required	Not Required	Required

HVAC - DISTRIBUTION SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
Name	Type	Design Type	Duct Ins. R-value		Duct Location		Surface Area		Bypass Duct	Duct Leakage	HERS Verification
			Supply	Return	Supply	Return	Supply	Return			
Air Distribution System 1	Conditioned space-entirely	Non-Verified	R-8	R-8	Conditioned Zone	Conditioned Zone	n/a	n/a	No Bypass Duct	Sealed and Tested	Air Distribution System 1-hers-dist

HVAC DISTRIBUTION - HERS VERIFICATION

01	02	03	04	05	06	07	08	09
Name	Duct Leakage Verification	Duct Leakage Target (%)	Verified Duct Location	Verified Duct Design	Buried Ducts	Deeply Buried Ducts	Low-leakage Air Handler	Low Leakage Ducts Entirely in Conditioned Space
Air Distribution System 1-hers-dist	Yes	5.0	Required	Not Required	Not Required	Credit not taken	Not Required	No

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 13)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example

Calculation Description: Title 24 Analysis

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HVAC - FAN SYSTEMS

01	02	03	04
Name	Type	Fan Power (Watts/CFM)	Name
HVAC Fan 1	HVAC Fan	0.45	HVAC Fan 1-hers-fan

HVAC FAN SYSTEMS - HERS VERIFICATION

01	02	03
Name	Verified Fan Watt Draw	Required Fan Efficacy (Watts/CFM)
HVAC Fan 1-hers-fan	Required	0.45

INDOOR AIR QUALITY (IAQ) FANS

01	02	03	04	05	06	07	08	09
Dwelling Unit	Airflow (CFM)	Fan Efficacy (W/CFM)	IAQ Fan Type	Includes Heat/Energy Recovery?	IAQ Recovery Effectiveness - SRE	Includes Fault Indicator Display?	HERS Verification	Status
SFam IAQVentRpt	87	0.35	Exhaust	No	n/a	No	Yes	Riverside Muni

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 14)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Residential Example	**Calculation Date/Time:** 2022-12-10T20:46:21-08:00 (Page 14 of 14)
Calculation Description: Title 24 Analysis	**Input File Name:** Single Family Sample-mb.ribd22x

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Company: **Educational Version**	Signature Date: 12/10/2022
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip: , CA	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design identified on this Certificate of Compliance.
2. I certify that the energy features and performance specifications identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
3. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.

Responsible Designer Name: **Rob Parker**	Responsible Designer Signature:
Company: **Bernard Parker & Assoc.**	Date Signed:
Address: **573 Oak Drive**	License:
City/State/Zip: **Sacramento, CA 95000**	Phone: **(415) 256-5555**

Registration Number:	Registration Date/Time:	HERS Provider:
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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 1)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00

Input File Name: Single Family EA+ADU-mb .ribd22x

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GENERAL INFORMATION

01	Project Name	Existing+Alterations+Addition			
02	Run Title	Title 24 Analysis			
03	Project Location	123 Main St.			
04	City	Sacramento	05	Standards Version	2022
06	Zip code	92990	07	Software Version	EnergyPro 9.0
08	Climate Zone	12	09	Front Orientation (deg/ Cardinal)	0
10	Building Type	Single family	11	Number of Dwelling Units	1
12	Project Scope	Addition and/or Alteration	13	Number of Bedrooms	4
14	Addition Cond. Floor Area (ft²)	405	15	Number of Stories	1
16	Existing Cond. Floor Area (ft²)	1050	17	Fenestration Average U-factor	0.3
18	Total Cond. Floor Area (ft²)	1455	19	Glazing Percentage (%)	13.20%
20	ADU Bedroom Count	1			

COMPLIANCE RESULTS

01	Building Complies with Computer Performance	
02	This building incorporates features that require field testing and/or verification by a certified HERS rater under the supervision of a CEC-approved HERS provider.	
03	This building incorporates one or more Special Features shown below	

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 2)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition   **Calculation Date/Time:** 2022-12-10T21:15:04-08:00   (Page 2 of 15)

Calculation Description: Title 24 Analysis   **Input File Name:** Single Family EA+ADU-mb .ribd22x

ENERGY USE SUMMARY

Energy Use	Standard Design Source Energy (EDR1) (kBtu/ft²-yr)	Standard Design TDV Energy (EDR2) (kTDV/ft²-yr)	Proposed Design Source Energy (EDR1) (kBtu/ft²-yr)	Proposed Design TDV Energy (EDR2) (kTDV/ft²-yr)	Compliance Margin (EDR1)	Compliance Margin (EDR2)
Space Heating	0	61.99	0	52.6	0	9.39
Space Cooling	0	57.45	0	58.04	0	-0.59
IAQ Ventilation	0	1.93	0	1.95	0	-0.02
Water Heating	0	80.86	0	80.17	0	0.69
Self Utilization/Flexibility Credit						
Efficiency Compliance Total	0	202.23	0	192.76	0	9.47
Photovoltaics		0		0		
Battery				0		
Flexibility						
Indoor Lighting	0	7.6	0	7.6		
Appl. & Cooking	0	35.32	0	35.37		
Plug Loads	0	45.71	0	45.71		
Outdoor Lighting	0	1.77	0	1.77		
TOTAL COMPLIANCE	0	292.63	0	283.21		

Registration Number: **Registration Date/Time:**   **HERS Provider:**

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 3)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition   Calculation Date/Time: 2022-12-10T21:15:04-08:00   (Page 3 of 15)

Calculation Description: Title 24 Analysis   Input File Name: Single Family EA+ADU-mb .ribd22x

ENERGY USE INTENSITY

	Standard Design (kBtu/ft^2 - yr)	Proposed Design (kBtu/ft^2 - yr)	Compliance Margin (kBtu/ft^2 - yr)	Margin Percentage
Gross EUI[1]	51.25	49.29	1.96	3.82
Net EUI[2]	51.25	49.29	1.96	3.82

Notes

1. Gross EUI is Energy Use Total (not including PV) / Total Building Area.
2. Net EUI is Energy Use Total (including PV) / Total Building Area.

REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- IAQ Ventilation System: as low as 0.24 W/CFM
- Cool roof
- Ceiling has high level of insulation
- Insulation below roof deck
- Non-standard duct location (any location other than attic)
- Variable capacity heat pump compliance option (verification details from VCHP Staff report, Appendix B, and RA3)
- Electric water heater exception - Exception 2 to Section 150.1(c)8
- Point of use

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 4)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition | **Calculation Date/Time:** 2022-12-10T21:15:04-08:00 | (Page 4 of 15)
Calculation Description: Title 24 Analysis | **Input File Name:** Single Family EA+ADU-mb .ribd22x |

HERS FEATURE SUMMARY

The following is a summary of the features that must be field-verified by a certified HERS Rater as a condition for meeting the modeled energy performance for this computer analysis. Additional detail is provided in the building tables below. Registered CF2Rs and CF3Rs are required to be completed in the HERS Registry

- Indoor air quality ventilation
- Kitchen range hood
- Verified Existing Conditions
- Verified EER/EER2
- Verified SEER/SEER2
- Verified Refrigerant Charge
- Airflow in habitable rooms (SC3.1.4.1.7)
- Refrigerant Charge verification required if a refrigerant containing component is altered
- Verified HSPF
- Verified heat pump rated heating capacity
- Wall-mounted thermostat in zones greater than 150 ft2 (SC3.4.5)
- Ductless indoor units located entirely in conditioned space (SC3.1.4.1.8)
- Duct Sealing required if a duct system component, plenum, or air handling unit is altered

BUILDING - FEATURES INFORMATION

01	02	03	04	05	06	07
Project Name	Conditioned Floor Area (ft²)	Number of Dwelling Units	Number of Bedrooms	Number of Zones	Number of Ventilation Cooling Systems	Number of Water Heating Systems
Existing+Alterations+Addition	1455	1	4	2	0	2

ZONE INFORMATION

01	02	03	04	05	06	07
Zone Name	Zone Type	HVAC System Name	Zone Floor Area (ft²)	Avg. Ceiling Height	Water Heating System 1	Status
Existing Home	Conditioned	Existing FAU & A/C1	1050	9	DHW Sys 1	Existing Unchanged
New ADU	Conditioned	New Mini-Split2	405	9	DHW Sys 3	New

Registration Number: | Registration Date/Time: | HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 5)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00

Input File Name: Single Family EA+ADU-mb .ribd22x

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OPAQUE SURFACES

01	02	03	04	05	06	07	08	09	10	11
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft²)	Window and Door Area (ft2)	Tilt (deg)	Wall Exceptions	Status	Verified Existing Condition
Front: To Remain	Existing Home	R-0 Wall	0	Front	180	70	90	none	Existing	No
Left: To Remain	Existing Home	R-0 Wall	90	Left	135	0	90	none	Existing	No
Left: New	Existing Home	R-15 Wall	90	Left	135	30	90	none	New	n/a
Rear: To Remain	Existing Home	R-0 Wall	180	Back	135	20	90	none	Existing	No
Right: To Remain	Existing Home	R-0 Wall	270	Right	405	42	90	none	Existing	No
Front	New ADU	R-21 Wall	0	Front	54	0	90	Extension	New	n/a
Left	New ADU	R-15 Wall	270	Right	135	40	90	Extension	New	n/a
Rear	New ADU	R-21 Wall w/XPS	180	Back	135	35	90	none	New	n/a
Wall to Addition	Existing Home>>New ADU	R-13 Wall	n/a	n/a	120	0	n/a		New	n/a
Existing Roof: Altered 2	Existing Home	R-49 Roof Attic	n/a	n/a	1046	n/a	n/a		Altered	Yes
New Roof 2	New ADU	R-49 Roof Attic	n/a	n/a	219	n/a	n/a		New	n/a
Existing Floor: Upgraded	Existing Home	R-19 Floor Crawlspace	n/a	n/a	1050	n/a	n/a		Altered	Yes

