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User's Manual

# EnergyPro Version 7

by EnergySoft, LLC  
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# What's New in EnergyPro Version 7?

Some of the new features in EnergyPro version 7 are listed below. EnergyPro has undergone several changes in the update to the 2016 Standards, which become effective January 1, 2017.

- [EnergyPro Version 7.2 Changes](#)
- [2016 Standards Changes](#)
- [Compliance and Report Managers](#)
- [Variable Refrigerant Flow Systems](#)
- [EnergyPro v6 Files](#)



## Significant Changes in EnergyPro version 7.2

The text below highlights some of the most significant changes to EnergyPro in version 7.2. There are several other changes incorporated as well. For additional details, refer to the Building Tree or Library topics.

- **Energy Design Rating (EDR):** The EDR now includes options to override the EDR credit limit for PV systems with capacity that exceeds estimated electricity usage. The inputs also allow users to specify a target EDR score for reach codes.
- **Battery Storage for PV Systems:** There is an EDR credit (not for compliance) available for PV systems with battery storage that include either standard (user-controlled) or advanced (utility or aggregator-controlled) controls.
- **Domestic Water Heating**

**Uniform Energy Factor (UEF):** As of June 12, 2017, Energy Factor (EF) ratings are replaced with the new federal standard for water heating energy efficiency, the Uniform Energy Factor (UEF). In addition, water heater types are now classified as consumer and commercial heaters rather than small and large units, and there is a new type: residential-duty commercial water heater. The UEF allows a direct comparison as it uses the same efficiency descriptor for all residential (and some commercial) water heaters. For the remainder of the 2016 Standards cycle, UEF inputs are automatically converted to EF by EnergyPro using methods described in Appendix B of the Residential ACM Reference Manual.

**Pipe insulation:** The plumbing code now requires all hot water pipes to be insulated. There remains a credit if the measure is HERS-verified.

**Heat Pump Water Heaters:** The list of available NEEA-rated heat pump water heaters has increased substantially.

- **Assembly Library:** The Assembly Library now has four tabs. Review the text on each tab carefully to ensure you are using the correct tab for the project and type of calculation.
- **Undefined HVAC Systems:** You may now leave the HVAC system set to “Undefined”, and EnergyPro will automatically model a default standard efficiency unit.

## Summary of Changes to the 2016 Building Energy Efficiency Standards

The text below describes some of the most significant changes to the 2016 Standards. It is NOT a comprehensive list of changes. Refer to the [CEC web site for the 2016 Standards](#) for comprehensive documentation regarding the requirements.

### Residential Standards (excerpts from 2016 CBECC-Res User's Manual)

#### **Attics**

*The 2016 standards have three variations of attics allowable for prescriptive compliance. The standard design attic is option B, which may include below deck insulation (depending on the climate zone), with a tile roof surface. Where below deck insulation is included in the high performance attic a radiant barrier is not feasible (given the installation requirements). Because of below deck insulation, the radiant barrier requirements of Package A vary greatly. Even in zones that did not include a radiant barrier in the past, it may provide a benefit. For purposes of illustrating the contrast between 2013 and 2016 standards, what might be considered a typical attic (with no above or below deck insulation) is option C. That option requires the ductwork be installed in the conditioned space. If the proposed design has ductwork in the attic with only ceiling below attic insulation, expect to notice a significant difference in compliance results for 2016.*

#### **Water Heating**

*The standard water heater becomes a tankless gas water heater with 0.82 Energy Factor.*

#### **Addition Walls and Attics**

*The 2016 standard design wall in all additions is the same as new construction requirements in Section 150.1, Table 150.1-A (“Package A”). Previously, while an addition alone was compared to the Package A wall, an existing plus addition was compared to an R-13 wall (for additions up to 700 ft<sup>2</sup>). For an explanation of the exception to the requirement for continuous insulation, see Section 10.1. By contrast to the wall construction, the attic/ceiling is based on mandatory insulation only for additions up to 700 ft<sup>2</sup> (changed from R-30 to R-22 to accommodate spray foam insulation).*

#### **Energy Design Rating and Photovoltaic (PV) System Credit (from Section 4.5)**

*The software includes the ability to calculate an energy design rating (EDR) as required in the CALGreen energy provisions (Title 24, Part 11). The EDR is an alternate way to express the energy performance of a home using a scoring system where 100 represents the performance of a building meeting the envelope requirements of the 2006 International Energy Conservation Code (IECC). A score of zero or less represents the energy performance of a building that combines high levels of energy efficiency and/or renewable generation to “zero out” its TDV energy use.*

*The EDR is similar to the energy rating index in the 2015 IECC and the 2014 Residential Energy Services Network (RESNET) standards. The lower the score, the more efficient the building.*

*Buildings complying with the current standards are more efficient than the 2006 IECC, so most newly constructed buildings will have EDR scores below 100 (if an EDR were calculated for an older, inefficient home, the score could go above 100). Buildings with renewable generation such as photovoltaics (PV) can have a negative score.*

*When the user requests an EDR calculation, more detail is needed for the PV system(s). These inputs only affect the EDR calculation.*

#### Nonresidential Standards (excerpt from 2016 NR ACM Reference Manual)

*This version of the Nonresidential ACM Reference Manual incorporates most of the required changes to align with the 2016 Title 24 Standards and Reference Appendices. All revisions for the CBECC-Com 2016 alpha release are included, as well as language for some measures and changes to be included in subsequent compliance software releases. The specific measures addressed include:*

- 1) Updates to the opaque envelope requirements.*
- 2) Revisions to mandatory minimum opaque envelope requirements.*
- 3) Compliance option for aggregate roofing meeting ASTM test requirements.*
- 4) Prescriptive requirement for a minimum of 3 percent skylight-to-roof ratio for spaces above 15 feet in ceiling height.*
- 5) Updates to metal building roof construction assembly layer properties (Appendix 5.5).*
- 6) Updates to power adjustment factor credits.*
- 7) Updates to lighting power density allowances (Appendix 5.4A).*
- 8) Draft language for requirement for interlocks with heating and cooling when zone contains operable windows.*
- 9) Optimal start requirement when control system type is direct digital control (DDC) to the zone level.*
- 10) Duct leakage requirement for ducts in unconditioned spaces (preliminary language).*
- 11) Unmet load hours planned adjustment to check for unmet load hours.*
- 12) Placeholder language for variable refrigerant flow (VRF) systems (future).*

## Compliance and Report Managers

The **Res T24 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 compliance calculations use the CEC 2016 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 Residential T24 Performance module uses the CBECC-Res compliance manager, and the NR T24 Performance module uses the CBECC-Com 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 at <http://www.energy.ca.gov/title24/2016standards/>

## Variable Refrigerant Flow Systems

The 2016 Standards allow users to model variable refrigerant flow and “mini-split” systems for Title 24 compliance. However, note that they must be modeled as a standard efficiency split system 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 7 Projects folder during [program installation](#).

## EnergyPro Version 6 Files

You may install both EnergyPro versions 6 and 7 on your computer simultaneously without conflict. In addition, you may use EnergyPro version 6 files in EnergyPro version 7. Carefully review your data inputs, add new and/or revise any data required by the 2016 Standards. Once you have opened the file in EnergyPro v7, save it as a v7 file.

# Introduction

**EnergyPro** is a comprehensive energy analysis program that may be used to document compliance with the California's 2016 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 7?](#)

### Overview

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- [Program Installation](#)
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## Modules and Calculations

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## Creating Reports

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## References

- CEC Publications
- DOE-2.1E Publications
- ASHRAE Publications

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# California Energy Commission Approval

EnergyPro version 7, developed by EnergySoft, LLC, is a software program which may be used for demonstrating compliance with the 2016 Title 24, Part 6 (*Building Energy Efficiency Standards*). These 2016 standards will become effective on January 1, 2017.

**Residential Compliance:** EnergyPro version 7.0 was approved by the CEC on January 13, 2016. The low-rise residential standards apply to single family dwellings (R-3 occupancy group) and to multi-family buildings (R-1 or R-2) with three stories or less. Hotels, motels, and multi-family buildings with four or more stories are outside the scope of the low-rise standards.

EnergyPro version 7.0 includes the latest CBECC-Res (version 2016.2.0) compliance manager, approved by the Commission on June 14, 2016.

**Nonresidential Compliance:** EnergyPro v7.0: EnergySoft has updated the EnergyPro NR T24 Performance module to use the CEC's CBECC-Com (version 2016 2.0) compliance manager, which is based upon the EnergyPlus simulation engine.

EnergyPro version 7.0 includes upgrades to the interface as well as the current CBECC-Com compliance manager, and obtained CEC approval on June 14, 2016.

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 is highly

recommended that you obtain and become familiar with all [2016 Standards Publications](#) prior to performing compliance calculations.

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## General Program Procedure

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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.

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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](#).

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## EnergyPro Installation

The EnergyPro Version 7 installation wizard will walk you through the program installation process.

**Program Files:** EnergyPro 7 program files are automatically installed on the local drive in the Program Files folder, in the EnergyPro 7 subfolder.

**Project Files:** EnergyPro 7 creates a subfolder in My Documents, also entitled EnergyPro 7. This subfolder contains all the working files, including project files, default libraries and detailed simulation results.

**Contact Database:** EnergyPro v7 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 7

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:

- 32-bit or 64-bit, Windows Operating System (Windows 7, 8, or 10)
- Hard Disk: 750 MB of free space
- RAM: 2 GB
- High speed Internet connection (cable or dsl) for downloading updates and registering 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.

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## What types of buildings may you analyze with EnergyPro?

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

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## 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 [2016 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 is 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](#).

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## 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, (Res Sample.bld, and NonRes Sample.bld), illustrate how to enter data and run compliance calculations for a sample residential 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: NR Built-UP VAV systems, VRF and Mini-Split Systems, Existing + Addition + Alteration, Outdoor Lighting, Residential Hydronic Systems, Tailored Lighting, NR Envelope and Mechanical Only, Thermal Energy Storage system files, as well as several files that highlight specific HVAC equipment.

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## 2016 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:

- *2016 Building Energy Efficiency Standards* (CEC-400-2015-037-CMF, June 2015) contains the official standards adopted by the Energy Commission.
- *Reference Appendices for the 2016 Building Energy Efficiency Standards* (CEC-400-2015-038-CMF, June 2015) is the source document for climate zones, HERS protocols for measures requiring verification by a HERS rater, as well as eligibility and installation criteria for energy efficiency measures.
- *Residential Compliance Manual* (CEC-400-2015-032-CMF, November 2015) is the interpretive manual for complying with the standards (also contains sample compliance forms).
- *Residential Alternative Calculation Methods (ACM) Reference Manual* (CEC-400-2015-024-CMF-REV, Revised June 2016) contains the rules that the software follows to establish the standard and proposed designs for a proposed building.
- *Nonresidential Compliance Manual* (CEC-400-2015-033-CMF, November 2015) is the interpretive manual for complying with the nonresidential standards (also contains sample compliance forms).
- *Nonresidential Alternative Calculation Methods (ACM) Reference Manual* (CEC-400-2015-025-CMF, November 2015) 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 (<http://www.energy.ca.gov/title24/2016standards/>) or from the CEC Publications Office at:

1516 9th Street  
Sacramento, CA 95814  
916-654-5200

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## 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 version 7 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 7 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 7, select Clock, Language, and Region.

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 7 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.

Place your mouse 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 now 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 and you may also load equipment information for CEC-certified HVAC equipment into these libraries using the Import function.

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. You may also load information on CEC-certified water heaters and boilers into this library using the CEC equipment directories provided with the program.

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 NR Loads and NR Performance noncompliance calculations. For Title 24 compliance, NR Performance uses internally fixed schedules. These schedules are set by the California Energy Commission 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.

## Filtering CEC Equipment Database Lists

You may filter the CEC equipment list when [importing items](#) from the CEC Appliance Efficiency Databases to the Central or Boiler Libraries. Filter the thousands of entries to display only the equipment that meets specific size/capacity and efficiency criteria. You may also filter the list to show only a specific equipment type or manufacturer. This ability not only simplifies the search for a specific piece of equipment, it gives the user an estimate of the number of products available that meet the criteria.

## 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.

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# 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:

- [Residential 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 CF1R registration or HERS testing.
- [Residential Title 24 Performance](#), an hourly energy simulation used to determine and document Title 24 compliance of low-rise 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 Residential 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, high-rise residential, 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 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 Title 24 Performance](#) compliance calculation which predicts annual building energy performance based on an hourly simulation. This module is not yet implemented for the 2016 Standards. 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 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, Refrigerated Warehouses, Compressed Air, and Process Boilers.
- [Nonresidential Title 24 Mandatory Measures](#) module issues the Electrical Power Distribution (ELC), Solar Ready Areas (SRA) 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:

- [Lowrise Residential Performance](#) allows you to calculate the energy performance of low-rise 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.
- [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.
- [Residential Load Calculations](#). Determine the size requirements of HVAC systems for low-rise 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.
- [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 either the 2004 or the 2007 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
- [Nonresidential Loads](#) Calculation which determines ASHRAE design heating and cooling loads useful for nonresidential HVAC equipment selection.

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## Residential Alternatives

EnergyPro allows you to test the impact of individual and multiple energy-saving measures for residential non-compliance projects 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. You may run alternatives in the [Res Performance](#), and [GreenPoint Rated](#) residential modules.



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## Calibrating Results

For existing buildings, EnergyPro allows you to easily compare your simulation results to the building's actual energy usage. Each Calculation module contains 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 now 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.
- Access to an on-screen database of the CEC equipment directories that allows you to load up-to-date information on certified HVAC and water heating equipment into the program's libraries.
- 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.

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## 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.

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## Saving Detailed Data

EnergyPro allows you to save detailed data for each simulation module in the EnergyPro 7\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. 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.

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## Printing Reports

### 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. A wizard welcomes you to the **Select Report Type** dialog box.

**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 by using menu commands. First, select Reports from the lower-left window pane. Expand the applicable report type to see the forms available, then 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.

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## Report File Format, Adobe Acrobat

EnergyPro 7 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 7 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.



Refer to [Exporting Reports and Data](#) for additional details.

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## 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 Software\EnergyPro 7\. If the program was installed on a network drive, the Forms folder will be located in the EnergyPro folder.

**Company Logo:** If you wish, EnergyPro will include your company's logo on the cover page of each report. You must first save the logo in the .jpg file format, name the file "logo.jpg", and place it in the EnergyPro 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 7 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".

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## Exporting Reports and Data

The software allows you to electronically export reports for use in other applications. Note that you may not use the exported file for submission to a Home Energy Rating System (HERS) Provider web site for compliance purposes. The file may be used for participation in the Energy Upgrade California program, or for other purposes. Select Register CF1R from the Tools Menu to register the document for Title 24 compliance.

From the software's menu, select **File/Export...** There is only one option in the list: Energy Upgrade California XML Schema File. Select the folder in which you wish to save the export file, and name the file.

### Using Reports in Other Applications

EnergyPro reports 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. Reports and forms can be imported in many different applications such as Word™, Corel™, or AutoCAD™. To use the file in Word, click Print Preview to display the form on screen. Copy the form from Acrobat™ and paste it into Word. It will be formatted as a picture that you can resize to fit your needs. You may also use the Paste Special...feature to select a different format. You may need to set the resolution for the form in Adobe Reader® to ensure it is clear and legible in AutoCAD. Select Preferences from the Edit menu, select Page Display, and Custom. Set the resolution to 300 dpi.