OPAQUE SURFACES - CATHEDRAL CEILINGS

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Name	Zone	Construction	Azimuth	Orientation	Area (ft²)	Skylight Area (ft²)	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Cool Roof	Status	Verified Existing Condition	Existing Construction
Existing Roof: Altered	Existing Home	R-49 Roof Attic1	0	Front	4.1	4	4	0.2	0.85	Yes		No	
New Roof	New ADU	R-49 Roof Attic1	0	Front	6.1	6	4	0.2	0.85	Yes	New	n/a	

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 6)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition   Calculation Date/Time: 2022-12-10T21:15:04-08:00   (Page 6 of 15)
Calculation Description: Title 24 Analysis   Input File Name: Single Family EA+ADU-mb .ribd22x

ATTIC

01	02	03	04	05	06	07	08	09	10
Name	Construction	Type	Roof Rise (x in 12)	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof	Status	Verified Existing Condition
Attic Existing Home	Attic RoofExisting Home	Ventilated	4	0.2	0.85	Yes	Yes	Altered	No
Attic New ADU	Attic RoofNew ADU	Ventilated	4	0.2	0.85	Yes	Yes	New	n/a

FENESTRATION / GLAZING

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Name	Type	Surface	Orientation	Azimuth	Width (ft)	Height (ft)	Mult.	Area (ft²)	U-factor	U-factor Source	SHGC	SHGC Source	Exterior Shading	Status	Verified Existing Condition
A: Window to Remain	Window	Front: To Remain	Front	0			1	50	1.04	Table 110.6-A	0.76	Table 110.6-B	Bug Screen	Existing	No
H: New Window	Window	Left: New	Left	90			1	30	0.3	NFRC	0.23	NFRC	Bug Screen	New	NA
D: Relocated Window	Window	Rear: To Remain	Back	180			1	20	0.3	NFRC	0.23	NFRC	Bug Screen	New	NA
E2/F2/G2: Replacements	Window	Right: To Remain	Right	270			1	42	0.3	NFRC	0.23	NFRC	Bug Screen	Altered	No
I: New Window	Window	Left	Right	270			1	20	0.3	NFRC	0.23	NFRC	Bug Screen	New	NA
J: New Window	Window	Rear	Back	180			1	20	0.3	NFRC	0.23	NFRC	Bug Screen	New	NA
Skylight	Skylight	Existing Roof: Altered	Front	0			1	4	0.3	NFRC	0.23	NFRC		New	NA
Skylight 2	Skylight	New Roof	Front	0			1	6	0.3	NFRC	0.23	NFRC		New	NA

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 7)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition
Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00
Input File Name: Single Family EA+ADU-mb .ribd22x

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OPAQUE DOORS

01	02	03	04	05	06
Name	Side of Building	Area (ft²)	U-factor	Status	Verified Existing Condition
Entry Door	Front: To Remain	20	0.5	Existing	No
Door	Left	20	0.2	New	n/a
Door 2	Rear	15	0.2	New	n/a

SLAB FLOORS

01	02	03	04	05	06	07	08	09	10
Name	Zone	Area (ft²)	Perimeter (ft)	Edge Insul. R-value and Depth	Edge Insul. R-value and Depth	Carpeted Fraction	Heated	Status	Verified Existing Condition
Slab-on-Grade	New ADU	225	40	none	0	80%	No	New	n/a

OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
R-0 Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-0	None / None	0.361	Inside Finish: Gypsum Board Cavity / Frame: no insul. / 2x4 Exterior Finish: 3 Coat Stucco
R-15 Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-15	None / None	0.095	Inside Finish: Gypsum Board Cavity / Frame: R-15 / 2x4 Exterior Finish: 3 Coat Stucco
R-21 Wall	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O. C.	R-21	None / None	0.069	Inside Finish: Gypsum Board Cavity / Frame: R-21 / 2x6 Exterior Finish: 3 Coat Stucco

Registration Number:

Registration Date/Time:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 8)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

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Input File Name: Single Family EA+ADU-mb .ribd22x

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OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
R-21 Wall w/XPS	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O. C.	R-21	None / None	0.048	Inside Finish: Gypsum Board Cavity / Frame: R-21 / 2x6 Sheathing / Insulation: R-5 Sheathing Exterior Finish: 3 Coat Stucco
R-19 Roof Attic1	Cathedral Ceilings	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-19	None / None	0.057	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x4 Inside Finish: Gypsum Board
R-49 Roof Attic1	Cathedral Ceilings	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-49	/	0.018	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Radiant Barrier Cavity / Frame: R-49 / 2x4 Sheathing / Insulation: R-13 Sheathing Inside Finish: Gypsum Board
R-13 Wall	Interior Walls	Wood Framed Wall	2x4 @ 16 in. O. C.	R-13	None / None	0.092	Inside Finish: Gypsum Board Cavity / Frame: R-13 / 2x4 Other Side Finish: Gypsum Board
Attic RoofExisting Home	Attic Roofs	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-13	None / None	0.078	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-13.0 / 2x4 Around Roof Joists: R-0.0 insul.
Attic RoofNew ADU	Attic Roofs	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-13	None / None	0.078	Roofing: Light Roof (Asphalt Shingle) Roof Deck: Wood Siding/sheathing/decking Cavity / Frame: R-13.0 / 2x4 Around Roof Joists: R-0.0 insul.

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 9)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition | **Calculation Date/Time:** 2022-12-10T21:15:04-08:00 | (Page 9 of 15)

Calculation Description: Title 24 Analysis | **Input File Name:** Single Family EA+ADU-mb .ribd22x

OPAQUE SURFACE CONSTRUCTIONS

01	02	03	04	05	06	07	08
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Interior / Exterior Continuous R-value	U-factor	Assembly Layers
R-19 Floor Crawlspace	Floors Over Crawlspace	Wood Framed Floor	2x10 @ 16 in. O. C.	R-19	None / None	0.046	Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: R-19 / 2x10
R-0 Floor Crawlspace	Floors Over Crawlspace	Wood Framed Floor	2x12 @ 16 in. O. C.	R-0	None / None	0.216	Floor Surface: Carpeted Floor Deck: Wood Siding/sheathing/decking Cavity / Frame: no insul. / 2x12
R-19 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-19	None / None	0.049	Over Ceiling Joists: R-9.9 insul. Cavity / Frame: R-9.1 / 2x4 Inside Finish: Gypsum Board
R-49 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O. C.	R-49	None / None	0.02	Over Ceiling Joists: R-39.9 insul. Cavity / Frame: R-9.1 / 2x4 Inside Finish: Gypsum Board

BUILDING ENVELOPE - HERS VERIFICATION

01	02	03	04	05
Quality Insulation Installation (QII)	High R-value Spray Foam Insulation	Building Envelope Air Leakage	CFM50	CFM50
Not Required	Not Required	N/A	n/a	n/a

WATER HEATING SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
Name	System Type	Distribution Type	Water Heater Name	Number of Units	Solar Heating System	Compact Distribution	HERS Verification	Water Heater Name (#)	Status	Verified Existing Condition	Existing Water Heating System
DHW Sys 1	DHW	Standard	DHW Heater 1	1	n/a	None	n/a	DHW Heater 1 (1)	Existing	No	

Registration Number: | Registration Date/Time: | HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 10)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition   Calculation Date/Time: 2022-12-10T21:15:04-08:00   (Page 10 of 15)

Calculation Description: Title 24 Analysis   Input File Name: Single Family EA+ADU-mb .ribd22x

WATER HEATING SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
Name	System Type	Distribution Type	Water Heater Name	Number of Units	Solar Heating System	Compact Distribution	HERS Verification	Water Heater Name (#)	Status	Verified Existing Condition	Existing Water Heating System
DHW Sys 3	DHW	Point of Use	DHW Heater 3	1	n/a	None	n/a	DHW Heater 3 (1)	New	NA	

WATER HEATERS

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Name	Heating Element Type	Tank Type	# of Units	Tank Vol. (gal)	Heating Efficiency Type	Efficiency	Rated Input Type	Input Rating or Pilot	Tank Insulation R-value (Int/Ext)	Standby Loss or Recovery Eff	1st Hr. Rating or Flow Rate	Tank Location	Status	Verified Existing Condition
DHW Heater 1	Gas	Small Storage	1	50	EF	0.57	Btu/Hr	75000	0	80			Existing	No
DHW Heater 3	Electric Resistance	Consumer Instantaneous	1	1	UEF	0.98	kW	12	0	99	8		New	n/a