AutoCAD 2010™ has a feature in the "Insert" menu called "pdf underlay". With that, you can cleanly insert pages from a .pdf file into a drawing. By saving the report as a .pdf file, you can insert whatever report pages you require into your drawings. The resulting .dwg file is small and it plots cleanly and quickly. You may also use the Paste Special function in Adobe Acrobat Reader®. You may also save the report or form as a .tif file and import it into AutoCAD™.

Follow the appropriate procedure to import forms using other applications.

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## 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 Ready Areas (SRA) 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 residential 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 (Residential 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.

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## 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 2016 Standards was expanded to include additional measures spanning all nonresidential end-uses.

In addition, the CEC adopted new requirements for training and certification of Acceptance Test Technicians. The defined thresholds for the lighting requirements were met in June 2014, but the HVAC supporting infrastructure for these requirements is still being developed. Once the infrastructure is fully in place (approved providers, sufficient number of technicians, etc.) the new requirements will become effective. Refer to the Nonresidential Manual, Chapter 13 and to the [CEC web site](#) for additional details regarding the new 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. Refer to [Table 2-3: Measures Requiring Acceptance Testing](#) from the Nonresidential Manual for a complete list of measures for which acceptance tests are required.

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## CF1R 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 *Residential Compliance Manual*, Section 2.1.1). The Certificate of Compliance (CF1R), 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 (CF2R) form. A HERS Rater confirms the measure is installed as required in the field, and completes and registers a certificate of verification (CF3R) 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 CF1R from the Tools menu to open the Register CF1R 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
  - [Residential Sample](#)
  - [Nonresidential Sample](#)

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## 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).

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.

Define the element characteristics in the tabbed entry boxes in the upper right window pane. 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 not be accepted, and those which allow you to choose from the list or 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.

EnergyPro uses **multi-edit boxes** to access the **libraries**. **Open a library** from a multi-edit box by clicking on the box or highlighting it and pressing 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:

- a) Select OK; your entries will be saved and you will return to the previous window (from a Library) or to the Building Tree or
- b) Select Cancel; your entries will not be saved and you will return to the previous window (from a Library) or to the Building Tree.

## **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:

- a) Click the right mouse button and select **Delete**; **or** b) Press the <Del> key; **or** c) 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.

### **Changing the order of elements as they appear on screen**

You may change the order in which elements appear on-screen by dragging and dropping them within the tree. There are some limitations to this feature; you might want to experiment with it if you are concerned about the on-screen appearance of the Building Tree.

### **Displaying Building Tree Elements**

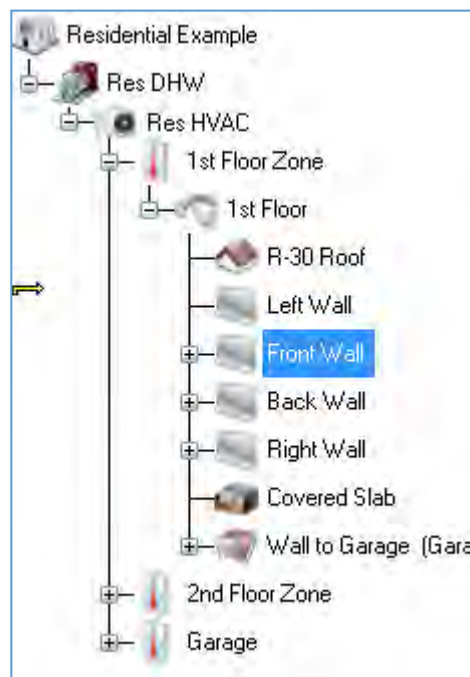
**Display all elements** in the Building Tree by selecting Expand Tree from the View Menu. In a New file, the Building element will be the only element in the Building Tree until you add additional elements.

**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.

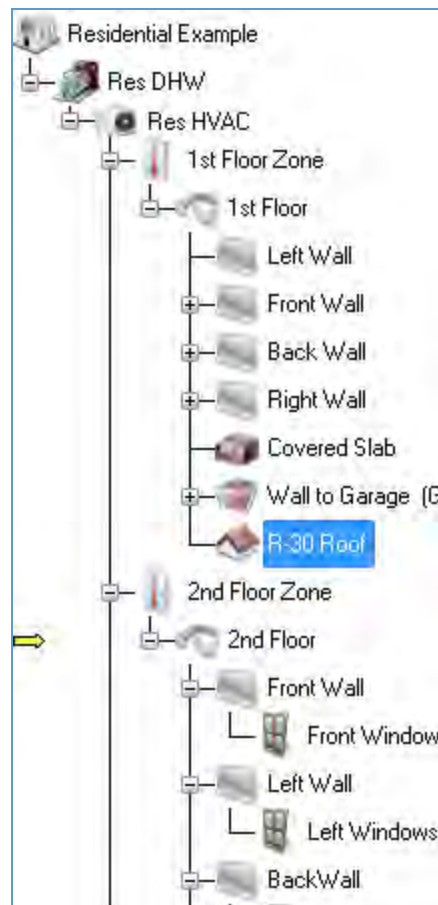
**Display all elements at a specific level** by first selecting any element at that level, then right-clicking and selecting “Show XXX” from the popup menu. For example, if you wish to view all Building Tree elements down to the Room element level, right-click on any Room element in the Tree and select “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.

---

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## Editing Techniques (Mouse and Keyboard)

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**

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 and exporting reports.

---

## File Management

### 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 and 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. Keep in mind that it is the Default libraries (including any modifications you have made in the past to these 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 software 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**

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.

- For [Res T24 Performance](#), choose whether to run the Res T24 Performance Calculation, select the analysis options, alternative simulations, and view results for calibration.

- For [Res Loads tab](#), choose whether to run the Res Loads calculation and indicate the Winter and Summer Design Conditions by selecting from the drop-down lists. Indicate with a check in the checkbox to Use Design Wet Bulb (not Mean Coincident Wet Bulb). Under Design Day for Schedules, select a day (Monday through Sunday), or Ignore Schedules (use 100%).
- For [Nonresidential \(NR\) Prescriptive](#), choose whether to run each NR Prescriptive calculation and select the analysis options. If you select Indoor Lighting, you may select a Complete Building occupancy type, and your zone occupancy entries will be overridden.
- For [NR T24 Performance](#), choose whether to run the performance calculation; select the scope and analysis features, and set the diagnostic level.
- For [Nonresidential \(NR\) Loads](#), choose whether to run the NR Loads calculation and indicate the Winter and Summer Design Conditions by selecting from the drop-down lists. Indicate with a check in the checkbox to Use Design Wet Bulb (not Mean Coincident Wet Bulb). Under Design Day for Schedules, select a day (Monday through Sunday), or Ignore Schedules (use 100%).

## **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**

EnergyPro'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. The 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

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  $(360^\circ - 15^\circ) = 345^\circ$ . **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](#).



# Residential Sample Building

This section illustrates how to input and calculate a residential 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 Residential T24 Performance calculation module. For further information on residential zoning and modeling techniques, see [Residential 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--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 Res Sample file that comes with EnergyPro as a model for this tutorial. Res Sample.bld is a single family, detached, two-story dwelling. **For practice:**

Open the Res 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 Res 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 Res 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 (Res Sample)

Project Design Data | Project Title | Designer | Lighting | Mechanical | Forms | Residential | Res Lighting | Utility | Outdoor | Exterior Uses | Pools | PV

**General**

Building Name: Residential Example

Building Type: New

Job No: M52000

Front Orientation: 90

Rotation: 0

**Location**

Country: UNITED STATES

State: California

City: San Bernardino

Zone: 10

☐ User Defined

**Principal Heating Source**

☒ Natural Gas

☐ Propane

☐ Electric (Natural Gas Available)

☐ Electric (No Natural Gas Available)

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*

**Principal Heating Source:** *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 your 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. There are no entries required for this project on the **Residential Tab**. If the conditions indicated, you would use this tab to enter data on building-level HERS measures, to describe the crawlspace, and ventilation cooling system. 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 **Res Lighting, Utility, Outdoor, Exterior Uses, and Pools** tabs are used for HERS II, GreenPoint Rated Res Performance, and Nonresidential Outdoor Lighting 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 tab is used to describe photovoltaic (PV) system and any associated battery storage data. Note that this residential project includes a 3 kW photovoltaic system. The 2016 Standards offer a [credit for renewable systems](#) in all climate zones except 6 and 7. Battery storage systems do not impact compliance in 2016, but do provide credit for the [Energy Design Rating](#) score.

Project Design Data
Project Title
Designer
Lighting
Mechanical
Forms
Residential
Res Lighting
Utility
Outdoor
Exterior Uses
Pools
PV

Photovoltaic
1 of 3

Module Type	Output (kW)	Cal Flex Install	Tilt (deg)	Azimuth	Inverter Eff	kWh	Savings
Standard	1.0	<input type="checkbox"/>	22.0	90	96.0	0	\$150
Standard	1.0	<input type="checkbox"/>	22.0	180	96.0	0	\$150
Standard	1.0	<input type="checkbox"/>	22.0	270	96.0	0	\$150

kWh and Savings not needed for Title 24 calculations.

☐ Allow excess PV production to be applied in EDR calculation

Battery Storage for PV

Capacity: 0 kWh
☐ Optimize charging and discharging

Charging
Discharging
Rate: 0 kW 0 kW
Efficiency: 0.0 % 0.0 %

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

## Editing the Plant Element (Res Sample)

Heating Hot Water Chilled Water Hydronic Domestic Hot Water Domestic Hot Water 2 Exceptional

**DHW Boiler**

Type: New

New Boiler: A. O. Smith FPTU 66

Multiplier: 1

☐ Multi-Family Central System

**Residential**

Distribution: Standard

**Solar Domestic Hot Water**

Net Solar Fraction: 0 %

**Pump**

Control: No loops or central system pump

Pump Multiplier: 1

Design Power: 0 hp

**Piping**

Length Outside: 0 feet

Length Underground: 0 feet

Length in Plenum: 0 feet

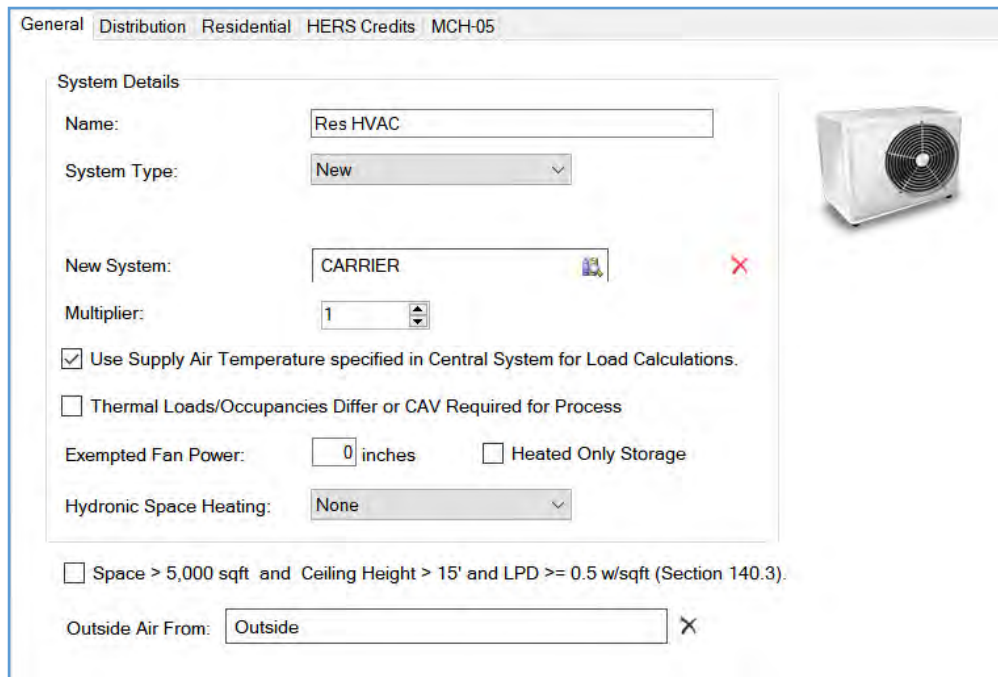
☐ Additional 1/2" Insulation

**Residential Heat Pump Water Heater**

Location: Garage Room:

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
3. Click on the tab, **Domestic Hot Water** to view the DHW system characteristics.  
Leave all DHW entries at their current values.
4. You will not use the remaining Plant tabs (Chilled Water, Hydronic, and Exceptional) in this example. Refer to the [Plant Element](#) in the Building Tree for detailed explanations of these entries.
5. Click on the System element, **Res HVAC** to continue.

# Editing the System Element (Res Sample)



General Distribution Residential HERS Credits MCH-05

System Details

Name: Res HVAC

System Type: New

New System: CARRIER

Multiplier: 1

☒ Use Supply Air Temperature specified in Central System for Load Calculations.

☐ Thermal Loads/Occupancies Differ or CAV Required for Process

Exempted Fan Power: 0 inches ☐ Heated Only Storage

Hydronic Space Heating: None

☐ Space > 5,000 sqft and Ceiling Height > 15' and LPD >= 0.5 w/sqft (Section 140.3).

Outside Air From: Outside

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.

## 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 or wood heating.

## 5. HERS Credits

This HVAC system includes the Verified Refrigerant Charge or Charge Indicator Display 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-05**

This tab is used for nonresidential projects only.

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

## Editing the Zone Element (Res Sample)

General | Lighting | Mechanical | Schedules | Dwelling Units

Zone Details

Name: 1st Floor Zone

Zone Type: Conditioned

Occupancy: Single Family

90.1 Ltg Occupancy: Building Area Office

# of Floors: 1

Envelope Status: New

Lighting Status: New

Year Built: 2016

Rotation: 0

Building Story: Select Floor 1  
North, East, South West

Display Perimeter: 0 feet 0 feet

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

1. Click on the Zone Element **1<sup>st</sup> 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 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 residential buildings. You do not use the **Lighting, Mechanical or Schedules** tabs.
4. On the **General** tab, input:  
**Name:** *1<sup>st</sup> Floor Zone*  
**Zone Type:** *Conditioned*  
**Occupancy** [drop-down list]: *Single Family*  
**90.1 Occupancy** [drop-down list]: Not used in residential projects.  
**# of Floors:** *1*  
**Envelope Status:** *New*  
**Lighting Status:** Not used in residential projects

**Year Built:** Enter **2017**, as this is a new home

Leave the Rotation Field set to 0.