WATER HEATING - HERS VERIFICATION

01	02	03	04	05	06	07
Name	Pipe Insulation	Parallel Piping	Compact Distribution	Compact Distribution Type	Recirculation Control	Shower Drain Water Heat Recovery
DHW Sys 1 - 1/1	Not Required	Not Required	Not Required	None	Not Required	Not Required
DHW Sys 3 - 1/1	Not Required	Not Required	Not Required	None	Not Required	Not Required

Registration Number: Registration Date/Time: HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 11)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition
Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00
Input File Name: Single Family EA+ADU-mb .ribd22x

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SPACE CONDITIONING SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
Name	System Type	Heating Unit Name	Heating Equipment Count	Cooling Unit Name	Cooling Equipment Count	Fan Name	Distribution Name	Required Thermostat Type	Status	Verified Existing Condition	Existing HVAC System
Existing FAU & A/C1	Heating and cooling system other	Heating Component 1	1	Cooling Component 1	1	HVAC Fan 1	Air Distribution System 1	n/a	Existing	No	
New Mini-Split2	Heat pump heating cooling	Heat Pump System 2	1	Heat Pump System 2	1	n/a	n/a	Setback	New	No	

HVAC - HEATING UNIT TYPES

01	02	03	04
Name	System Type	Number of Units	Heating Efficiency
Heating Component 1	Central gas furnace	1	AFUE-80

HVAC - COOLING UNIT TYPES

01	02	03	04	05	06	07	08	09
Name	System Type	Number of Units	Efficiency Metric	Efficiency EER/EER2/CEER	Efficiency SEER/SEER2	Zonally Controlled	Mulit-speed Compressor	HERS Verification
Cooling Component 1	Central split AC	1	EER/SEER	12.2	14	Not Zonal	Single Speed	Cooling Component 1-hers-cool

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 12)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00

Input File Name: Single Family EA+ADU-mb .ribd22x

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HVAC - HEAT PUMPS

01	02	03	04	05	06	07	08	09	10	11	12	13
			Heating				Cooling					
Name	System Type	Number of Units	Efficiency Type	HSPF / HSPF2 / COP	Cap 47	Cap 17	Efficiency Type	SEER / SEER2	EER / EER / CEER	Zonally Controlled	Compressor Type	HERS Verification
Heat Pump System 2	VCHP-ductless	1	HSPF	10	24000	20000	EERSEER	16	13	Not Zonal	Single Speed	Heat Pump System 2-hers-htpump

HVAC HEAT PUMPS - HERS VERIFICATION

01	02	03	04	05	06	07	08	09
Name	Verified Airflow	Airflow Target	Verified EER/EER2	Verified SEER/SEER2	Verified Refrigerant Charge	Verified HSPF/HSPF2	Verified Heating Cap 47	Verified Heating Cap 17
Heat Pump System 2-hers-htpump	Not Required	0	Required	Required	Yes	Yes	Yes	Yes

VARIABLE CAPACITY HEAT PUMP COMPLIANCE OPTION - HERS VERIFICATION

01	02	03	04	05	06	07	08	09	10
Name	Certified Low-Static VCHP System	Airflow to Habitable Rooms	Ductless Units in Conditioned Space	Wall Mount Thermostat	Air Filter Sizing & Pressure Drop Rating	Low Leakage Ducts in Conditioned Space	Minimum Airflow per RA3.3 and SC3.3.3.4.1	Certified non-continuous Fan	Indoor Fan not Running Continuously
Heat Pump System 2	Not required	Required	Required	Required	Not required	Not required	Not required	Not required	Not required

Registration Number:

Registration Date/Time:

HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 13)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition
Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00
Input File Name: Single Family EA+ADU-mb .ribd22x

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HVAC - DISTRIBUTION SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
			Duct Ins. R-value		Duct Location		Surface Area						Verified Existing Condition	Existing Distribution system	New Ducts 25 ft
Name	Type	Design Type	Supply	Return	Supply	Return	Supply	Return	Bypass Duct	Duct Leakage	HERS Verification	Status			
Air Distribution System 1	Conditioned space-entirely	Non-Verified	R-8	R-8	Conditioned Zone	Conditioned Zone	n/a	n/a	No Bypass Duct	Existing (not specified)	Air Distribution System 1-hers-dist	Existing	No		No

HVAC - FAN SYSTEMS

01	02	03	04
Name	Type	Fan Power (Watts/CFM)	Name
HVAC Fan 1	HVAC Fan	0.45	HVAC Fan 1-hers-fan

HVAC FAN SYSTEMS - HERS VERIFICATION

01	02	03
Name	Verified Fan Watt Draw	Required Fan Efficacy (Watts/CFM)
HVAC Fan 1-hers-fan	Not Required	0

INDOOR AIR QUALITY (IAQ) FANS

01	02	03	04	05	06	07	08	09
Dwelling Unit	Airflow (CFM)	Fan Efficacy (W/CFM)	IAQ Fan Type	Includes Heat/Energy Recovery?	IAQ Recovery Effectiveness - SRE	Includes Fault Indicator Display?	HERS Verification	Status
SFam ADU IAQVentRpt 1-1	50	0.24	Exhaust	No	n/a	No	Yes	Merced/Macready Fld

Registration Number:

CA Building Energy Efficiency Standards - 2022 Residential Compliance

Registration Date/Time:

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HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 14)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

Project Name: Existing+Alterations+Addition

Calculation Description: Title 24 Analysis

Calculation Date/Time: 2022-12-10T21:15:04-08:00

Input File Name: Single Family EA+ADU-mb .ribd22x

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HERS RATER VERIFICATION OF EXISTING CONDITIONS

OPAQUE SURFACES - VERIFIED AND ALTERED

01	02	03	04	05
Name	Zone	Existing Construction	Surface Type	Total Cavity R-value
Existing Roof: Altered 2	Existing Home	R-19 Roof Attic	Wood Framed Ceiling	R-19
Existing Floor: Upgraded	Existing Home	R-0 Floor Crawlspace	Wood Framed Floor	No insulation

Dwelling Unit 1/0500.24ExhaustVentfalsen/an/a

Registration Number:

CA Building Energy Efficiency Standards – 2022 Residential Compliance

Registration Date/Time:

Report Version: 2022.0.000
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HERS Provider:

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Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 15)

CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD		
Project Name: Existing+Alterations+Addition	**Calculation Date/Time:** 2022-12-10T21:15:04-08:00	**(Page 15 of 15)**
Calculation Description: Title 24 Analysis	**Input File Name:** Single Family EA+ADU-mb .ribd22x	

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Company: **Educational Version**	Signature Date: 12/10/2022
Address:	CEA/ HERS Certification Identification (If applicable):
City/State/Zip: **CA**	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design identified on this Certificate of Compliance.
2. I certify that the energy features and performance specifications identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
3. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.

Responsible Designer Name: **Jack Smith AIA Architect**	Responsible Designer Signature:
Company: **Smith Associates**	Date Signed:
Address: **65432 Valley Road**	License:
City/State/Zip: **San Rafael, CA 94949**	Phone: **415-555-9283**

Registration Number:	Registration Date/Time:	HERS Provider:
CA Building Energy Efficiency Standards - 2022 Residential Compliance	Report Version: 2022.0.000 Schema Version: rev 20220901	Report Generated: 2022-12-10 21:16:04

Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 1)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD				NRCC-PRF-E
Nonresidential Performance Compliance Method				(Page 1 of 21)
Project Name:		Nonresidential Sample	Date Prepared:	2022-12-10

A. General Information

1	Project Name	Nonresidential Sample			
2	Run Title	Title 24 Analysis			
3	Project Location	1234 Main St.			
4	City	Sacramento	5	Standards Version	
6	Zip code	95823	7	Compliance Software (version)	EnergyPro 9.0
8	Climate Zone	12	9	Building Orientation (deg)	0
10	Building Type(s)	• Nonresidential	11	Weather File	SACRAMENTO-EXECUTIVE_STYP20.epw
12	Project Scope	• New complete scope	13	Number of Dwelling Units	0
14	Total Conditioned Floor Area in Scope (ft²)	4480	15	Total # of hotel/motel rooms	0
16	Total Unconditioned Floor Area (ft²)	1200	17	Fuel Type	Natural gas
18	Nonresidential Conditioned Floor Area	4480	19	Total # of Stories (Habitable Above Grade)	2
20	Residential Conditioned Floor Area	0			

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 2)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD					NRCC-PRF-E
Nonresidential Performance Compliance Method					(Page 2 of 21)

B1. PROJECT SUMMARY

Table B shows which building components are included in the performance calculation. If indicated as not included, the project must show compliance prescriptively if within the permit application.