**Building Story:** Click on the “Select” button.

Select the Building Story

1 of 2

Name: Floor 1

Story Multiplier: 1

Ceiling Height: 8 feet

Elevation Above Grade: 0.7 feet

Floor to Floor Height: 9 feet

Window Head Height: 6.7 feet

2nd Floor FTF = 9'

2nd Floor Ceiling Height = 8'

1st Floor FTF = 9'

1st Floor Ceiling Height = 8'

2nd Floor Elevation = 9.7'

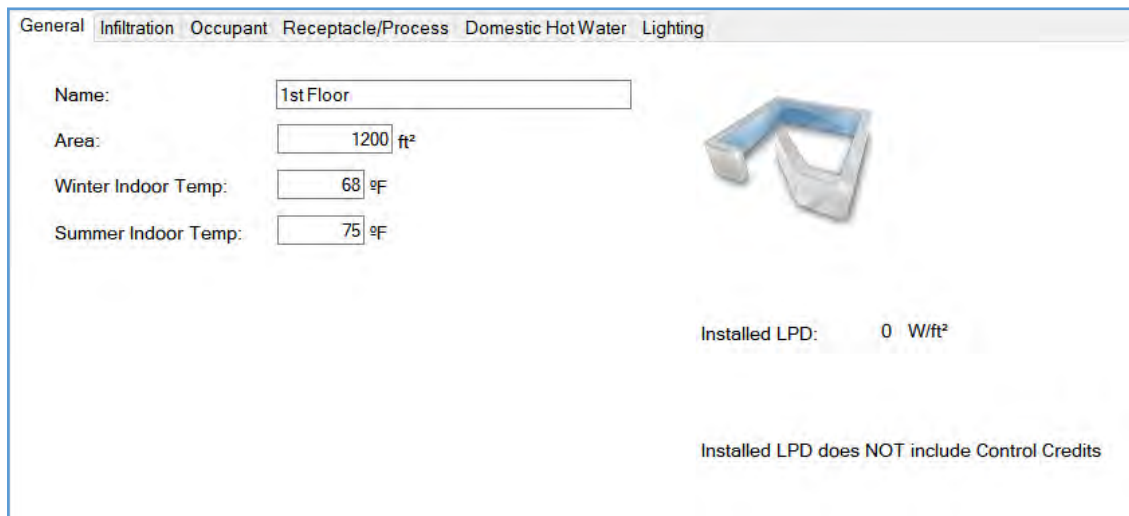
1st Floor Elevation = 0.7'

OK Cancel

Complete the entries in the Select the Building Story dialog box to specify the features of the building story of the Zone.

- Name:** **Floor 1**
  - Story Multiplier:** **1**
  - Ceiling Height:** **8 feet**
  - Elevation Above Grade:** **0.7 feet**
  - Floor to Floor Height:** **9 feet**
  - 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, you must 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; you may leave the default entries here.
- For additions only and multi-family buildings, you must provide additional information on this tab, as explained in [Dwelling Units](#).
- Leave the remaining **1<sup>st</sup> Floor Zone** inputs set to their default values. You have completed zonal data input for the **1<sup>st</sup> Floor Zone**.
6. Next you'll add a **Room Element**

## Editing the Room Element (Res Sample)



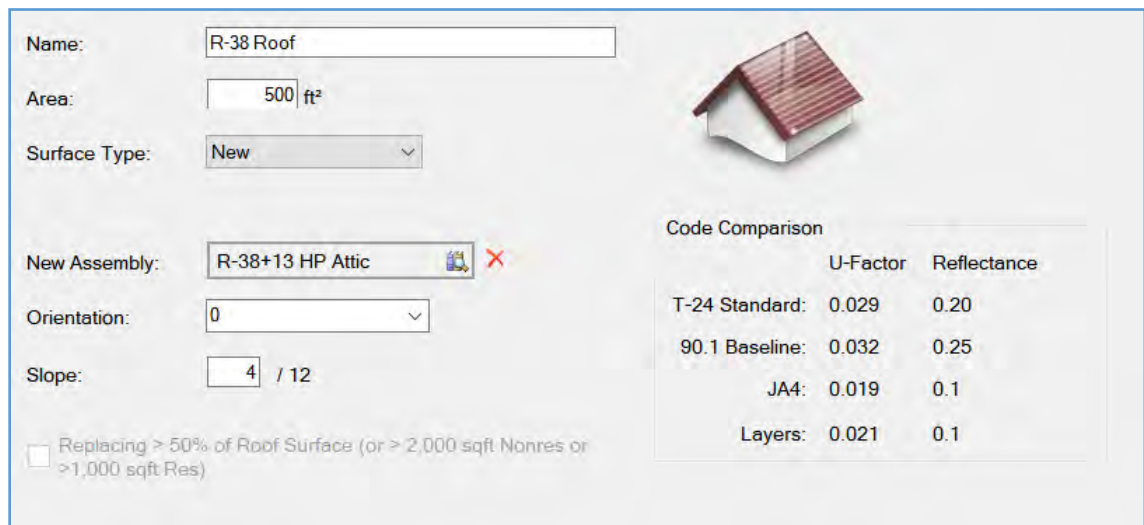
The screenshot shows the 'General' tab of the EnergyPro software interface. The 'Name' field is set to '1st Floor'. The 'Area' field is set to '1200 ft²'. The 'Winter Indoor Temp' field is set to '68 °F'. The 'Summer Indoor Temp' field is set to '75 °F'. To the right of these fields is a 3D model of a building. Below the model, the 'Installed LPD' is set to '0 W/ft²'. At the bottom right, a note states 'Installed LPD does NOT include Control Credits'.

Now you will [add](#) a **Room Element** to the **1<sup>st</sup> Floor Zone Element**

1. Right click on the **1<sup>st</sup> 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 1<sup>st</sup> Floor.
3. The **General** tab is the first tab displayed. Input:  
Name: **1st Floor**  
Area: **1,200** ft<sup>2</sup> (111.5m<sup>2</sup>). 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 **1<sup>st</sup> 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 (Res Sample)



Name: R-38 Roof

Area: 500 ft²

Surface Type: New

New Assembly: R-38+13 HP Attic

Orientation: 0

Slope: 4 / 12

☐ Replacing > 50% of Roof Surface (or > 2,000 sqft Nonres or >1,000 sqft Res)

Code Comparison		
	U-Factor	Reflectance
T-24 Standard:	0.029	0.20
90.1 Baseline:	0.032	0.25
JA4:	0.019	0.1
Layers:	0.021	0.1

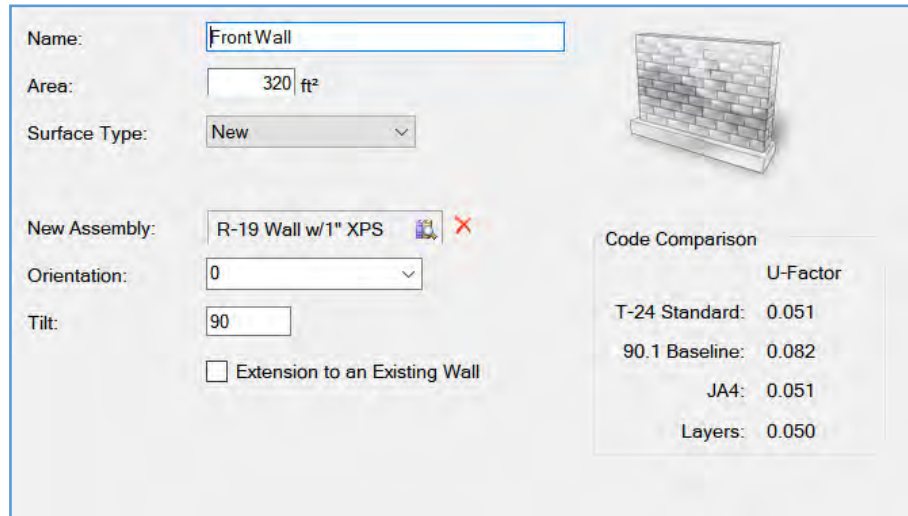
Now you will add a **Roof Element** to the **1<sup>st</sup> Floor Room Element**

1. Click on the **1<sup>st</sup> Floor Room Element** and right click. Highlight the **Add** and then click on **Roof**. The **Roof** element is now added under the Room 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-13 at the roof deck, and a radiant barrier.  
**Area:** **500** ft² (46.5 m²)  
**Surface Type:** **New**  
**New Assembly:** [Assembly Library]: **R-38 + 13 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
4. (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 (Res Sample)

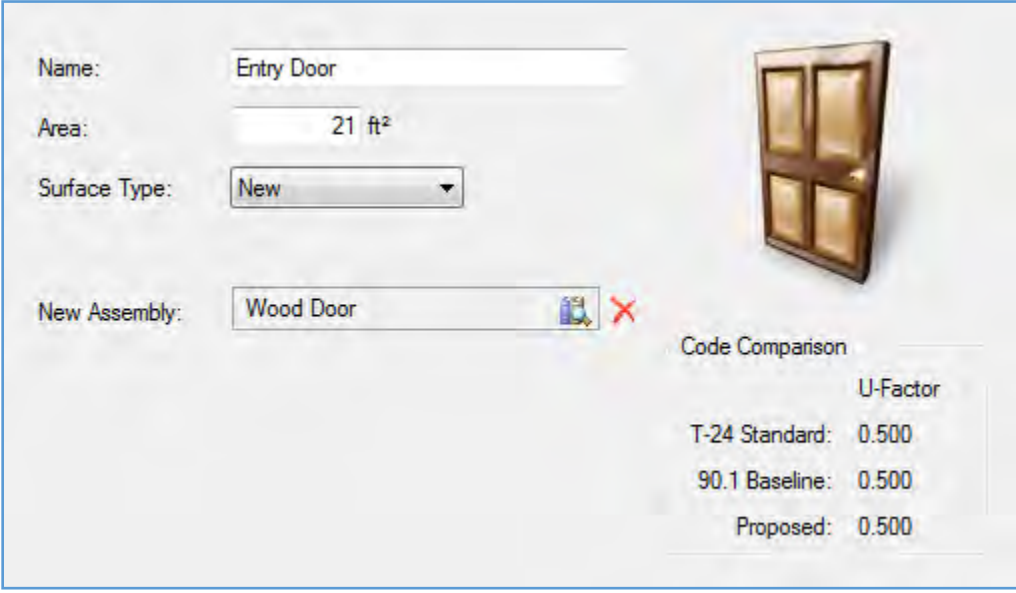


Code Comparison	
	U-Factor
T-24 Standard:	0.051
90.1 Baseline:	0.082
JA4:	0.051
Layers:	0.050

1. Click on the **1<sup>st</sup> Floor Room Element** then right click and then select [Add](#). Choose the **Exterior Wall Element** from the list. It will be added after the **Roof Element**. You may also use the [Insert](#) 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* ft<sup>2</sup> (29.7 m<sup>2</sup>)  
**Surface Type:** *New*  
**New Assembly:** [Assembly Library]: *R-19 Wall with 1" XPS*. (Click on this field to select R-19 Wall 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 (Res Sample)




Name:

Area:

Surface Type:

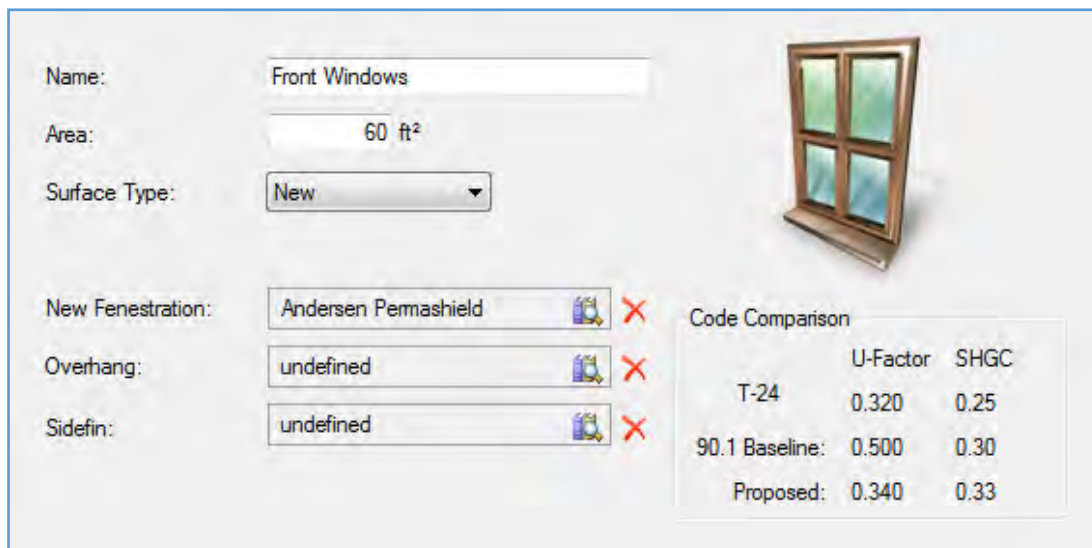
New Assembly:   



Code Comparison	
	U-Factor
T-24 Standard:	0.500
90.1 Baseline:	0.500
Proposed:	0.500

1. Click on the **Door Element** to input:  
**Name:** *Entry Door*  
**Area:** *21* ft² (2.0 m²)  
**Surface Type:** *New*  
**New Assembly:** [Assembly Library]: *Wood Door*
2. Next you'll edit the **Window Element** you just added.

## Editing the Window Element (Res Sample)



	U-Factor	SHGC
T-24	0.320	0.25
90.1 Baseline:	0.500	0.30
Proposed:	0.340	0.33

1. Click on the **Window Element**. The **General** tab is displayed. Input:  
**Name:** *Front Windows*  
**Area:** *60* ft<sup>2</sup> (5.6 m<sup>2</sup>)  
**Surface Type:** *New*  
**New Fenestration** [Fenestration Library]: *Anderson Permashield* (*Click in this field to choose Anderson Permashield, 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 (Res Sample)

Continue adding **Walls and the Window and Door Elements** that belong to each wall to the **1<sup>st</sup> 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<sup>2</sup> (22.3m<sup>2</sup>)

**Surface Type:** *New*

**New Assembly:** [Assembly Library]: *R-19 Wall w/1" XPS*. (Click on this field to select R-19 Wall 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* ft<sup>2</sup> (3.7 m<sup>2</sup>)

**Surface Type:** *New*

**New Fenestration** [Fenestration Library]: *Anderson Permashield* (*Click in this field to choose Anderson Permashield, then click on OK*)

Leave the Overhangs and Sidesfins undefined.

3. [Add](#) another **Exterior Wall Element** and input:

**Name:** *Back Wall*

**Area:** *320* ft (29.7 m)

**Surface Type:** *New*

**New Assembly:** [Assembly Library]: *R-19 Wall w/1" XPS*. (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* ft<sup>2</sup> (1.6 m<sup>2</sup>)

**Surface Type:** *New*

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

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

**Name:** *Back Windows*

**Area:** *72* ft<sup>2</sup> (6.7 m<sup>2</sup>)

**Surface Type:** *New*

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

Leave the Overhangs and Sidesfins undefined.

6. [Add](#) another **Exterior Wall Element** and input:

**Name:** **Right Wall**

**Area:** **240** ft<sup>2</sup> (22.3 m<sup>2</sup>)

**Surface Type:** **New**

**New Assembly:** [drop-down list]: **R-19 Wall w/1" XPS.**

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

**Tilt:** **90** degrees

7. [Add](#) to the **Right Wall Element**, a **Window Element** and input:

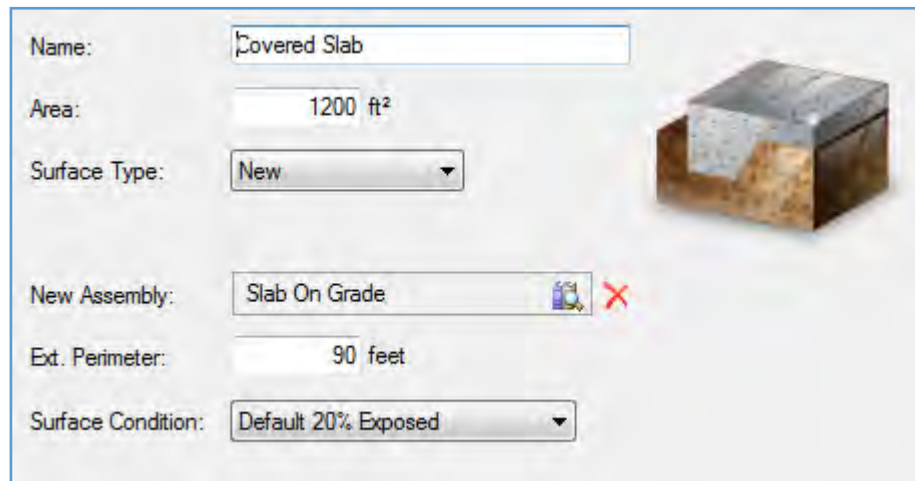
**Name:** **Right Windows**

**Area:** **32** ft<sup>2</sup> (3.0 m<sup>2</sup>)

**New Fenestration** [Fenestration Library]: **Anderson Permashield** (*Click in this field to choose Anderson Permashield, then click OK*).

---

## Editing the Slab Element (Res Sample)



Name: Covered Slab

Area: 1200 ft<sup>2</sup>

Surface Type: New

New Assembly: Slab On Grade

Ext. Perimeter: 90 feet

Surface Condition: Default 20% Exposed

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

**Name:** Covered Slab

**Area:** 1,200 ft<sup>2</sup>

**Surface Type:** New

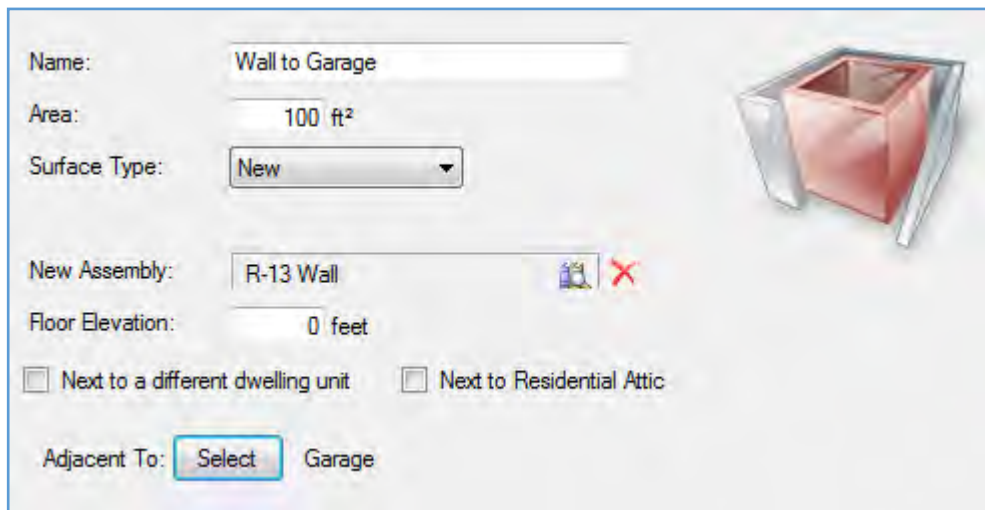
**New Assembly:** [Assembly Library]: Slab on Grade

**Ext. Perimeter:** 90 feet (27.4 meters)

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

---

## Editing the Interior Surface Element (Res Sample)



1. The 2016 Standards require that you model interior surfaces between zones in residential projects. Add an Interior Surface to the **1<sup>st</sup> Floor Room** and input the following data.

**Name:** Wall to Garage

**Area:** 100 ft² (9.3 m²)

**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 1<sup>st</sup> 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 1<sup>st</sup> Floor Zone.**

Review the 2<sup>nd</sup> Floor Zone data.

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

---

## Running Calculations (Res 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 Res T24 Performance module, you will not be able to run the Res T24 Performance calculation.

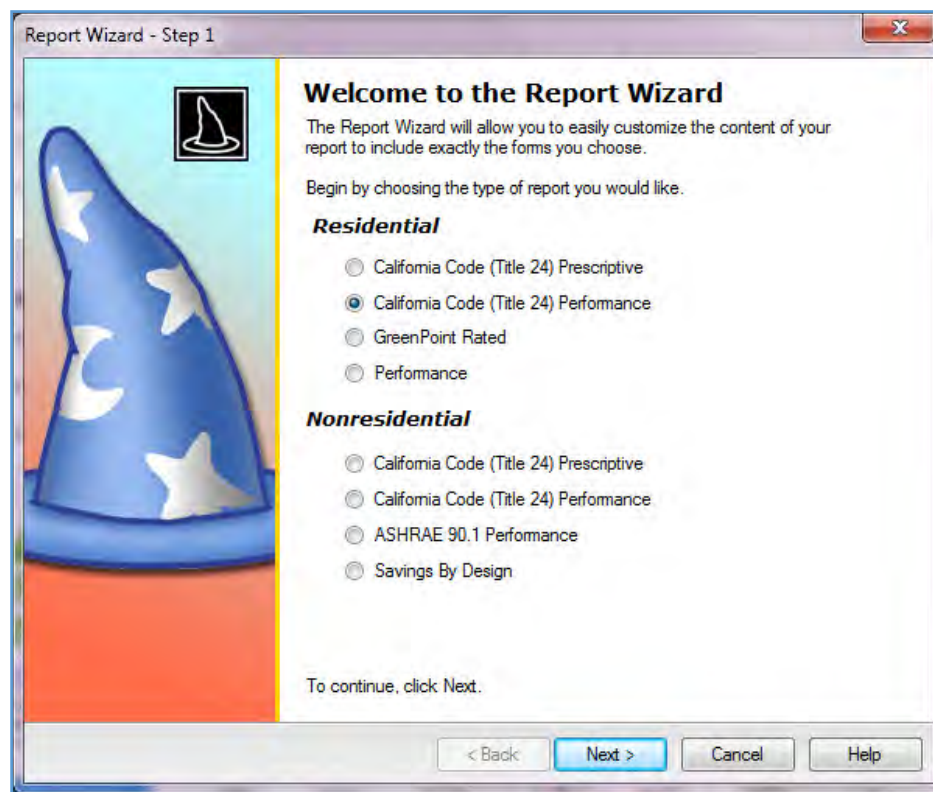
---

3. Now you are ready to run the 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 Residential Sample Building** complies with the *Standards* as shown in the [Res T24 Performance Results](#) tab.



## Preparing and Printing Reports (Res 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 checking (clicking on) 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 underlined italics.**

**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 screenshot shows the 'Project Design Data' tab of a software interface. The tab bar at the top includes: Project Title, Designer, Lighting Designer, Mechanical Designer, Residential, Res Lighting, Utility, Outdoor, and Exterior Uses. The 'General' section contains: Building Name (Nonresidential Sample), Building Type (New), Job No (M98000), Front Orientation (0), and Rotation (0). The 'Location' section contains: Country (UNITED STATES), State (California), City (Sacramento CO), and Zone (12). There is a 'User Defined' checkbox and 'Edit' and 'Select' buttons. The 'Principal Heating Source' section has radio buttons for Natural Gas (selected), Propane, Electric (Natural Gas Available), and Electric (No Natural Gas Available). A 3D house icon is shown on the right.

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 Practice*

**Building Type** [from drop-down list]: *New*

**Job Number:** *(your choice)*

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

**Rotation:** *0* degrees

## 2. Location

[from Location Library]: *Sacramento CO*

## 3. Click on the next tab, **Project Title**. Input:

**Project**

**Name:** *NonRes Practice* This is the name 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. The **Residential**, **Res Lighting**, **Utility**, **Outdoor**, **Exterior Uses**, and **Pool** tabs are not used in this example.

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)

The screenshot shows the 'Heating Hot Water' tab selected in the EnergyPro software. The interface is divided into several sections:

- DHW Boiler:** Type: New (dropdown), New Boiler: 80 Gall (text box), Multiplier: 1 (spin box).
- Residential:** Distribution: Standard (dropdown).
- Solar Domestic Hot Water:** Net Solar Fraction: 0 (spin box) %.
- Pump:** Control: No loops or central system pump (dropdown), Pump Multiplier: 1 (spin box), Design Power: 0 hp (spin box).
- Piping:** Length Outside: 0 feet (spin box), Length Underground: 0 feet (spin box), Length in Plenum: 0 feet (spin box), Additional 1/2" Insulation (checkbox).
- Residential Heat Pump Water Heater:** Location: Garage (dropdown), Room: (empty dropdown).

Click on the Plant element, **Plant - DHW**, if you haven't already, 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 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.

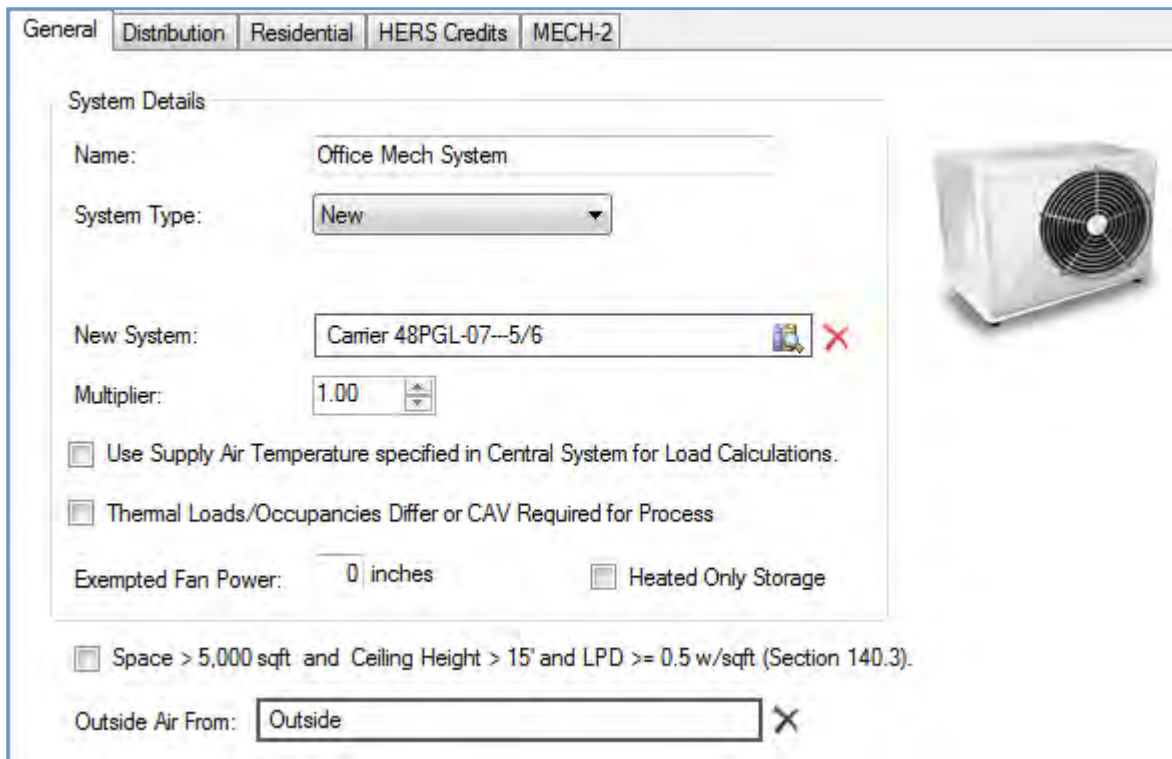
You will not use the other Plant tabs (Chilled Water, Hydronic, DHW 2, Renewables and Exceptional systems) in this example.

3. Click on the System element, **Office Mech System** to continue.

---

## Editing the System Element (NR Sample)

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



The screenshot shows a software window with tabs: General, Distribution, Residential, HERS Credits, and MECH-2. The MECH-2 tab is active. Under 'System Details', the 'Name' field is 'Office Mech System'. The 'System Type' dropdown is set to 'New'. The 'New System' field contains 'Carrier 48PGL-07--5/6'. The 'Multiplier' is set to '1.00'. There are three checkboxes: 'Use Supply Air Temperature specified in Central System for Load Calculations.' (unchecked), 'Thermal Loads/Occupancies Differ or CAV Required for Process' (unchecked), and 'Exempted Fan Power: 0 inches' (checked). There is also a 'Heated Only Storage' checkbox (unchecked). At the bottom, there is a checkbox for 'Space > 5,000 sqft and Ceiling Height > 15' and LPD >= 0.5 w/sqft (Section 140.3)' (unchecked), and an 'Outside Air From:' dropdown set to 'Outside'. An image of an HVAC unit is shown on the right side of the window.

1. The **Office Mechanical System** (Heating, Ventilation and Air Conditioning) 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 [Nonresidential Compliance Modeling](#).

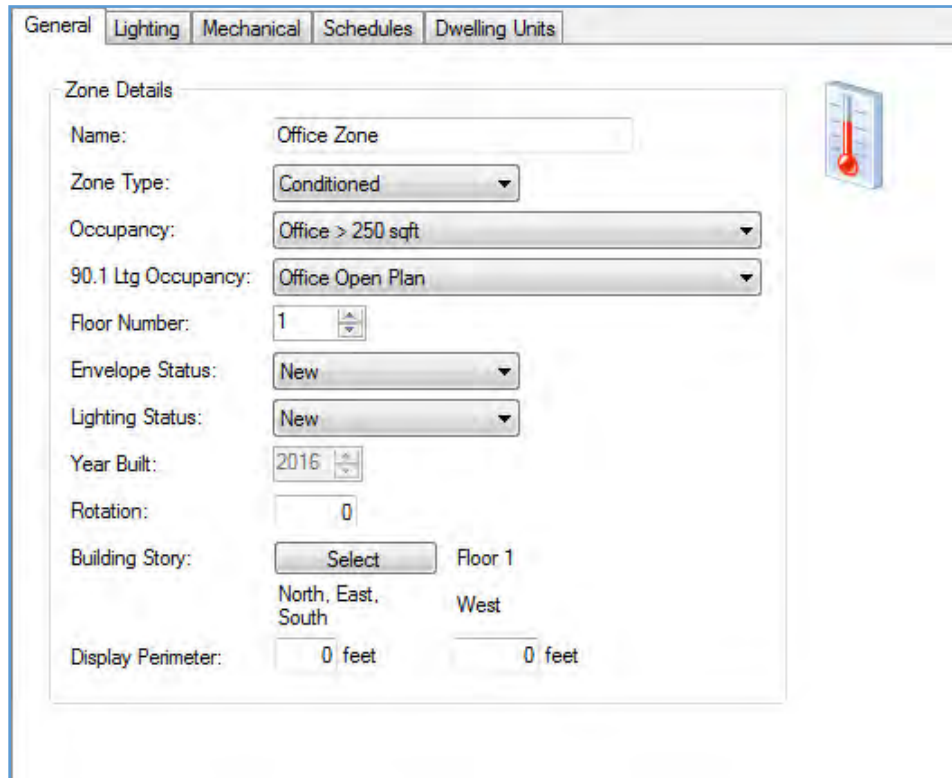
---

**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 system from the default Central System Library. You can review HVAC System details in the Central System Library.
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**, if you haven't already. Click the right mouse button, select **Delete**.
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:** *Conditioned*.

**Occupancy [drop-down list]:** *Office >250 sqft*. This is an Area Category occupancy; do not select Complete Building Office from the drop-down list by mistake. 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.



- 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.