		Building Components Complying via Performance				**Building Components Complying Prescriptively**	
Envelope (See Table G) Nonres	☒	Performance	Covered Process: Commercial Kitchens (see Table J)	☐	Performance	The following building components are ONLY eligible for prescriptive compliance and should be documented on the NRCC form listed if within the scope of the permit application (i.e. compliance will not be shown on the NRCC-PRF-E).	
	☐	Not Included		☒	Not Included		
Mechanical (See Table H) Nonres	☒	Performance		☐	Performance	Indoor Lighting (Unconditioned) 140.6 & 170.2(e)	NRCC-LTI-E is required
	☐	Not Included		☒	Not Included	Outdoor Lighting 140.7 & 170.2(e)	NRCC-LTO-E is required
Domestic Hot Water (See Table I) Nonres	☒	Performance	Covered Process: Laboratory Exhaust (see Table J)	☐	Performance	Sign Lighting 140.8 & 170.2(e)	NRCC-LTS-E is required
	☐	Not Included		☒	Not Included		
Lighting (Indoor Conditioned, see Table K) Nonres	☒	Performance	Electrical power systems, commissioning, solar ready, elevator and escalator requirements are mandatory and should be documented on the NRCC form listed if applicable (i.e. compliance will not be shown on the NRCC-PRF-E.)			**Building Components Complying with Mandatory Measures**	
	☐	Not Included				Electrical Power Distribution 110.11	NRCC-ELC-E is required
Solar Thermal Water Heating (See Table I3)	☐	Performance				Commissioning 120.8	NRCC-CXR-E is required
	☒	Not Included				Solarand Battery 110.10	NRCC-SAB-E is required

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 3)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 3 of 21)

C1. COMPLIANCE SUMMARY

	COMPLIES[3]		
	Time Dependent Valuaton (TDV)		Source Energy Use
	Efficiency[1] (kBtu/ft² - yr)	Total[2] (kBtu/ft² - yr)	Total[2] (kBtu/ft² - yr)
Standard Design	294.36	222.84	33.68
Proposed Design	257.56	107.16	25.95
Compliance Margins	36.8	115.68	7.73
	Pass	**Pass**	**Pass**

[1] Efficiency measures include improvements like a better building envelope and more efficient equipment
[2] Compliance Totals include efficiency, photovoltaics and batteries
[3] Building complies when efficiency and total compliance margins are greater than or equal to zero and unmet load hour limits are not exceeded

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 4)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 4 of 21)

C2. TDV ENERGY COMPLIANCE RESULTS FOR PERFORMANCE COMPONENTS (Annual TDV Energy Use, kBtu/ft^2 - yr)

COMPLIES^2

Energy Component	Standard Design (TDV)	Proposed Design (TDV)	Compliance Margin (TDV)^1
Space Heating	22.63	45.38	-22.75
Space Cooling	83.73	98.02	-14.29
Indoor Fans	92.02	30.95	61.07
Heat Rejection	0	0	0
Pumps & Misc.	0	0	0
Domestic Hot Water	48.06	44.43	3.63
Indoor Lighting	47.92	38.78	9.14
Flexibility	---	---	---
EFFICIENCY COMPLIANCE TOTAL	294.36	257.56	36.8 (12.5%)
Photovoltaics	-70.15	-144.36	74.21
Batteries	-1.37	-6.04	4.67
TOTAL COMPLIANCE	222.84	107.16	115.68 (51.9%)

^{1} Notes: This number in parenthesis following the Compliance Margin in column 4, represents the Percent Better than Standard.

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 5)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 5 of 21)

C3. TDV ENERGY RESULTS FOR NON-REGULATED COMPONENTS[1]

Non-Regulated Energy Component	Standard Design (TDV)	Proposed Design (TDV)	Compliance Margin (TDV)[1]
Receptacle	87.03	87.03	---
Process	86.49	86.49	---
Other Ltg	5.01	5.01	---
Process Motors	23.96	23.96	---
TOTAL (TOTAL COMPLIANCE + NON-REGULATED COMPONENTS)	425.33	309.65	115.68 (27.2%)

[1] Notes: This table is not used for Energy Code Compliance.

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 6)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 6 of 21)

C4. SOURCE ENERGY COMPLIANCE RESULTS FOR PERFORMANCE COMPONENTS (Annual SOURCE Energy Use, kBtu/ft² /yr)

COMPLIES²

Energy Component	Standard Design (SOURCE)	Proposed Design (SOURCE)	Compliance Margin (SOURCE)[1]
Space Heating	5.4	6.6	-1.2
Space Cooling	3.62	4.05	-0.43
Indoor Fans	8.38	2.05	6.33
Heat Rejection	0	0	0
Pumps & Misc.	0	0	0
Domestic Hot Water	15.28	16.29	-1.01
Indoor Lighting	3.98	3.36	0.62
Flexibility	---	---	---
EFFICIENCY COMPLIANCE TOTAL	36.66	32.35	4.31 (11.8%)
Photovoltaics	-2.5	-5.08	2.58
Batteries	-0.48	-1.32	0.84
TOTAL COMPLIANCE	33.68	25.95	7.73 (23%)

[1] Notes: This number in parenthesis following the Compliance Margin in column 4, represents the Percent Better than Standard.

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 7)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 7 of 21)

C5. SOURCE ENERGY RESULTS FOR NON-REGULATED COMPONENTS[1]

Non-Regulated Energy Component	Standard Design (SOURCE)	Proposed Design (SOURCE)	Compliance Margin (SOURCE)[1]
Receptacle	6.72	6.72	—
Process	7.47	7.47	—
Other Ltg	0.5	0.5	—
Process Motors	2.63	2.63	—
TOTAL (TOTAL COMPLIANCE + NON-REGULATED COMPONENTS)	51	43.27	7.73 (15.2%)

[1] Notes: This table is not used for Energy Code Compliance.

C6. 'ABOVE CODE' QUALIFICATIONS

☐ This project is pursuing CalGreen Tier 1   ☐ This project is pursuing CalGreen Tier 2

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 8)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD						NRCC-PRF-E
Nonresidential Performance Compliance Method						(Page 8 of 21)

C7. ENERGY USE SUMMARY

Energy Component	Standard Design Site (MWh)	Proposed Design Site (MWh)	Margin (MWh)	Standard Design Site (MBtu)	Proposed Design Site (MBtu)	Margin (MBtu)
Space Heating	1.5	6.5	-5	18.1	---	---
Space Cooling	9.3	10.6	-1.3	---	---	---
Indoor Fans	13.9	3.4	10.5	---	---	---
Heat Rejection	---	---	---	---	---	---
Pumps & Misc.	---	---	---	---	---	---
Domestic Hot Water	1.4	---	---	69.9	78.4	-8.5
Indoor Lighting	8.1	6.4	1.7	---	---	---
Flexibility	---	---	---	---	---	---
EFFICIENCY TOTAL	34.2	26.9	7.3	88	78.4	9.6
Photovoltaics	-16.1	-32.7	16.6	---	---	---
Batteries	0.1	0.2	-0.1	---	---	---
ENERGY USE SUBTOTAL	18.2	-5.6	23.8	88	78.4	9.6
Receptacle	15.1	15.1	0	---	---	---
Process	15	15	0	---	---	---
Other Ltg	0.8	0.8	0	---	---	---
Process Motors	3.8	3.8	0	---	---	---
ENERGY USE TOTAL	52.9	29.1	23.8	88	78.4	9.6

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 9)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD		NRCC-PRF-E
Nonresidential Performance Compliance Method		(Page 9 of 21)

C8. ENERGY USE INTENSITY (EUI)

	Standard Design (kBtu/ft² / yr)	Proposed Design (kBtu/ft² / yr)	Margin (kBtu/ft² / yr)	Margin Percentage
GROSS EUI[1]	56.94	50.93	6.01	10.55
NET EUI[1]	47.27	31.28	15.99	33.83

[1]Notes: Gross EUI is Energy Use Total (not including PV)/Total Building Area. Net EUI is Energy Use Total (including PV)/Total Building Area.

D1. EXCEPTIONAL CONDITIONS

- PrescriptiveDayLightCtrl
- ParkingGarageExhaustCheck

F1. REQUIRED PV SYSTEMS

01	02	03	04	05	06	07	08	09	10	11	12
DC System Size (kWdc)	Exception	Module Type	Array Type	Power Electronics	CFI	Azimuth (deg)	Tilt Input	Array Angle (deg)	Tilt: (x in 12)	Inverter Eff. (%)	Annual Solar Access (%)
20	n/a	Standard (14-17%)	Fixed	none	false	180	Degrees	22	4.85	96	100

F2. BATTERY SYSTEMS

01	02	03		04	05	06	07
Control	Capacity (kWh)	Charging			Discharging		Round Trip Efficiency
		Charging Efficiency	Charging Rate (kW)		Discharging Efficiency	Discharging Rate (kW)	
TOU	16	NotApplicable	5		NotApplicable	5	0.9

G1. ENVELOPE GENERAL INFORMATION (conditioned spaces only)

1	2	3	4

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 10)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD			NRCC-PRF-E
Nonresidential Performance Compliance Method			(Page 10 of 21)

G1. ENVELOPE GENERAL INFORMATION (conditioned spaces only)

Opaque Surfaces & Orientation	Total Gross Surface Area (ft²)	Total Fenestration Area (ft²)	Window to Wall Ratio (%)
North-Facing[1]	800	320	40
East-Facing[2]	1040	320	30.77
South-Facing[3]	2000	260	13
West-Facing[4]	720	0	0
Total	4560	900	19.74
Roof	2880	0	0

Notes

[1]North-Facing is oriented to within 45 degrees of true north, including 45 00'00" east of north (NE), but excluding 45 00'00" west of north (NW),
[2]East-Facing is oriented to within 45 degrees of true east, including 45 00'00" south of east (SE), but excluding 45 00'00" north of east (NE),
[3]South-Facing is oriented to within 45 degrees of true south, including 45 00'00" west of south (SW), but excluding 45 00'00" east of south (SE),
[4]West-Facing is oriented to within 45 degrees of true west, including 45 00'00" north of west (NW), but excluding 45 00'00" south of west (SW),

G4. NONRESIDENTIAL AIR BARRIER

01	02
Building Story Name	Air Barrier
Com-Floor 1	No air barrier
Com-Floor 2	No air barrier

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 11)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD									NRCC-PRF-E
Nonresidential Performance Compliance Method									(Page 11 of 21)

G5. OPAQUE SURFACE ASSEMBLY SUMMARY

01	02	03	04	05	06		07	08	09	10
Surface Name		Area (ft²)	Framing Type	Cavity R-Value	Continuous R-Value		Units	Value	Description of Assembly Layers	Status[1]
					Interior	Exterior				
R-13 Wall10	Exterior Wall	4,560	Wood	13	N/A	N/A	U-factor	0.1015	Stucco - 7/8 in. Vapor permeable felt - 1/8 in. Composite-1 Gypsum Board - 1/2 in.	N
Slab On Grade16	Underground Floor	4,400	N/A	0	N/A	N/A	F-factor	0.73	Slab Type =Unheated slab on grade Insulation Orientation =None Insulation R-Value =none	N
R-13 Wall101	Interior Wall	200	Wood	13	N/A	N/A	U-factor	0.0952	Stucco - 7/8 in. Vapor permeable felt - 1/8 in. Composite-1 Gypsum Board - 1/2 in.	N
R-30 Roof Attic25	Roof	3,680	Wood	30	N/A	N/A	U-factor	0.0383	AsphaltShingles0_25In Vapor permeable felt - 1/8 in. Plywood - 1/2 in. Air - Cavity - Wall Roof Ceiling - 4 in. or more Composite-2 Gypsum Board - 1/2 in.	N
R-0 Floor No Crawlspace52	Interior Floor	1,280	N/A	0	N/A	N/A	U-factor	0.1832	Air - Cavity - Wall Roof Ceiling - 4 in. or more Plywood - 1/2 in. Carpet - 3/4 in.	N

[1] Status: N - New, A - Altered, E - Existing

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 12)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD — NRCC-PRF-E

Nonresidential Performance Compliance Method — (Page 12 of 21)

G6A. OPAQUE DOOR SUMMARY (NONRESIDENTIAL)

01	02	03	04
Assembly Name	Area (ft²)	Overall U-factor	Status¹
Wood Door37	24	0.5	N

G7A. FENESTRATION ASSEMBLY SUMMARY (NONRESIDENTIAL)

01	02	03	04	05	06	07	08	09
Fenestration Assembly Name	Fenestration Type/ Product Type / Frame Type	Certification Method¹	Assembly Method	Area (ft²)	Overall U-factor	Overall SHGC	Overall VT	Status²
Double Metal Tinted	Vertical fenestration Fixed window Metal	Default 110.6	Site built	900	0.71	0.6	0.77	New

G8. OVERHANG DETAILS

01	02	03	04	05	06	07
Fenestration Tag/ ID	Azimuth	Depth (ft)	Height from Top of Sill to Overhang (ft)	Right Extent (ft)	Left Extent (ft)	Flap Height
East Windows14	90	6	8.1	6	6	N/A
East Windows32	90	6	8.1	6	6	N/A
South Windows34	180	6	8.1	6	6	N/A
South Windows49	180	6	5.1	6	6	N/A

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Nonresidential Performance Compliance Method | (Page 13 of 21)

H1. DRY SYSTEM EQUIPMENT (FURNACES, AIR HANDLING UNITS, HEAT PUMPS, VRF, ECONOMIZERS ETC.)

01	02	03	04	05	06	07	08	09	10	11	12
			Heating				Cooling				
Equipment Name	Equipment Type	Qty	Total Heating Output (kBtu/h)	Supp Heat Output (kBtu/h)	Efficiency Unit	Efficiency	Total Cooling Output (kBtu/h)	Efficiency Unit	Efficiency	Economizer Type (if present)	Status[1]
Retail Mech. System	Package SZ VAV Heat Pump Air System	1	95.3	0	COP	3.4	95.3	EER	13	Differential DB	N
Office Mech System	Package SZ VAV Heat Pump Air System	1	63.32	0	COP	3.4	63.32	EER	13	Differential DB	N
Restaurant Mech Sys.	Package SZ VAV Heat Pump Air System	1	154.56	0	COP	3.4	154.56	EER	13	Differential DB	N

[1] Status: N - New, A - Altered, E - Existing

H3. NONRESIDENTIAL / COMMON USE AREA FAN SYSTEMS SUMMARY

01	02	03	04	05	06	07	08	09	10	11	12	13
		Design OA CFM	Supply Fan				Return / Relief Fan					Status[1]
Name or Item Tag	Qty		CFM	Power	Power Units	Control	Fan Type	CFM	Power	Power Units	Control	
Retail Mech. System	1	256	2,400	1.2	BHP	VSD	N/A	N/A	N/A	N/A	N/A	N
Office Mech System	1	288	2,400	1.14	BHP	VSD	N/A	N/A	N/A	N/A	N/A	N
Restaurant Mech Sys.	1	640	5,000	3.04	BHP	VSD	N/A	N/A	N/A	N/A	N/A	N

[1] Status: N - New, A - Altered, E - Existing

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 14)

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H5. GENERAL EXHAUST FAN SUMMARY

1	2	3	4	5	6	7	8
System ID	Zone Name	Qty	CFM	PowerPowerPower	Power Units	Continuous Operation?	Status[1]
Retail Zone3	1-Retail Zone	2	50	0.02	0.4	1.89	New
Parking Garage18	2-Parking Garage	1	1000	0.5	0.44	2.06	New
Office Zone26	3-Office Zone	2	75	0.02	0.27	1.26	New
Restaurant Zone39	4-Restaurant Zone	2	70	0.02	0.29	1.35	New

[1] Status: N - New, A - Altered, E - Existing

H8. SYSTEM SPECIAL FEATURES

1	2	3	4
System Name	Equipment Type	Interlocks per 140.4(n)[1]	Other Special Features and Controls
Retail Mech. System	Package SZ VAV Heat Pump Air System	N/A	Zone(s) With CO2 Sensor Vent. Control Differential DB
Office Mech System	Package SZ VAV Heat Pump Air System	N/A	Differential DB
Restaurant Mech Sys.	Package SZ VAV Heat Pump Air System	N/A	Zone(s) With CO2 Sensor Vent. Control Differential DB
Plant - DHW1 - SHW	Service Hot Water	N/A	Fixed Temperature Control

Notes: This table includes controls related to the performance path only. For projects using the prescriptive path, mandatory and prescriptive controls requirements are documented on the NRCC-MCH-E.

[1] Yes = interlocks are provided, No = interlocks are not provided, NA means no operable openings.

H9. NONRESIDENTIAL / COMMON USE AREA & HOTEL/MOTEL VENTILATION

1	2	3	4	5	6	7
Zone Name	Mechanical Ventilation				Conditioned Area (sf)	DCV or Occupant Sensor Controls, or Both
	Ventilation Function	# of People# of People	Supply OA CFM	Exhaust CFM		
1-Retail Zone	Retail - Sales	10.67	256	100	1280	DCV
3-Office Zone	Office - Office space	9.6	288	150	1920	N/A

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H9. NONRESIDENTIAL / COMMON USE AREA & HOTEL/MOTEL VENTILATION

1	2		3	4	5	6	7
Zone Name	Mechanical Ventilation					Conditioned Area (sf)	DCV or Occupant Sensor Controls, or Both
	Ventilation Function	# of People# of People		Supply OA CFM	Exhaust CFM		
4-Restaurant Zone	Food Service - Bars, cocktail lounges	50		640	140	1280	DCV

H11. ZONAL SYSTEM AND TERMINAL UNIT SUMMARY

01	02	03	04	05	06	07	08	09	10	11	12
System ID	System Type	Qty	Rated Capacity (kBtuh)		Airflow (cfm)			Fan			VSD
			Heating	Cooling	Design	Min.	Min. Ratio	Power	Power Units	Cycles	
1-Retail Zone-Trm	Variable Air Volume No Reheat Box	1	N/A	N/A	2,400	600	0.25	1.2	BHP	N/A	Variable Speed
3-Office Zone-Trm	Variable Air Volume No Reheat Box	1	N/A	N/A	2,400	600	0.25	1.14	BHP	N/A	Variable Speed
4-Restaurant Zone-Trm	Variable Air Volume No Reheat Box	1	N/A	N/A	5,000	1,200	0.24	3.04	BHP	N/A	Variable Speed

I1. WATER HEATER EQUIPMENT SUMMARY

01	02	03	04	05	06	07	08	09	10	11	12	13	14
Name	Heater Element Type	Tank Type	Qty	Tank Vol (gal)	Rated Input	Rated Input Unit	Efficiency	Efficiency Unit	Tank Insulation R-value Int/Ext	Standby Loss Fraction	1st Hr. Rating or Flow Rate (gal)	Heat Pump Type	Tank Location or Ambient Condition
Standard Gas 50 gal or Le2	Natural Gas	Storage	1	50	40	kBtu/Hr	kBtu/Hr	UEF	N/A	N/A	80	N/A	N/A