The screenshot shows the 'Select the Building Story' dialog box. On the left, a list contains 'Floor 1' and 'Floor 2', with 'Floor 1' selected. The right side of the dialog contains the following fields and values:

- Name: Floor 1
- Story Multiplier: 1
- Ceiling Height: 9 feet
- Elevation Above Grade: 0 feet
- Floor to Floor Height: 10 feet
- Window Head Height: 6.7 feet

Below the input fields is a diagram of a two-story building. The diagram labels the following dimensions:

- 2nd Floor FTF = 9'
- 2nd Floor Ceiling Height = 8'
- 1st Floor FTF = 9'
- 1st Floor Ceiling Height = 8'
- 2nd Floor Elevation = 9.7'
- 1st Floor Elevation = 0.7'

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

**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.

- 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, select **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.

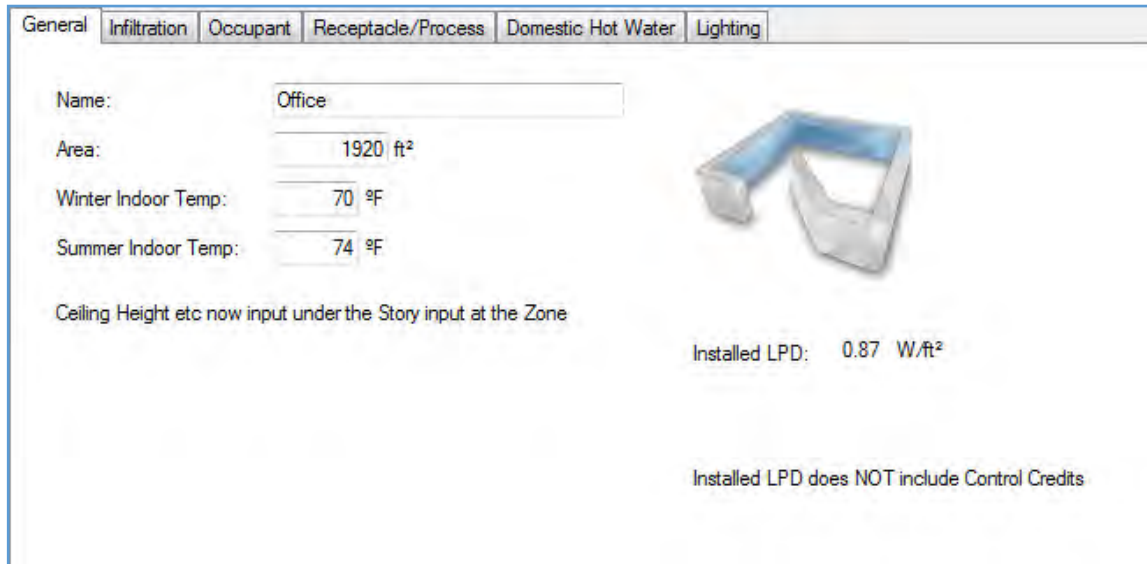
If you are **following along**, note that the program has calculated the Installed LPD at 0.872 watts/sqft. If you are doing **practice** input, you can return to this tab after you have entered actual lighting fixtures under the Room element, to confirm that the LPD is indeed 0.872 watts/sqft.

- Click on the **Mechanical** tab. Leave all Mechanical System Data entries set to their default values.
- Click on the **Schedules** tab. In this tab you will find two types of schedules: Loads 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)



General Infiltration Occupant Receptacle/Process Domestic Hot Water Lighting

Name: Office

Area: 1920 ft<sup>2</sup>

Winter Indoor Temp: 70 °F

Summer Indoor Temp: 74 °F

Ceiling Height etc now input under the Story input at the Zone

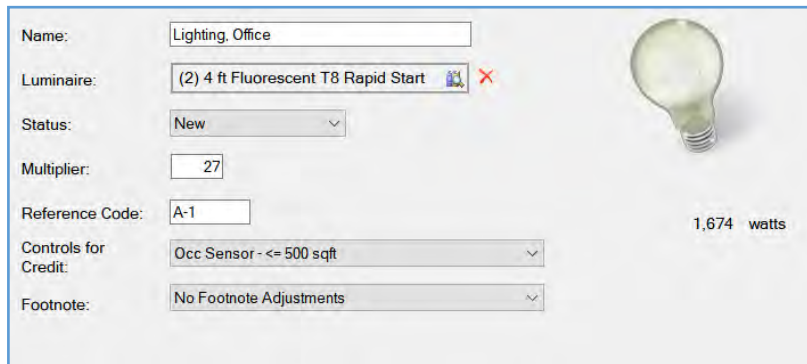
Installed LPD: 0.87 W/ft<sup>2</sup>

Installed LPD does NOT include Control Credits



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<sup>2</sup> (178.4 m<sup>2</sup>). 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.
5. 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.
6. Skip the next three tabs, **Domestic Hot Water, Exhaust Fans, and Lighting**; they do not apply to this job.
7. You have completed your entries for the **Office Room Element**.
8. At this point you have a choice of Building Tree elements under the level of the Room element. Highlight the Room element, click the right mouse button and select **Add** to display the list of new components. Choose each component by highlighting one at a time, as we will do in the next part of this example.

---

## Editing the Lighting Element (NR Sample)



Name:

Luminaire:   

Status:

Multiplier:

Reference Code:

Controls for Credit:

Footnote:

1,674 watts

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*

**Luminaire:** [Luminaire Library]: *(2) 4 ft Fluorescent T8 Rapid Start Elec*

**Status:** *New*

**Multiplier:** *27*

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

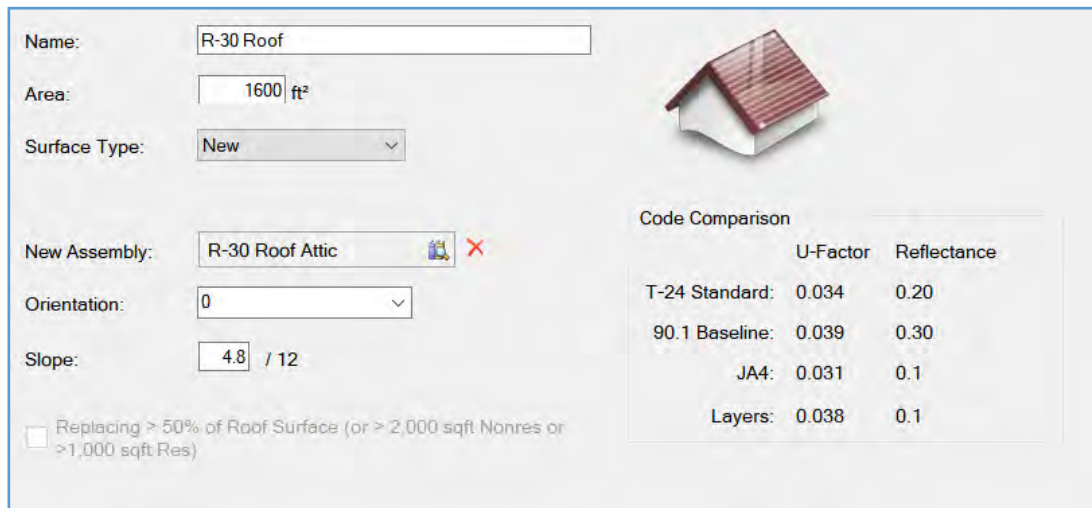
**Controls for Credit [drop-down]:** *Occ Sensor <= 500 sqft*

**Footnote [drop-down]:** *No Footnote Adjustments*

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)



Name: R-30 Roof

Area: 1600 ft²

Surface Type: New

New Assembly: R-30 Roof Attic

Orientation: 0

Slope: 4.8 / 12

☐ Replacing > 50% of Roof Surface (or > 2,000 sqft Nonres or > 1,000 sqft Res)

Code Comparison

	U-Factor	Reflectance
T-24 Standard:	0.034	0.20
90.1 Baseline:	0.039	0.30
JA4:	0.031	0.1
Layers:	0.038	0.1

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* ft (148.6 m)

**Surface Type:** *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)

Name:

Area:  ft²

Surface Type:

New Assembly:

Orientation:

Tilt:

☐ Extension to an Existing Wall

Surface Geometry for Shading Devices

Wall Width:  feet

Wall Height:  feet

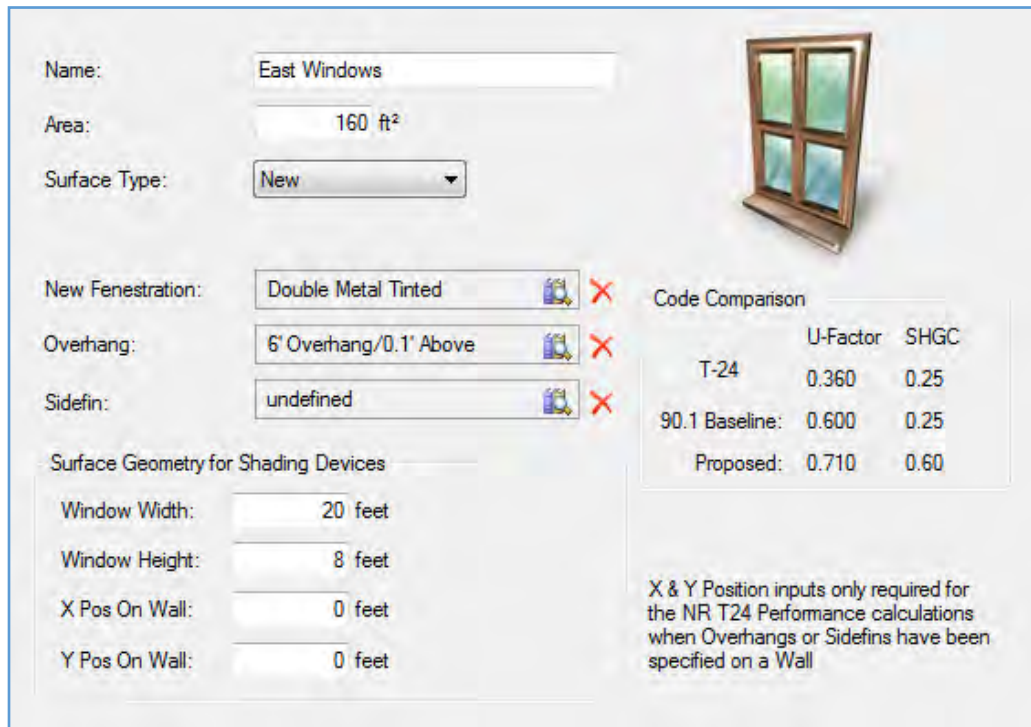
Code Comparison

	U-Factor
T-24 Standard:	0.059
90.1 Baseline:	0.077
JA4:	0.102
Layers:	0.102

Width & Height only required for the NR T24 Performance calculations when Overhangs or Sidesfins have been specified

1. 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* ft (37.2 m)  
**Surface Type:** *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  
**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 sidesfin for windows on the wall.
2. You have completed input for the East Wall.
3. You may insert two types of **sub-components** for each wall, as applicable: **Windows** and **Doors**. (Doors or portions of doors made of glass are input using the Windows element, as shown under the Retail System.) **Insert a** Window element in the East Wall.

## Editing the Window Element (NR Sample)



Name: East Windows

Area: 160 ft<sup>2</sup>

Surface Type: New

New Fenestration: Double Metal Tinted

Overhang: 6' Overhang/0.1' Above

Sidefin: undefined

Surface Geometry for Shading Devices

Window Width: 20 feet

Window Height: 8 feet

X Pos On Wall: 0 feet

Y Pos On Wall: 0 feet

Code Comparison

	U-Factor	SHGC
T-24	0.360	0.25
90.1 Baseline:	0.600	0.25
Proposed:	0.710	0.60

X & Y Position inputs only required for the NR T24 Performance calculations when Overhangs or Sidefins have been specified on a Wall

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 ft<sup>2</sup>* (14.9 m<sup>2</sup>)

**Surface Type:** *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 indicate 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*

---

## 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* ft<sup>2</sup> (37.2 m<sup>2</sup>)

**Surface Type:** *New*

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

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

**Tilt:** *90* degrees

**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* ft<sup>2</sup> (14.9 m<sup>2</sup>)

**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* ft<sup>2</sup> (37.2 m<sup>2</sup>)

**Surface Type:** *New*

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

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

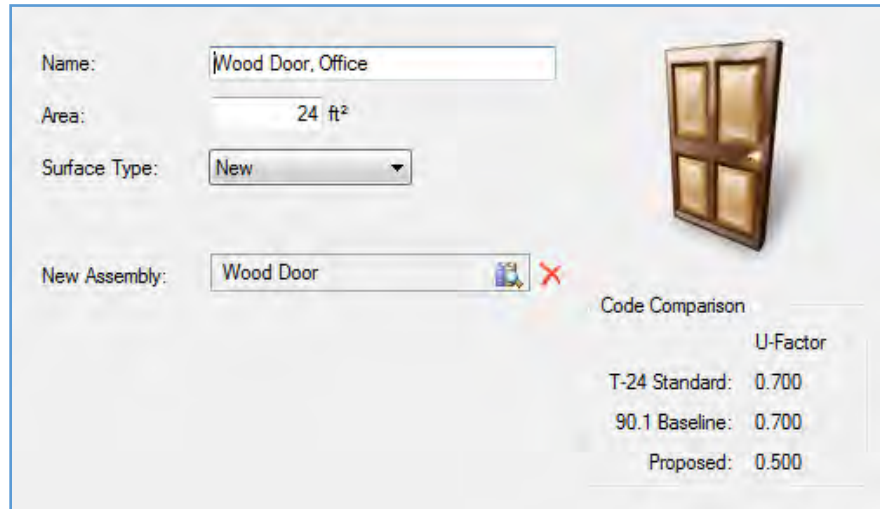
**Tilt:** *90* degrees

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.



Name:

Area:

Surface Type:

New Assembly:   

Code Comparison

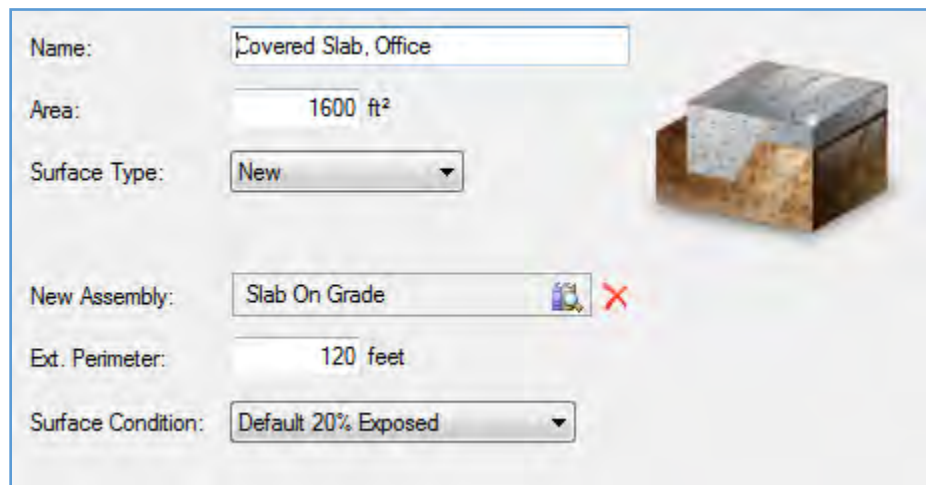
	U-Factor
T-24 Standard:	0.700
90.1 Baseline:	0.700
Proposed:	0.500

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)



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

**Name:** *Covered Slab, Office*

**Area:** *1600* ft<sup>2</sup> (148.6 m<sup>2</sup>)

**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 with the Windows element. Also note that it has no Roof input because it is beneath conditioned space, the Restaurant area. It shows 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, **Save** the file and run calculations.