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 16)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD					NRCC-PRF-E
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J1. ENCLOSED PARKING GARAGE

1	2	3	4	5
Garage Exhaust System Name	Design Exhaust Flow Rate (cfm)	Minimum Exhaust Flow Rate (cfm)	Fan Power (Watts)	CO Control Yes/No
Parking Garage18	1000	0	0.44	NO

K1. INDOOR CONDITIONED LIGHTING GENERAL INFO

01	02	03	04	05	06
				Additional (Custom) Allowance	
Occupancy Type[1]	Conditioned Floor Area[2] (ft^2)	Installed Lighting Power (Watts)	Lighting Control Credits (Watts)	Area Category Footnotes (Watts)	Area Category Footnotes (Watts)
Dining - Bar/Fine	1280	720	0	0	0
Office (250 square feet)	1920	756	0	0	0
Retail Merchandise Sales	1280	560	0	0	0
Building Totals:	4480	2036	0	0	0

[1]See Table 140.6-C
[2]See NRCC-LTI–E for unconditioned spaces
[3]Lighting information for existing spaces modeled is not included in this table

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 17)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD		NRCC-PRF-E
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K2. INDOOR CONDITIONED LIGHTING SCHEDULE

Luminaire Schedule (includes all permanent installed lighting in conditioned space, and portable lighting over 0.3 w/ft² in offices)

01	02	03	04	05	06
			Installed Watts (Conditioned)		
Name or Item Tag	Complete Luminaire Description (i.e. 3-lamp fluorescent troffer, F32T8, one dimmable electronic ballast)	Watts per luminaire	How is Wattage determined	Total Number of Luminaires	Installed Watts
F-1	Suspended LED	28	According to	20	560
A-1	Suspended LED	28	According to	27	756
D-1	LED Can	12	According to	10	120
F-2	Standard Track	300	According to	2	600

¹If lighting power densities were used in the compliance model Building Departments will need to check prescriptive forms for Luminaire Schedule details.

K3. INDOOR CONDITIONED LIGHTING CONTROL CREDITS

Lighting Control Credits Schedule (includes all lighting controls installed in conditioned space for compliance credit per 140.6(a)2 and Table 140.6-A)

01	02	03	04	05	06	07	08	09
Area Description	Primary Function Area (must meet requirements of Table 140.6-A and 170.2-L)	Type of Lighting Control	Power Adjustment Factor (PAF)	Luminaire Item Tag	Watts per Luminaire	# of Luminaires	Lighting Controlled (Watts)	Control Credit (Watts)
S-1-Retail Zone	Retail Merchandise Sales			F-1	28	20	560	0
S-3-Office Zone	Office (250 square feet)			A-1	28	27	756	0
S-4-Restaurant Zone	Dining - Bar/Fine			D-1	12	10	120	0
S-4-Restaurant Zone	Dining - Bar/Fine			F-2	300	2	600	0
					Lighting Control Credits (Conditioned) Total (Watts)			0

K4. INDOOR CONDITIONED LIGHTING MANDATORY LIGHTING CONTROL

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 18)

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Nonresidential Performance Compliance Method (Page 18 of 21)

1			2			
Required			Required			

3	4	5	6	7	8	9
Offices	Office250FtOrLess	Required	Required	Required	Required	Required
Retail Space	RetailSalesArea	Required	Required	Required	Required	Required
Restaurant	BarLoungeFineDiningArea	Required	Required	Required	Required	Required

L. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Selections made by Documentation Author indicate which Certificates of Installation must be submitted for the features to be recognized for compliance. These documents must be retained and provided to the building inspector during construction and can be found online

Building Component	Form/Title
Envelope	NRCI-ENV-01-E - Must be submitted for all buildings
Envelope	NRCI-ENV-E - Envelope (for all buildings)
Mechanical	NRCI-MCH-01-E - Must be submitted for all buildings
Mechanical	NRCI-MCH-E - For all buildings with Mechanical Systems
Plumbing	NRCI-PLB-01-E - Must be submitted for all buildings
Plumbing	NRCI-PLB-E - For all buildings with Plumbing Systems
Indoor Lighting	NRCI-LTI-01-E - Must be submitted for all buildings
Indoor Lighting	NRCI-LTI-E - Indoor Lighting (for all buildings)
Covered Process	NRCI-PRC-01-E - Must be submitted for all Covered Processes

M. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Selections made by Documentation Author indicate which Certificates of Acceptance must be submitted for the features to be recognized for compliance. These documents must be provided to the building inspector during construction and must be completed through an Acceptance Test Technician Certificaiton Provider (ATTCP). For more information visit: https://www.energy.ca.gov/title24/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/

Building Component	Form/Title
Envelope	NRCA-ENV-02-F - NRFC label verification for fenestration
Indoor Lighting	NRCA-LTI-02-A - Occupancy Sensors and Automatic Time Switch Controls.

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 19)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD	NRCC-PRF-E
Nonresidential Performance Compliance Method	(Page 19 of 21)

M. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Selections made by Documentation Author indicate which Certificates of Acceptance must be submitted for the features to be recognized for compliance. These documents must be provided to the building inspector during construction and must be completed through an Acceptance Test Technician Certificaiton Provider (ATTCP). For more information visit: https://www.energy.ca.gov/title24/2019standards/2019_compliance_documents/Nonresidential_Documents/NRCA/

Building Component	Form/Title
Indoor Lighting	NRCA-LTI-03-A - Automatic Daylight Controls.
Covered Process	NRCA-PRC-03-F Garage Exhaust
Covered Process	NRCA-PRC-12-F Elevator Lighting & Ventilation Controls
Covered Process	NRCA-PRC-13-F Escalators & Moving Walkways Speed Controls
Mechanical	NRCA-MCH-02-A - Outdoor Air must be submitted for all newly installed HVAC units. Note: MCH-02-A can be performed in conjunction with MCH-07-A Supply Fan VFD Acceptance (if applicable) since testing activities overlap
Mechanical	NRCA-MCH-05-A - Air Economizer Controls
Mechanical	NRCA-MCH-06-A Demand Control Ventilation Systems must be submitted for all systems required to employ demand controlled ventilation (refer to) can vary outside ventilation flow rates based on maintaining interior carbon dioxide (CO2) concentration setpoints.
Mechanical	NRCA-MCH-07-A Supply Fan Variable Flow Controls
Mechanical	NRCA-MCH-12-A FDD for Packaged Direct Expansion Units
Mechanical	NRCA-MCH-21-H Multifamily Envelope

N. DECLARATION OF REQUIRED CERTIFICATES OF VERIFICATION

Selections made by Documentation Author indicate which Certificates of Verification must be submitted for the features to be recognized for compliance. These documents must be retained and provided to the building inspector during construction and can be found online

Building Component	Form/Title
Mechanical	NRCV-MCH-24 Enclosure Air Leakaage

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 20)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD	NRCC-PRF-E
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Documentation Author's Declaration Statement

1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Company: Educational Version	Signature Date:
Address:	CEA/HERS Certification Identification (if applicable):
City/State/Zip: ,	Phone:

Responsible Person's Declaration statement

2. I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer)
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I understand that a registered copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections, and I will take the necessary steps to accomplish this requirement.
6. I understand that a registered copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy, and I will take the necessary steps to accomplish these requirements.

Responsible Designer Name: Michael Gray	Responsible Designer Signature:	
Company: Architectural Services		
Address: 440 Yuba Dr. Suite C	Date Signed:	
City/State/Zip: Sacramento, CA 95833	License #: C12344	
Phone: (916) 555-5678	Title:	Scope:
Responsible Designer Name: Alan Lux	Responsible Designer Signature:	
Company: Luminaire Design		
Address: 3030 Pine	Date Signed:	
City/State/Zip: Los Altos, CA 92334	License #: KS-3345	
Phone: (916) 555-4321	Title:	Scope:

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Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 21)

CERTIFICATE OF COMPLIANCE - NONRESIDENTIAL PERFORMANCE COMPLIANCE METHOD		NRCC-PRF-E
Nonresidential Performance Compliance Method		(Page 21 of 21)

Responsible Designer Name: Robert Harper, P.E	Responsible Designer Signature:	
Company: Harper Associates		
Address: 4519 E. Hwy 20	Date Signed:	
City/State/Zip: Sacramento, CA 98776	License #: ML-2039	
Phone: (916) 555-9245	Title:	Scope:

Not Authorized for Compliance

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Appendix 3: Form NRCC-LTO-E Sample – Outdoor Lighting (Page 1)

STATE OF CALIFORNIA
Outdoor Lighting   CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE				NRCC-LTO-E

This document is used to demonstrate compliance with requirements in 110.9, 130.0, 130.2, 140.7, and 141.0(b)2L for outdoor lighting scopes using the prescriptive path for nonresidential and hotel/motel occupancies. It is also used to document compliance with requirements in 160.5, 170.2(e)6, 180.1(a) and 180.2(b)4Bv for outdoor lighting scopes using the prescriptive path for multifamily and mixed-use occupancies. Multifamily includes dormitory and senior living facilities.