---

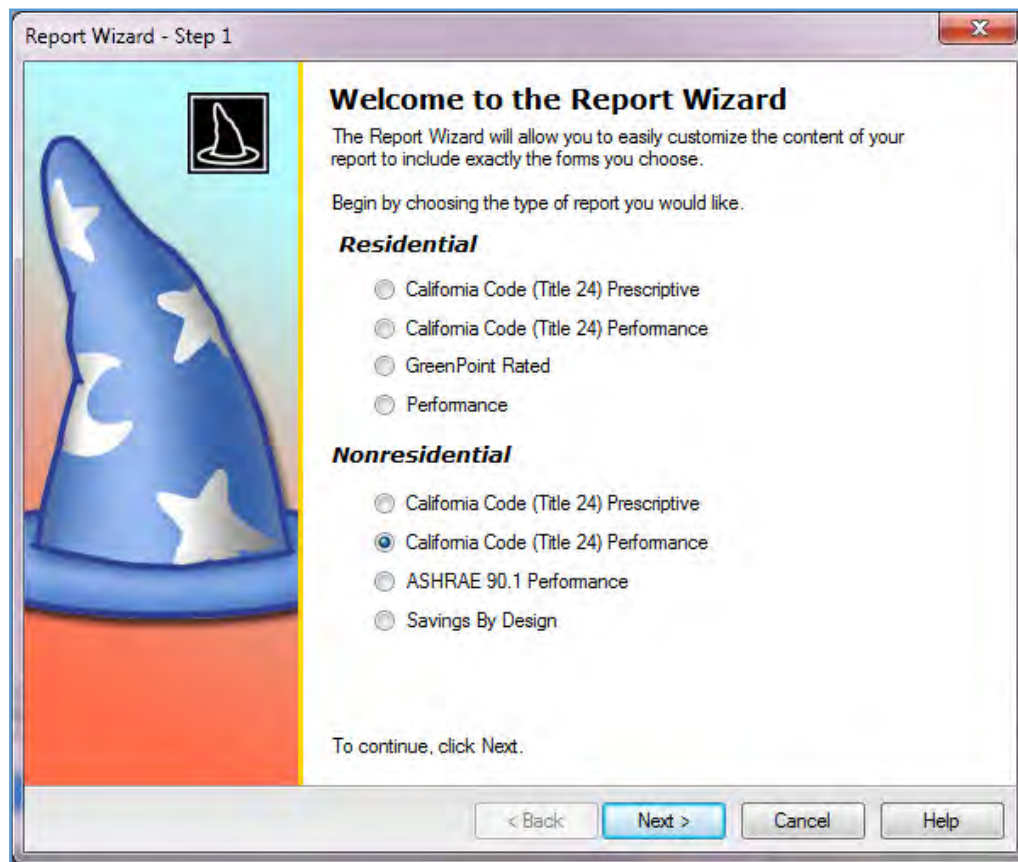
## Running Calculations (NR Sample)

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 on the Calculate button 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 NR Performance calculation. The applicable boxes have been checked for you: Envelope, Indoor Lighting, Mechanical, and DHW.
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* by 5% using the Performance Method, 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.

## Preparing and Printing Reports (NR Sample)



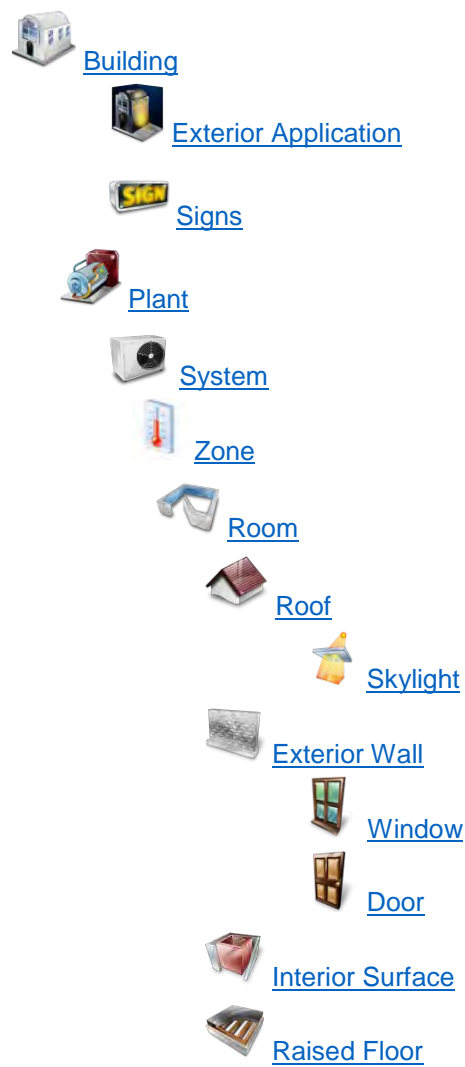
1. You may either use the Report Wizard to prepare a report for printing or select Reports from the choices in the bottom-right window pane. Select **File/Report Wizard...** from the Main Menu or click on the Report Wizard icon in the toolbar. A wizard welcomes you to the Select Report Type dialog box.
2. Select California Code (Title 24) Performance and move to the next box from the list of Nonresidential reports and Next to continue.
3. Select the Forms you wish to include in your report by checking (clicking on) the appropriate boxes, then select Next. Note those that have been selected for this sample.
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. You can page up or down through the Title 24 Report that has been prepared for this sample building.



# 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.

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





[Slab-on-Grade](#)



[Lighting](#)



[Lighting Task](#)



[Underground Wall](#)



[Underground Floor](#)



## Building Element

[Project Design Data](#), [Project Title](#), [Designers](#), [Forms](#), [Residential](#), [Res Lighting](#), [Utility](#), [Outdoor](#), [Exterior Uses](#), [Pools](#), [PV](#).

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.



### Building Type

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



### 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 the Section 9.3 of the Residential 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 for additional details regarding the Addition Alone method.

Range & Units: 0 - 100



## Principal Heating Source

Select the fuel used as the principal project heating source. Choices include: Natural Gas, Propane, Electric (Natural Gas Available), and Electric (No Natural Gas Available).



## Location Data

EnergyPro stores weather data in the Location List. The database includes entries from all 50 states in the United States and all Provinces in Canada. Click “Select” to open the Location List and select the project location.

The list is not a standard 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 location list.



## State

The State 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 location list.



## 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 location list.



## 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 location list.



## 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 checkbox labeled User Defined 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 <http://www.doe2.com>. Place the files in the Energy Pro weather folder, usually located at the following path if installed locally-- C:\Program Files (x86)\Energy Pro 7\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 these tabs 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 PERF-1C form for nonresidential projects. Remarks do not appear on any residential forms.



## 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 found 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 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, and 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 Mandatory Measures in the Forms Tab:

- NRCC-ELC-01: Electrical Power Distribution
- NRCC-LTI-02: Indoor Lighting Controls
- NRCC-LTO-02: Outdoor Lighting Controls
- NRCC-MCH-02: HVAC Dry and Wet Systems Requirements (Plans Reference)
- NRCC-SRA-01, -02: Solar Ready Areas

You may complete the following Covered Process forms in the Forms Tab:

- PRC-02: Garage Exhaust
- PRC-03: Commercial Kitchens
- PRC-04: Computer Room
- PRC-09: Laboratory Exhaust
- PRC-11: Process Boilers
- PRC-12: Elevator Lighting and Ventilation Controls
- PRC-13: Escalators and Moving Walkways Speed Controls

In addition, the Commissioning, Commercial Refrigeration, Refrigerated Warehouse, and Compressed Air forms are provided as fillable forms (select in Reports menu), but are not auto-populated by EnergyPro through the Forms Tab.

## Residential Tab

### HERS Measures



#### Date of Rating

Click on the arrow at the right of the field to display the calendar. Select the date the rating was conducted from the calendar and EnergyPro will automatically populate the entry field. Alternatively, you may enter the data directly in the field.



#### 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 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. QII compliance credit requires HERS verification. Credit for verified quality insulation installation is applicable to all insulated assemblies in the building—ceilings/attics, knee walls, exterior walls and exterior floors.

Additions: You may use the QII credit in New Construction, Addition-only, or Existing plus Addition plus Alteration (E+A+A) projects. 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. To obtain compliance credit for envelope leakage testing in an altered envelope, you must check the Building Leakage checkbox in the HERS Verified Existing Conditions Being Altered section of the dialog box.

To receive the credit, 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, as specified in the *Residential Manual*, Section 3.9.5, and in the Reference Appendices, Section RA3.8.



#### Leakage Type

If you check the Building Leakage Testing checkbox to claim credit for reduced leakage as described above, you must assign an identity or Type for the project. Select from the three options a Type that most closely matches your project.

- **Existing**

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

- **New**

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

- **Altered**

Select Altered if the building is being altered from existing conditions but is not part of an addition. To obtain compliance credit for envelope leakage testing in an altered envelope, you must check the Building Leakage checkbox in the HERS Verified Existing Conditions Being Altered section of the dialog box. You must then enter the existing building leakage to illustrate the building prior to any changes or replacement as well as the new leakage after the alteration.



## 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. The ACH50 credit is not available for multi-family buildings.

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, as specified in the *Residential Manual*, Section 3.9.5, and in the Reference Appendices, Section RA3.8.

Range & Units: 0 - 99

## 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 9.7 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 9.7 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 9.7 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 9.7 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 9.7 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 9.7 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 9.7 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 9.7 of the Residential Manual, and [Existing Plus Addition Plus Alteration Analysis](#) for additional details.

## Multi-Family

### Central Laundry

Check the box for multi-family projects with central laundry facilities.

### Location

Select the zone in which the laundry facility is located from the drop down list.

## 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



### 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

## Ventilation Cooling

Specify the type of ventilation cooling system, or None if none exists. Choices include: None, Whole House Fan, Central Fan Integrated (fixed flow), and Central Fan Integrated (variable flow).

Enter the system airflow (cfm) and power (watts) in the [Residential Tab of the System Element](#).

For Whole House Fans, enter manufacturer data or use the ventilation cooling fan default values equal to 1.5 cfm per square foot and 0.1 W/cfm.

*If you leave the airflow and power fields set to zero, the simulation will ignore the ventilation cooling system.*

## Residential Lighting Tab

Enter the data describing the indoor and outdoor lighting at the residence. Residential lighting measures are mandatory, and do not impact performance-based compliance calculations. This information is used for non-compliance calculations only, including HERS ratings.



### Indoor Lighting

Enter the quantity of each permanently-installed interior luminaire. Refer to [Table 7](#) from the CEC HERS Technical Manual to determine the luminaire count for each different luminaire type. Operating hours for Interior lighting for HERS projects are shown in [Table 6: Daily Lighting Hours – Interior](#).

Use the drop-down lists to quantify the permanently-installed interior lighting in the home. For each luminaire type, enter the number of luminaires, type, location, and type of control.

Luminaire Controls include:

- On / Off Switch
- Dimmer
- Occupant Sensor

Refer to [Table 8](#) from the CEC HERS Technical Manual to determine the proper classification for each luminaire type.

Luminaire Types include:

- High Efficacy
- Screw-in CFL
- Incandescent

Locations include:

- Small Closet
- Bedroom / Walk-in Closet
- Hall / Entry / Stairs / Other
- Living
- Utility / Laundry, and
- Kitchen/Dining/Nook

### Lighting Reduction from Standard

Enter the amount of lighting reduction below the Standard allowance, in percent.



### Outdoor Lighting

Enter the quantity of each permanently-installed exterior luminaire. Refer to [Table 7](#) from the CEC HERS Technical Manual to determine the luminaire count for each different luminaire type. Operating hours for exterior lighting for HERS projects are shown in [Table 10: Daily Lighting Hours – Exterior](#).

Use the drop-down lists to quantify the permanently-installed exterior lighting in the home. For each luminaire type, enter the number of luminaires, the location, and the type of control.

Luminaire Control choices include:

- On / Off Switch
- Sensor (photocontrol with motion sensing for outdoor lighting, occupant sensor for interior garage lighting)

Luminaire Types include:

- High Efficacy
- Screw-in CFL
- Incandescent

Refer to [Table 8](#) from the CEC HERS Technical Manual to determine the proper classification for each luminaire type.

Locations include:

- Garage
- Front Entry
- Outdoor

## 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, where no continuous lighting is allowed, with increasingly more power allowed in Zones 1, (parks, wildlife preserves, etc.), 2 (rural areas), 3 (urban areas), and 4 (special use districts).

Exterior lighting applications addressed by the Standards are shown in [Table 6-2, 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. The program automatically determines the allowable lighting power to be used in the Standard (Budget) Energy calculation. 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 box.

EnergyPro will calculate the allowable outdoor lighting power for both the Title 24 and ASHRAE standards.

### **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 Building Tree. The installed LPD (including control credits) is shown to the right.

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.


EnergyPro will calculate the allowable outdoor lighting power for both the Title 24 and ASHRAE standards.

### **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 Btu/hour, 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 home has a swimming pool, select the swimming pool characteristics from the drop-down list. Choices include:

- None
- Gas heated with cover
- Gas heated with no cover
- Solar or not heated
- Electric heated with cover, and
- Electric heated with no cover

If there is no swimming pool, select None.



### **Pool Volume**

Enter the volume of the pool, in gallons. You may click on the “Pool Volume” hyperlink to open a web page that contains a Pool Volume Calculator tool.



### **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. 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 5.7 in the Residential Manual for details regarding the minimum pipe sizes required by pool volume (and other requirements).



### **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 5.7 in the Residential Manual for details regarding the minimum pipe sizes required by pool volume (and other requirements).

## **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 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.

### **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 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.

### **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.

## **PV Tab**

The Standards provide a compliance credit for photovoltaic systems that meet the eligibility requirements for new single family and low-rise multifamily projects. Enter the specifications for the photovoltaic (PV) system in the PV Tab. Refer to Section 2.2.3: PV System Credit, in the Residential ACM Reference Manual for additional 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 as of 2013.



### **Output**

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



### **California Flexible Installation**

When California Flexible Installation (CFI) is selected, inputs are simplified and specific orientation, tilt and shading conditions are not required. The performance of the PV system is estimated based on a PV system

installed with an azimuth ranging from 150° and 270° and with all modules at the same tilt as the roof (for roof pitches between 0:12 and 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. Additionally, each system on each site must meet the “minimal shading” criterion.

#### **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

#### **kWh**

Enter the estimated annual electricity production from each module. You may obtain this information from the CECPV Calculator Results data.

#### **Savings**

Enter the estimated annual cost savings from each module.

### **Allow Excess PV Production to be Applied in EDR Calculation**

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 6 kWh, the EDR credit is limited to a system size equal to 1.6 times the estimated site annual electricity usage. The effect of a larger PV array has a minimal impact on the EDR score.

### **Battery Storage for PV**

Net Energy Metering (NEM) sets rules for compensating PV-generated electricity. NEM sizing rules limit the PV to a size equal to the site annual kWh. Compensation varies by (1) behind the meter self-utilized kWh, (2) hourly exports, and (3) net annual surplus.

#### **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

## **Optimize Charging and Discharging**

Check the box if the battery control strategy meets the requirements for an EDR credit for Advanced/Utility or Aggregator-Controlled storage. This is a more sophisticated control strategy that maximizes the TDV value of stored electricity. If charging is optimized (advanced control), the software assumes the batteries are charged when generation exceeds the load; batteries only discharge during the highest “anticipated” TDV intervals to maximize the value of the stored electricity.