Project Name:	Outdoor Lighting Example	Report Page:	(Page 1 of 12)
Project Address:	45 West Grand	Date Prepared:	12/11/2022

A. GENERAL INFORMATION

01	Project Location (city)	Aliso Viejo	04	Total Illuminated Hardscape Area (ft²)	31000
02	Climate Zone	8			

03 Outdoor Lighting Zone per Title 24 Part 1 10.114 or as designated by Authority Having Jurisdiction (AHJ):

☐ LZ-0: Very Low - Undeveloped Parkland	☐ LZ-2: Moderate - Urban Clusters	☐ LZ-4: High - Must be reviewed by CA Energy Commission for Approval
☐ LZ-1: Low - Rural Areas	☒ LZ-3: Moderately High - Urban Areas	

05 Occupancy Types within Project

● All Other Occupancies

B. PROJECT SCOPE

This table includes outdoor lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.7 / 170.2(e)6 or 141.0(b)2L / 180.2(b)4Bv for alterations.

My Project Consists of:

01		02		
☒ New Lighting System		Must Comply with Allowances from 140.7 / 170.2(e)6		
☐ Altered Lighting System		Is your alteration increasing the connected lighting load (Watts)? ○ Yes ○ No		
03		04		05
% of Existing Luminaires Being Altered¹		Sum Total of Luminaires Being Added or Altered		Calculation Method
☐ < 10% ☐ >= 10% and < 50% ☐ >= 50%				

Please proceed to Table F. Outdoor Lighting Fixture Schedule to define the project's luminaires.

¹ FOOTNOTES: % of Existing Luminaires Being Altered = (Sum Total of Luminaires Being Added or Altered / Existing Luminaires within the Scope of the Permit Application) x 100.

Registration Number:	Generated Date/Time:	Documentation Software: EnergyPro
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Appendix 3: Form NRCC-LTO-E Sample – Outdoor Lighting (Page 2)

STATE OF CALIFORNIA
Outdoor Lighting   CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Outdoor Lighting Example	Report Page:	(Page 2 of 12)
Project Address:	45 West Grand	Date Prepared:	12/11/2022

C. COMPLIANCE RESULTS

Results in this table are automatically calculated from data input and calculations in Tables F through N. Note: If any cell on this table says "COMPLIES with Exceptional Conditions" refer to Table D. Exceptional Conditions for guidance or see applicable Table referenced below.

Calculations of Total Allowed Lighting Power (Watts) 140.7 / 170.2(e)6 or 141.0(b)2L / 180.2(b)4Bv											Compliance Results		
01		02		03		04		05		06		07		08	09
General Hardscape Allowance 140.7(d)1 / 170.2(e)6 (See Table I)	+	Per Application 140.7(d)2 / 170.2(e)6 (See Table J)	+	Sales Frontage 140.7(d)2 (See Table K)	+	Ornamental 140.7(d)2 / 170.2(e)6 (See Table L)	+	Per Specific Area 140.7(d)2 / 170.2(e)6 (See Table M)	OR	Existing Power Allowance 141.0(b)2L / 180.2(b)4Bv (See Table N)	=	Total Allowed (Watts)	≥	Total Actual (Watts)	07 must be >= 08
1,321	+	239	+	400	+	80	+	1,852.5	OR	---	=	3,892	≥	3,464	COMPLIES
Shielding Compliance (See Table G for Details)															COMPLIES
Controls Compliance (See Table H for Details)															COMPLIES

D. EXCEPTIONAL CONDITIONS

This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.

E. ADDITIONAL REMARKS

This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.

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Appendix 3: Form NRCC-LTO-E Sample – Outdoor Lighting (Page 3)

STATE OF CALIFORNIA
Outdoor Lighting   CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE			NRCC-LTO-E
Project Name:	Outdoor Lighting Example	Report Page:	(Page 3 of 12)
Project Address:	45 West Grand	Date Prepared:	12/11/2022

F. OUTDOOR LIGHTING FIXTURE SCHEDULE

For new or altered lighting systems demonstrating compliance with 140.7 / 170.2(e)6 all new luminaires being installed and any existing luminaires remaining or being moved within the spaces covered by the permit application are included in the Table below. For altered lighting systems using the Existing Power method per 141.0(b)2L only new luminaires being installed and replacement luminaires being installed as part of the project scope are included (ie, existing luminaires remaining or existing luminaires being moved are not included). Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

Designed Wattage:

01	02		03	04	05	06	07	08	09	10	
Name or Item Tag	Complete Luminaire Description		Watts per luminaire[1,2]	How is Wattage determined	Total Number Luminaires[2]	Luminaire Status[3]	Excluded per 140.7(a) / 170.2(e)6A	Design Watts	Cutoff Req. > 6,200 initial lumen output 130.2(b) / 160.5(c)1[4]	Field Inspector	
										Pass	Fail
F-1	50w High Pressure Sodium	☐ Linear	66	Mfr. Spec	13	New	☐	858	NA: < 6200 lumens	☐	☐
F-2	40 W LED	☐ Linear	40	Mfr. Spec	33	New	☐	1,320	Provided	☐	☐
F-3	40 W LED	☐ Linear	40	Mfr. Spec	10	New	☐	400	Provided	☐	☐
F-3A	1 Lamp 10w Compact 2D	☐ Linear	16	Mfr. Spec	5	New	☐	80	NA: < 6200 lumens	☐	☐
F-3B	2 Lamp 10w Compact 2D Elec	☐ Linear	26	Mfr. Spec	3	New	☐	78	NA: < 6200 lumens	☐	☐
F-4	30 watt LED	☐ Linear	30	Mfr. Spec	12	New	☐	360	NA: < 6200 lumens	☐	☐
F-5	1 Lamp 42w Compact Trip/Quad 4pin Elec	☐ Linear	46	Mfr. Spec	8	New	☐	368	NA: < 6200 lumens	☐	☐
R-1	75w Low Voltage Halogen	☐ Linear	80	Mfr. Spec	12	New	☒	---	NA: < 6200 lumens	☐	☐
						Total Design Watts:		3464			

* NOTES: Selections with a * require a note in the space below explaining how compliance is achieved.
EX: Luminaire is lighting a statue; EXCEPTION 2 to 130.2(b)

[1]FOOTNOTES: Authority Having Jurisdiction may ask for Luminaire cut sheets to confirm wattage used for compliance per 130.0(c) / 160.5(b)

[2] For linear luminaires, wattage should be indicated as W/lf instead of Watts/luminaire. Total linear feet should be indicated in column 05 instead of number of luminaires.

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Appendix 3: Form NRCC-LTO-E Sample – Outdoor Lighting (Page 4)

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Outdoor Lighting   CALIFORNIA ENERGY COMMISSION

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F. OUTDOOR LIGHTING FIXTURE SCHEDULE

For new or altered lighting systems demonstrating compliance with 140.7 / 170.2(e)6 all new luminaires being installed and any existing luminaires remaining or being moved within the spaces covered by the permit application are included in the Table below. For altered lighting systems using the Existing Power method per 141.0(b)2L only new luminaires being installed and replacement luminaires being installed as part of the project scope are included (ie, existing luminaires remaining or existing luminaires being moved are not included). Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

Designed Wattage:

01	02	03	04	05	06	07	08	09	10

[3] Select "New" for new luminaires in a new outdoor lighting project, or for added luminaires in an alteration. Select "Altered" for replacement luminaires in an alteration. Select "Existing to Remain" for existing luminaires within the project scope that are not being altered and are remaining. Select "Existing Reinstalled" for existing luminaires which are being removed and reinstalled as part of the project scope.

[4] Compliance with mandatory shielding requirements is required for luminaires with initial lumen output >= 6,200 unless exempted by 130.2(b)/ 160.5(c)

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G. SHIELDING REQUIREMENTS (BUG)

This table includes fixtures of >=6,200 initial lumens indicated on Table F as needing to comply with Shielding Requirements. Maximum lumens can be found in Title 24, Part 11, Section 5.106.8.

01	02	03	04	05	06	07	08	09	10	11	12	
		Backlight Rating[2]			Uplight Rating[2]			Glare Rating (Lumens)[2]			Field Inspector	
Name or Item Tag	Complete Luminaire Description	Mounting Height[1]	Max Allowable Backlight Rating[3]	Backlight Rating Per Design	Lighting type	Max Allowable Uplight Rating[3]	Uplight Rating Per Design	Mounting Height[1]	Max Allowable Glare Rating[3]	Glare Rating Per Design	Pass	Fail
F-3	40 W LED	2 MH from property line	No Limit	B0	All other outdoor lighting, including decorative	U3	U0	2 MH from property line	G3	G0	☐	☐
F-2	40 W LED	2 MH from property line	No Limit	B0	All other outdoor lighting, including decorative	U3	U0	2 MH from property line	G3	G0	☐	☐
F-2	40 W LED	2 MH from property line	No Limit	B0	All other outdoor lighting, including decorative	U3	U0	2 MH from property line	G3	G0	☐	☐

[1] FOOTNOTES: Mounting Height is labeled MH in this table.

[2] Authority Having Jurisdiction may ask for Luminaire cut sheets or other documentation to confirm luminaire type, uplight ratings and glare ratings used for compliance per 130.2(b)/ 160.5(c)

[3] BUG ratings with a lower number than the 'Max Allowable' are compliant. Ex. If Max Allowable is Bug Rating B4, then B0, B1, B2 and B3 are all compliant.