Note that this credit only applies to the EDR score. It is not a compliance credit in the 2016 Standards.

## **Charging/Discharging Rate**

Enter the charging and discharging rates (in kW) for the battery storage system, from manufacturer’s data. The default rate is 5 kW.

Range & Units: 0.0 - 999.0 kW

## **Charging/Discharging Efficiency**

Enter the efficiency with which the battery charges and discharges, as a percentage. The default efficiency is 95%.



## Exterior Application Element

The Standards now address general site illumination and specific outdoor lighting applications (Section 140.7). Exterior lighting applications addressed by the Standards are shown in the Nonresidential Manual, [Table 6-2, 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 Outdoor Lighting and Signs can be found in Chapter 6 of the Nonresidential 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 Table 140.7-A (in the Standards) General Hardscape Lighting Power Allowance or Table 140.7-B (in the Standards) 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 the Outdoor Lighting Chapter of the Nonresidential 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.

90.1 Baseline: Displays the maximum lighting power (Watts) allowed by ASHRAE 90.1 based upon 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 sign energy Standards 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 energy Standards 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, §140.8. §140.8 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 Compliance Manual.



### Name

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



### 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<sup>2</sup> 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<sup>2</sup> times the area of the sign face.
- Alternate Lighting Sources. 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 (T5 & T8)  
Compact Fluorescent  
Electronic Ballast



### 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 ft<sup>2</sup>

**SI (Metric):** 0.00 - 92,899.9 m<sup>2</sup>





## Plant Element

[Heating Hot Water](#)

[Chilled Water](#)

[Hydronic Tab](#)

[Domestic Hot Water Tabs](#)

[Exceptional Tab](#)

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



#### Type

Select Existing, New, or Altered from the drop-down list to indicate the Hot Water Boiler type.

- **Existing**

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

- **New**

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

- **Altered**

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



#### 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

## 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



### HW (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), divide 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

## Input as Watts

You may 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

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.



### 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](#).

## 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](#). This entry is required for buildings with central Chillers. 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.

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.

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.

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.



## Balance Load

Check the box if you wish to operate all chillers in each load range. Leave the checkbox blank (unchecked) if you wish to operate only particular chillers within each load range. The standard design chiller(s), as defined in the Nonresidential ACM Reference Manual Section 6.8.8 Plant Management, operates to 90% capacity prior to the staging of the next chiller.



## 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), divide 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

### **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)



### **Percentage Propylene Glycol in Loop**

Enter the percentage of propylene glycol in the water loop, if any. Propylene glycol reduces the temperature at which the water/glycol mixture will freeze, providing anti-freeze protection in VRF condenser water loops. However, propylene glycol provides a lower heat transfer rate than water-only closed loop systems.

### **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), divide 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

## 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



## Type

Select Existing, New, or Altered from the drop-down list to indicate the DHW or Boiler type.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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](#).

---

**NOTE:** For NR T24 Performance calculations, **CBECC-Com** assumes a storage natural gas water heater for the Standard Design. If the project is using an electric resistance water heater, the performance simulation will produce a large penalty. Electric resistance water heaters (provided they meet all mandatory requirements) do comply using the prescriptive approach. If your project includes an electric resistance water heater, you may wish to exclude it from the simulation and use the prescriptive method to avoid a compliance penalty.

---



## Multiplier

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

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

## 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
- All Pipes Insulated (HERS)
- Parallel Piping (HERS)
- Recirculation: Demand Push Button (HERS)
- Recirculation: Demand Motion (HERS)
- Compact (HERS)

Mandatory requirements for distribution systems are explained in Section 5.3 of the state's *Residential Compliance Manual*. Refer to Section 5.5 of the Residential Compliance Manual for Performance Method distribution system multipliers.

## Solar Domestic Hot Water



## Net Solar Fraction

Enter the percentage of domestic hot water heating load that is met by the solar water heating system. See Chapter 5 of the state's *Residential Manual* for the guidelines and the use of an approved program (e.g., f-Chart) to calculate annual solar performance.

Range & Units: 0 – 100%



## Multi-Family Central System

Check this option when the proposed design has a central system which requires that you describe the pump and pipes.

## (Multi-family Central System) Pump



## Pump - Control

Choose the type of control for the multi-family central DHW system recirculation pump. The choices are:

- No loops or central system pump
- Dual Loop Design
- No Control (continuous pumping)
- Demand Control (Standard Design)
- Temperature Modulation

- Temperature Modulation plus Monitoring



### Pump Multiplier

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

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



### Design Power

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):** 0.000 - 99,999.000 hp (brake horsepower)

**SI (Metric):** 0.00 - 74,599.25 kW

## (Multi-family Central System) Piping



### Length Outside

Enter the length, in linear feet, of the central DHW system piping located outside.

Range & Units:

**Imperial (US):** 0.0 - 99,999.0 feet

**SI (Metric):** 0.0 - 30,479 meters



### Length Underground

Enter the length, in linear feet, of the central DHW system piping located underground.

Range & Units:

**Imperial (US):** 0.0 - 99,999.0 feet

**SI (Metric):** 0.0 - 30,479 meters



### Length in Plenum

Enter the length, in linear feet, of the central DHW system piping located in the plenum space.

Range & Units:

**Imperial (US):** 0.0 - 99,999.0 feet

**SI (Metric):** 0.0 - 30,479 meters



### Additional ½" Insulation

Check this box if the pipe has at least ½ inch more insulation than the minimum Title 24 requirement.

## Residential Heat Pump Water Heater

### Location

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.

## Exceptional Tab

The entries on this tab apply only to LEED Innovation in Design calculations.



### Name

Enter a descriptive name for the innovative or exemplary technology or strategy.



### Description

Enter a brief description of the technique or strategy.

## Electricity Tab

Enter the monthly energy usage, demand, and cost savings associated with the technology or strategy.



### Energy

Enter the estimated renewable system energy production (nonrenewable energy savings) for each month.



### Demand

Enter the estimated maximum demand (in kW) produced by the renewable system each month.



### Cost

Enter the estimated electricity cost savings (in \$) from the photovoltaic system each month.

## Gas Tab

Enter the monthly energy usage and cost savings associated with the innovative or exemplary technology or strategy.



### Energy

Enter the estimated renewable system gas savings (in therms) for each month.



### Cost

Enter the estimated gas cost savings (in \$) from the renewable system each month.



# System Element

Use the System element of the Building Tree to enter the Heating, Ventilating, and Air Conditioning System information. The System element contains five tabs, General, Distribution, Residential, HERS Credits, and MECH-2. 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 [MECH-2 Tab](#) contains information that will appear on the Title 24 MECH-2 nonresidential forms.

## System Details



### Name

Enter a descriptive name for the System. The system name will appear on both residential and nonresidential compliance and loads documentation.



### System Type

Select Existing, New, or Altered from the drop-down list to indicate the System Type.

- **Existing**

An existing system that will not be altered. Select when performing an Existing + Addition + Alteration or Existing + Alteration.

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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.



### Thermal Loads/Occupancies Differ or Constant Volume Required For Process

Check the box if the system must supply constant air volume to serve a process load. Fan power required solely for process loads is excluded from the system fan power calculations.



### Exempted Fan Power

Enter the fan power that is exempt from the fan power consumption requirements. Exempted fan power includes fans used solely for air treatment or filtering where the pressure drop is greater than one inch water column (or 245 pascals), or fans serving a process load. Note that only the fan energy associated with pressure drop over one-inch water column may be excluded.



### Heated Only Storage

Check the box if the space is a storage space with mechanical heating, but no mechanical cooling.



### 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](#)



### Space >5,000 square feet, AND Ceiling Height >15 feet AND LPD $\geq$ 0.5 Watts per square foot.

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 this criteria. Under the Performance Approach, this will set the baseline.



### Outside Air From:

Section 120.1 of the Standards lists requirements for mechanical ventilation. 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



### Distribution Type

When performing an Existing + Addition/Alteration calculation, the user must specify the status or Type for each element in the building tree. Select from the three options a Type that most closely matches your distribution system.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the “existing” field.



### 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 40 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 40 feet.

## 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



## 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 Insulation

Input the rated R-Value of the duct insulation.

Range & Units:

**Imperial (US):** 0.0-999.0 (hr)(ft<sup>2</sup>)(°F)/Btu

**SI (Metric):** 0.00 - 174.2 (m<sup>2</sup>)(°C)/W



## Less than 12 Feet of Duct in Unconditioned

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 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

Check the box if the ducts have been sealed to minimize leakage. 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

Check the box 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.



### 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.



### Ducts in Conditioned Space with Leakage Verified

Check the box 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 25cfm when measured at CEC-specified conditions by an approved HERS rater.



### 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 area. Refer to Reference Appendix 3.1.4.1 for additional information regarding the duct design requirements.



### Supply Duct Area

Enter the area, in square feet, of the supply ducts in the distribution system if the project meets the criteria for duct design credit, and will be field-verified by a HERS rater.



### Return Duct Area

Enter the area, in square feet, of the return ducts in the distribution system if the project meets the criteria for duct design credit, and will be field-verified by a HERS rater.



### Buried Ducts in Attic

Select the status of the ducts from the drop-down list. Choices include: Not Buried, Buried, or Deeply Buried.

## 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. 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, Whole House Fan directory at <http://www.appliances.energy.ca.gov/>

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 4.7.12 in the Residential Manual for additional information regarding whole house fans and ventilation cooling requirements.



### Ventilation Cooling Airflow

If the house has a ventilation cooling system, you must specify the type in the [Residential Tab of the Building Element](#) to enable the Airflow and Power input fields.

Enter the airflow of the whole house fan, or Central Fan Integrated (CFI) system, in cfm. Prescriptive requirements in Climate Zones 8-15 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 0.1 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

Enter the ventilation cooling system power demand, in watts.



### 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.

## HERS Credits Tab

There are several compliance credits available for improving the efficiency of heating and cooling 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](#)

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**NOTE:** All HERS credits require field inspection and verification by an approved HERS rater. Also refer to the *Residential Manual*, Section 2.5 and Chapters 3 and 4 for more details regarding HERS credits and requirements.

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### 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 or Charge Indicator Display**

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 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-C and 150.0-D (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 4.5.2 of the Residential Manual, and Standards Section 150.0(m)15 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 is for an air-handling unit fan efficacy less than or equal to 0.58 Watts/cfm as verified by a HERS rater. 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 Residential 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 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  $\leq 0.58$  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.

Refer to [Zonal Controls](#) and to Section 4.5.2 in the Residential Manual for additional information regarding the requirements for the zonal control credit.

## **MECH-2 Tab**

### **MECH-2 Features**



#### **Time Control**

Select the type of time control device for the system from the drop-down list. As stated in the Nonresidential Manual, *Section 4.5.1*, the choices include:

- Programmable Switch - with weekday/weekend features.
- Occupancy Sensor - for intermittently occupied spaces only
- Manual Timer - for intermittently occupied spaces only



#### **Outdoor Damper**

Select the type of outdoor air damper control. Choices include either Auto (motorized) or Gravity.



## Zone Element

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 Unconditioned, Conditioned, Return Air Plenum, Residential Living, Residential Sleeping, Residential Garage, and Indirectly Conditioned.

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. Refer to the Residential Manual, Section 4.6, for additional information on indoor air quality requirements, and 4.6.6 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.



#### Occupancy

View Occupancy List

Select Single Family or Multi-Family for low-rise residential buildings. Select High-Rise Residential Living for the living spaces in multi-family dwellings with four or more habitable floors. Select an occupancy type from the remaining categories for all other occupancies covered under the Nonresidential Standards.

Select a Complete Building occupancy if all areas of the entire building are complete; 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.)



#### 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 residential projects: Number of Floors - Enter the number of identical floors in the zone.

For 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.



## 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 Room Type, enter the year the Zone was first built. Refer to Appendix B of the Residential Manual for additional information.



## Rotation

Use zone rotation for parts of the building which are set at an angle to the main building. The zone rotation will influence the orientations of all the walls, roofs, glazing, and doors in the zone. The Rotation field in the [Building Element](#) is available to set the orientation for the whole building.

Enter the rotation of the zone measured clockwise from the building rotation, in degrees. A zone rotation of zero means the zone has the same orientation as the whole building; a zone rotation from 0° to 180° indicates the zone is rotated to the east of the building rotation; while a zone rotation from 181° to 359° means that the zone is rotated to the west of the building rotation.

It is recommended that you not use this feature in residential buildings and use it very judiciously in nonresidential buildings.

Range & Units: 0 - 360°



## 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, all zones on that floor are multiplied by the number entered, even if served by a different HVAC system.



### (Select Building Story) Floor Name

Enter the Floor Name for the zone.



### (Select Building Story) Floor Multiplier

Enter the number of identical floors, stacked vertically. Note that when you use the Floor Multiplier, all zones on that floor are multiplied by the number entered, even if served by a different HVAC system.

The Floor Multiplier allows you to describe one floor then enter the number of times it occurs including the first occurrence, as a floor (vertical) multiplier. The floor multiplier assumes that the multiplied 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 multiplier equals three, then the multiplied floors are assumed to be the second, third, and fourth floors.

The Floor Multiplier 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.

Range & Units: 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 daylight spaces. Window head height is used to calculate the primary and secondary sidelit daylight areas.

The following text is an excerpt from the Standards, Sec 130.1(d) Automatic Lighting Controls. .

*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.*

*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.

#### 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/ft

**SI (Metric):** 0.00 - 1,065.24 W/m



## 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)



### 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 CO2 sensors, and do not allow VOC or other indoor air quality sensors to meet the requirement. The following text is an excerpt from the Section 4.3.7 of the Nonresidential Manual. Refer to that section for additional details on DCV system requirements.

The Standards require the use of DCV systems for spaces with all of the following characteristics:

1. Served by single zone units with any controls or multiple zone systems with Direct Digital Controls (DDC) to the zone level, and
2. Have a design occupancy of 40 ft<sup>2</sup>/person or smaller (for areas without fixed seating where the design density for egress purposes in the CBC is 40 ft<sup>2</sup>/person or smaller), and
3. Has an air economizer

There are five exceptions to this requirement:

1. The following spaces are permitted to use DCV but are not required to: classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft<sup>2</sup> per §120.1(b)2B (Table 4-13 and [Table 4-14](#)), healthcare facilities and medical buildings, and public areas of social services buildings.
2. Where the space exhaust is greater than the required ventilation rate minus 0.2 cfm/ft<sup>2</sup>.
3. DCV devices are not allowed in the following spaces: 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 or areas designated for unvented food service preparation, or beauty salons.
4. Spaces with an area of less than 150 ft<sup>2</sup>, or a design occupancy of less than 10 people per §120.1(b)2B (Table 4-13 and Table 4-14).
5. Spaces less than 1500 ft<sup>2</sup> that comply with §120.1(c)5 Occupant Sensor Ventilation Control Devices.



### Operable Window Interlock

Check this box if the building is designed with both natural ventilation (operable windows) and mechanical ventilation and cooling. The interlock controls are required when modeling natural ventilation systems.



### 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.

Range & Units: 0.00 - 20.00 AC/Hr



### Heating Supply Air Flowrate

Enter the Heating Supply Air Flowrate 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 Exhaust Fan.

## **Ventilation (from Room Inputs)]**

Enter the Supply Air Flowrate. This input is only required for VAV systems which will comply under the Prescriptive Approach.