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H. OUTDOOR LIGHTING CONTROLS

This table demonstrates compliance with controls requirements for all new or altered luminaires installed as part of the permit application. For alteration projects, luminaires which are existing to remain (ie untouched) and luminaires which are removed and reinstalled (wiring only) do not need to be included in this table even if they are within the spaces covered by the permit application.
Outdoor lighting for nonresidential buildings, parking garages and common service areas in multifamily buildings must be documented separately from outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit

Mandatory Controls for Nonresidential Occupancies, Parking Garages & Common Areas in Multifamily Buildings

01	02	03	04	05	
Area Description	Shut-Off 130.2(c)1 / 160.5(c)	Auto-Schedule 130.2(c)2 / 160.5(c)	Motion Sensor 130.2(c)3 / 160.5(c)	Field Inspector	
				Pass	Fail
Electrical Panel	Photocontrol	Provided	Provided	☐	☐
Parking Lot Lights	Photocontrol	Provided	Provided	☐	☐
Sales Lot Lighting	Photocontrol	Provided	Provided	☐	☐

[1]FOOTNOTE: Text has been abbreviated, please refer to Table 160.5-A to confirm compliance with the specific light source technologies listed.
[2]Authority having jurisdiction may ask for cutsheets or other documentation to confirm compliance of light source.
[3]Recessed luminaires marked for use in fire-rated installations, and recessed luminaires installed in non-insulated ceilings are excepted from ii and iii.

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I. LIGHTING POWER ALLOWANCE (per 140.7 / 170.2(e))

This table includes areas using allowance calculations per 140.7 / 170.2(e). General Hardscape Allowance is per Table 140.7-A/Table 170.2-R while "Use it or lose it" Allowances are per Table 140.7-B /Table 170.2-S. Indicate which allowances are being used to expand sections for user input. Luminaires that qualify for one of the "Use it or lose it" allowances shall not qualify for another "Use it or lose it" allowance. Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

	01				
		"Use it or lose it" Allowance (select all that apply) (select all that apply)			
☒ General Hardscape Allowance Table I (below)	☒ Per Application Table J	☒ Sales Frontage Table K	☒ Ornamental Table L	☒ Per Specific Area Table M

Calculated General Hardscape Lighting Power Allowance per Table 140.7-A for Nonresidential & Hotel/Motel

02	03	04	05	06	07	08	09
	Area Wattage Allowance (AWA)			Linear Wattage Allowance (LWA)			Total General
Area Description	Illuminated Area (ft²)	Allowed Density (W/ft²)	Area Allowance (Watts)	Perimeter Length (lf)	Allowed Density (W/lf)	Linear Allowance (Watts)	AWA + LWA (Watts)
Plaza	6000	0.021	126	300	0.2	60	186
Office Parking Lot	15000	0.021	315	1200	0.2	240	555
Front Driveway	10000	0.021	210	600	0.2	120	330
						Initial Wattage Allowance for Entire Site (Watts):	250
						Instances of Initial Wattage Allowance (LZ 0 only)[1]	
						Total General Hardscape Allowance (Watts):	1321

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J. LIGHTING ALLOWANCE: PER APPLICATION

This table includes areas using the wattage allowance per application from Table 140.7-B / Table 170.2-S.

01	02	03	04	05	06	07	08	09	10
		CALCULATED ALLOWANCE (Watts)			DESIGN WATTS				Additional Allowance (Watts)
Area Description	Application per Table 140.7-B[1]	# of Locations	Allowance per Location[2]	Extra Allowance (Watts)	Luminaire Name or Item Tag	Watts per Luminaire	# of Luminaires	Design Watts	
Gas Pumps	Uncovered Fuel Dispenser	2	81	162	F-4	30	4	120	120
						Total Design Watts for this Area:		120	
Service Window	Drive up Window	2	50	100	F-1	66	3	198	100
						Total Design Watts for this Area:		198	
Building Entrance	Building Entrance/Exit	1	19	19	F-1	66	1	66	19
						Total Design Watts for this Area:		66	
						Total Allowance (Watts) All Areas:			239

[1] FOOTNOTES: Primary entrance applications are only available for senior care facilities, healthcare facilities, police stations, hospitals, fire stations, and emergency vehicle facilities.

[2] The Allowance per Location for ATMs is 100W for the first ATM and 35W for each additional per Table 140.7-B /Table 170.2-S.

[3] For luminaires indicated in Table F as linear, wattage in column 07 is W/lf instead of Watts/luminaire. Total linear feet should be indicated in column 08 instead of number of luminaires.

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K. LIGHTING ALLOWANCE: SALES FRONTAGE

The table includes areas using wattage allowance for Outdoor Sales Frontage from Table-140.7-B. This allowance may be used for one or two frontage sides per site.

01	02	03	04	05	06	07	08	09
	CALCULATED ALLOWANCE(Watts)			DESIGN WATTS				Additional Allowance (Watts)
Area Description	Linear ft. of Sales Frontage (lf)	Allowed Density (W/lf)	Extra Allowance (Watts)	Luminaire Name or Item Tag	Watts per Luminaire	# of Luminaires	Design Watts	
Sales Frontage	150	19	2,850	F-3	40	10	400	400
					Total Design Watts for this Area:		400	
					Total Allowance (Watts) All Areas:			400

[1]FOOTNOTES: For luminaires indicated in Table F as linear, wattage in column 06 is W/lf instead of Watts/luminaire. Total linear feet should be indicated in column 07 instead of number of luminaires.

L. LIGHTING ALLOWANCE: ORNAMENTAL

This table includes all ornamental luminaires within the scope of the permit application to calculate the allowance per Table-140.7-B /Table 170.2-S.

01	02	03	04	05	06	07	08	09
	CALCULATED ALLOWANCE(Watts)			DESIGN WATTS				Additional Allowance (Watts)
Area Description	Illuminated Area (ft²)	Allowed Density (W/ft²)	Extra Allowance (Watts)	Luminaire Name or Item Tag	Watts per Luminaire[1]	# of Luminaires	Design Watts	
Total Illuminated Hardscape Area for Site	31,000	0	403	F-3A	16	5	80	80
					Total Design Watts for this Area:		80	
					Total Allowance (Watts) Ornamental:			80

[1]FOOTNOTES: Luminaires qualifying for this allowance shall be rated <= 50 W and shall be post-top luminaires, lanterns, pendants or chandeliers.

[2] For luminaires indicated in Table F as linear, wattage in column 06 is W/lf instead of Watts/luminaire. Total linear feet should be indicated in column 07 instead of number of luminaires.

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M. LIGHTING ALLOWANCE: PER SPECIFIC AREA

This table includes areas using the wattage allowance per specific area from Table 140.7-B /Table 170.2-S. More than one specific area allowance may be taken in a single project, if applicable. However, multiple specific area allowances may not be taken for the exact same area on the site.

01	02	03	04	05	06	07	08	09	10
			CALCULATED ALLOWANCE (Watts)			DESIGN WATTS			Additional Allowance (Watts)
Area Description	Specific Area Type per Table 140.7-B	Specific Area (ft²)¹	Allowed Density (W/ft²)	Extra Allowance (Watts)	Luminaire Name or Item Tag	Watts per Luminaire	# of Luminaires	Design Watts	
Auto Sales Lot	SalesLot	12000	0.3	3360	F-2	40	32	1,280	1280
					Total Design Watts for this Area:			1280	
Service Canopy	NonSalesCanopy	5000	0.3	1350	F-4	30	8	240	240
					Total Design Watts for this Area:			240	
Building Facade	BuildingFacade	1000	0.2	170	F-5	46	8	368	170
					Total Design Watts for this Area:			368	
Guardhouse	GuardStation	500	0.3	162.5	F-1	66	3	198	162.5
					Total Design Watts for this Area:			198	
					Total Allowance (Watts) All Areas:				1852.5

¹ FOOTNOTES: See Table 140.7-B /Table 170.2-S for rules for calculating the specific areas (ft² for these additional lighting allowances.
² For luminaires indicated in Table F as linear, wattage in column 07 is W/lf instead of Watts/luminaire. Total linear feet should be indicated in column 08 instead of number of luminaires.

N. EXISTING CONDITIONS POWER ALLOWANCE (alterations only)

This section does not apply to this project.

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O. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Selections have been made based on information provided in this document. If any selection has been changed by permit applicant, an explanation should be included in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and can be found online

Form/Title
NRCI-LTO-E - Must be submitted for all buildings

P. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Selections have been made based on information provided in this document. If any selection has been changed by permit applicant, an explanation should be included in Table E. Additional Remarks. These documents must be provided to the building inspector during construction and must be completed through an Acceptance Test Technician Certification Provider (ATTCP). For more information visit: http://www.energy.ca.gov/title24/attcp/providers.html

Form/Title	Systems/Spaces To Be Field Verified
NRCA-LTO-02-A - Must be submitted for all outdoor lighting controls except for alterations where controls are added to <= 20 luminaires.	Electrical Panel; Parking Lot Lights; Sales Lot Lighting;

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DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Company: Educational Version	Signature Date: 2022-12-11
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer)
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: Bill Smith	Responsible Designer Signature:
Company: Bill's Electric	Date Signed: 2022-12-11
Address: 123 Main St.	License:
City/State/Zip: San Diego CA 92112	Phone: (619) 523-1212

Registration Number:	Generated Date/Time:	Documentation Software: EnergyPro
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