### **Area Basis**

The software automatically calculates the mechanical ventilation based upon floor area of the space, and the occupancy type, as shown in Standards Table 120.1-A in the NR T24 Performance compliance calculations, as described in Section 4.3 of the Nonresidential Compliance Manual.



### Occupancy Basis

The Occupancy Basis method uses the Ventilation and Occupant Density values input in the [Occupant Tab](#) 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 4.3 of the Nonresidential Compliance Manual.



### **Air Change Basis**

Enter the number of air changes per hour for the Air Change Basis.

Range & Units: 0.00 - 20.00 AC/Hr

### **[Exhaust Fan Basis]**

This is not a Program input. The field displays the airflow per square foot of all exhaust fans in the zone.

## **Exhaust Fan**



### **Type**

Select the type of exhaust fan, options include: General, Laboratory, Commercial Kitchen, or Parking Garage.



### **Quantity**

Enter the number of identical exhaust fans in the Zone.



### **CO Sensors**

Check the box if the exhaust fan is controlled by CO sensors. This input is only used for Parking Garage ventilation systems.



### **(Exhaust Fan) Flow Control**

Select the type of exhaust fan airflow control. Options include: Constant Flow Constant Speed, Variable Flow Constant Speed, and Variable Flow Variable Speed.



### **Fan Control**

Select the type of exhaust fan control. Options include: Constant Volume, Variable Speed Drive, Discharge Dampers, Inlet Vanes, and Two Speed.



### **Fan Type**

Select the exhaust fan type. Options include: Centrifugal Air Foil, Centrifugal Backward Inclined, Centrifugal Forward Curved, and Axial.



### **Configuration**

Specify the exhaust fan configuration. Options include: Blow-Through, Draw-Through, or Outside Airflow.



### **Design Airflow**

Enter the rate at which the exhaust fan expels air from the room.

Range & Units:

**Imperial (US):** 0 - 999,999 cfm

**SI (Metric):** 0 - 999,999 L/s



### **Minimum Airflow**

Enter the minimum rate at which the exhaust fan expels air from the room.

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 exhaust fan 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% (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.

Range & Units: 1 – 9,999,999 watts

## **Process**

### **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 PRC-12-E Elevator Lighting and Verification.

### **Escalators**

Enter the number of escalators in the zone. 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 Escalators and Moving Walkways Speed Controls.

## 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 of major appliances, and the ventilation system for indoor air quality (IAQ) 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 [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 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:  $\text{Area of addition} / (\text{Area of existing} + \text{addition})$ .

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.

### Appliances



#### Range

Check the box if there is a Range/Oven located in the dwelling unit. This entry does not impact the compliance results.





### **(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**

Check the box if there is a Washer located in the dwelling unit.



### **Dryer**

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.

## **Mechanical Ventilation**

New low-rise residential buildings and additions greater than 1,000 square feet must have mechanical ventilation that complies with ASHRAE Standard 62.2 to provide acceptable indoor air quality. In addition, the system must be field-verified by a certified HERS rater. This is a mandatory measure, and may not be omitted or traded off.

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.

Many times, the energy used for mechanical ventilation is compliance neutral or nearly neutral because the standard design is often set equal to the proposed design



### Use Non-Default IAQ Fan

Check the box if you plan to use a mechanical ventilation system that is different from the default system. The default system is a standalone exhaust fan that meets ASHRAE Standard 62.2 requirements. You must also complete the additional information describing the system. If you leave it blank, EnergyPro will automatically calculate and model the default system.



### Fan Type

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.



### Airflow

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



### Power

Enter the total Watts for the IAQ fans.

Range & Units: 0 - 99,999 W



### Heat Recovery

If the IAQ fan type is “Balanced”, enter the efficiency of the heat recovery system.

Range & Units: 0.0 – 1.0



# 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 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 ft

**SI (Metric):** 0.00 - 92,899.9 m



### Winter Indoor Temperature

Enter the indoor temperature of the zone during the heating season. The value specified in the Title 24 Standards is 68°F (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 Residential Tab of the Building Element.

Range & Units: 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 [Mechanical Tab](#) 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 ft/occ

**SI (Metric):** 0.1 - 9,289.9 m/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

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 (Res T24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

Range & Units:

**Imperial (US):** 0.000 - 999.000 W/ft

**SI (Metric):** 0.0 - 10,749.24 W/m



### (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 (Res T24 Performance and NR T24 Performance) is internally fixed by the program according to occupancy.

#### Range & Units:

**Imperial (US):** 0.000 - 999.000 W/ft

**SI (Metric):** 0.0 - 10,749.24 W/m



### **(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/ft

**SI (Metric):** 0.0 - 10,749.24 W/m



### **(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/ft

**SI (Metric):** 0.0 - 10,749.24 W/m



### **(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 Internal Gains**



#### **Load**

Enter the load attributable to domestic hot water.

#### Range & Units:

**Imperial (US):** 0.0 - 999,999.0 Btu/hr-occ

**SI (Metric):** 0.0 - 293,099.7 W/occ



#### **Sensible Heat Gain**

Enter the portion, as a decimal, of the DHW load that is sensible heat gain. Sensible heat is the energy required to change the temperature of completely dry air (0% relative humidity) measured by a dry bulb thermometer.

Range & Units: 0.00 - 1.00 (units N/A)



### Latent Heat Gain

Enter the portion of the DHW load that is latent heat gain. 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.

Range & Units: 0.00 - 1.00 (units N/A)

## Lighting Tab

### Task Data



#### IES Lux

Use this field when performing Tailored Lighting calculations. Enter the allowed illumination level from Standards Table 140.6-D, in lux. Use this value, in combination with the Room Cavity Ratio, to determine the Allowed Lighting Power Density (LPD) for general lighting.



#### 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 daylight area. Refer to [Nonresidential Compliance Modeling Topics](#) for more details.

Range & Units:

**Imperial (US):** 0.0 – 9,999,999 ft

**SI (Metric):** 0.00 - 929,030 m



#### 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 daylight area. Refer to [Nonresidential Compliance Modeling Topics](#) for more details.

Range & Units:

**Imperial (US):** 0.0 – 9,999,999 ft

**SI (Metric):** 0.00 - 929,030 m

## **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 ft

**SI (Metric):** 0.0 - 9,289.9 m

---

**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.

---



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 Performance calculations, only create the Existing component if the existing condition for that component will be field-verified by a HERS Rater. Otherwise, the software sets the baseline as shown in Table 150.2-B in the Standards. You must check the box in the Residential Tab of the Building Element indicating the existing condition will be HERS Verified prior to the alteration to enable the “existing” field, and to obtain compliance credit for the alteration.



### 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 90° tilt. However, The software will accept values between 60° and 135°. A surface with a tilt of less than 60° is considered a Roof.



## Extension to an Existing Wall

Check the box if the new wall is 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 Residential T24 Prescriptive additions.

## Surface Geometry for Shading Devices

If you specify exterior shading (overhangs or sidefins) for glazing in 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. Specify the window geometry in the [Window Element](#) screen.



## 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 glazing in NR T24 Performance calculations, you must specify the wall width and height. You must also specify the window width, height, and the position of the window on the wall in the Window Element.

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. You must also specify the window width, height, and the position of the window on the wall in the Window Element.

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 2016 Title 24 and 2013 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 ft

**SI (Metric):** 0.0 - 9,289.9 m

---

**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.

---



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the Building Tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 2016 Title 24 and 2013 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.



### Overhang

Click in this multi-edit box to select an Overhang assembly from the [Overhang Library](#). For NR T24 Performance calculations, when you specify an overhang or sidefin, you must also enter the surface geometry (window width, height, and position on the wall) of the glazing with overhang or sidefin. In the Wall Element, you must also specify the width and height of the wall.



### Sidefin

Click in this multi-edit box to select a Sidefin assembly from the [Sidefin Library](#). For NR T24 Performance calculations, when you specify an overhang or sidefin, you must also enter the surface geometry (window width, height, and position on the wall) of the glazing with overhang or sidefin. In the Wall Element, you must also specify the width and height of the wall.

## 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).



## 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 ft

**SI (Metric):** 0.0 - 9,289.9 m

---

**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.

---



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 50% glass are input as glazing. For a partial glass door ( $\leq 50\%$ ), 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.

---

### **[Not a Program Input] Code Comparison**

EnergyPro displays the 2016 Title 24 and 2013 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 3.8 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 Res T24 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 ft (3.7m). 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 ft

**SI (Metric):** 0.0 - 9,289.9 m



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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

### [Not a Program Input] Code Comparison

EnergyPro displays the 2016 Title 24 and 2013 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 ft

**SI (Metric):** 0.0 - 9,289.9 m

---

**NOTE:** The range for skylight area is dynamic. The total skylight area in one roof can never be greater than the total roof area.

---



### Surface Type

When performing an Existing + Addition/Alteration calculation, the user must assign an identity or Type for each element in the building tree. Select from the three options a Type that most closely matches your surface.

- **Existing**

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

- **New**

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

- **Altered**

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

For Res T24 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 Residential 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 2016 Title 24 and 2013 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.

## Daylighting Tab

### Skylight Well



#### Reflectance

Enter the reflectance of the walls of the skylight well. Used in the daylight effectiveness calculation for the well. A value of 1.0 would indicate a perfectly reflecting surface.

Range & Units: 0.10 - 1.00 (units: N/A)



#### Height

Enter the height of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

**Imperial (US):** 0.0 – 999.0 ft<sup>2</sup>

**SI (Metric):** 0.0 – 304.5 m<sup>2</sup>



#### Width

Enter the width of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

**Imperial (US):** 0.0 – 999.0 ft<sup>2</sup>

**SI (Metric):** 0.0 – 304.5 m<sup>2</sup>



#### Length

Enter the length of the skylight well. Used to determine the overall well effectiveness in daylighting calculations.

Range & Units:

**Imperial (US):** 0.0 – 999.0 ft<sup>2</sup>

**SI (Metric):** 0.0 – 304.5 m<sup>2</sup>



# Lighting Element



## Name

Enter a descriptive name of the fixture(s).



## 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](#).



## Status

Select the status of the luminaire from the drop-down list. Options include Existing, New, and Altered.



## 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.



## Control (Indoor Lighting Only)

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 and 5.6 of the *Nonresidential Manual*. If you select any of the daylighting controls, you must first calculate the credit that the fixture is eligible to receive using the criteria listed in the Standards, Table 140.6-A. Controls must be installed on all fixtures specified in this element. You must provide supporting documentation for lighting control credits.



## Footnote

When using the Area Category method of compliance, the Standards allow additional lighting power for illuminating specialized task work, ornamental lighting, precision work, accent, display, and decorative, features, white boards, chalk boards, and lighting for a video-conferencing studio.

If eligible, select one of the Footnote Adjustments from the drop-down list, also shown in the footnotes of Table 140.6-C and Section 5.7.2 of the *Nonresidential Manual*.



## Lighting Task Element




### Name

Enter a descriptive name of the Task.



### Type

Use the Type drop down list to either select the “Task” or a Display (Wall, Floor, Ornamental, or Very Valuable) lighting category. Selecting Task enables the Select Activity button  to select a specific task activity as described in the “Activity” entry. Selecting a Display type enables the Tailored Method entries below. Refer to the Nonresidential Manual for additional details.



### Area

Enter the area of the task.

Range & Units:

**Imperial (US):** 0.0 - 99,999.0 ft

**SI (Metric):** 0.0 - 9,289.9 m



### 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.

### Task Lighting

**NOTE:** Insert the 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

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.

The libraries that 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 with access to the CEC-certified HVAC Equipment Directories.
- [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), with access to CEC-certified equipment directories.
- [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. You may revise the Project Defaults from the left pane also, but your changes will not be applied 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 automatically saved in Version 7. 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.



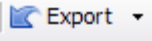
*Delete:* Click the “X” after highlighting the item you want removed from the library. Use caution--there is no Undo feature to recover items you delete; you must re-create them.



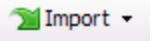
*Move Item Up:* Use the up arrow “↑” to move the selected entry up on line. You may rearrange the order of the library entries at any time.



*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.



*Import:* This choice is only available for selected libraries that are based upon the CEC Equipment Directories (Assembly, Central and Boiler). Use Import to add an entry from the CEC's equipment directory to your library. In the Central and Boiler Libraries, you may [filter the equipment list](#) by capacity/volume and efficiency criteria to simplify your search.

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**NOTE:** You may access the CEC Equipment Directories and **Import** selected listings into your Assembly, Central System and Boiler libraries.

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# 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 software 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 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 related to the roof. For Doors, specify whether the door has an automatic closer.

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. 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 3.8.2 of the Residential Manual for additional details regarding radiant barrier installation requirements.

Note that because of limitations in the CEC Compliance Manager, you may not model a radiant barrier in a part of the attic at this time. The presence of a radiant barrier must be applied to the entire attic space. If there is no radiant barrier specified in any part of the attic, the software assumes there is no radiant barrier at all.



#### **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 Cool Roof. The roofing material must have CRRC Certification and an initial thermal emittance greater than or equal to 0.75 and a minimum initial solar reflectance of 0.20. The reflectance and emittance values are ignored unless you check the CRRC 1 Certified Roofing checkbox. Compliance credit may be taken when a certified cool roof is installed when using the performance approach. There is no heating impact calculated for a cool roof (while there is some heating benefit assumed for a radiant barrier).

Default values used in T24 performance calculations for uncertified asphalt shingle roofs are equal to 0.08 for solar reflectance and 0.75 for emittance. For all other roofs, the values are 0.10 and 0.75 respectively. Liquid-applied coatings are not commonly used on residential buildings, but the Standards allow for them as cool materials for low-slope applications under §110.8(i).



### Roofing Type

Select the roofing type that best describes the project roof. Choices include:

- Lightweight (<5 lbs/sqft) / Asphalt
- 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) requires all directly conditioned spaces with 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:

Loads, Res T24 Prescriptive, Res Green Point Rated, Res Performance, and NR T24 Prescriptive.

### [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)(ft<sup>2</sup>)(°F)/Btu

**SI (Metric):** 0.00 - 17.42 (m<sup>2</sup>)(°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)(ft<sup>2</sup>)(°F)/Btu

**SI (Metric):** 0.00 - 17.42 (m<sup>2</sup>)(°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)(ft<sup>2</sup>)(°F)

**SI (Metric):** W/m<sup>2</sup>(°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/(ft<sup>2</sup>)(°F)

**SI (Metric):** kJ/m<sup>2</sup>(°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.



### Cavity

Enter the R-value of the insulation being added to the cavity/interior/exterior of the assembly.

Range & Units:



**Imperial (US):** 0.0-99.0 (hr)(ft<sup>2</sup>)(°F)/Btu  
**SI (Metric):** 0.00 - 17.42 (m<sup>2</sup>)(°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



### Exterior Wall Finish

Select the exterior wall finish from the drop-down list. Choices include: Stucco, Synthetic Stucco, and Wood 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 3.7](#) 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 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.

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# 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.

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NOTES: 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.

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## 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. When entering glass names, you might consider including abbreviations for the type of application. For example:

(R) = Residential application

(NR) = Nonresidential application



### 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. Selecting the Default U-Factor enables the Fenestration Properties fields. EnergyPro will select the appropriate U-Factor from [Table 110.6-A](#) for the glazing product.
- **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 NA6-2016](#), for skylights and site-built fenestration in projects with less than 1,000 square feet of glazing.
- [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-ft<sup>2</sup>(°F)

**SI (Metric):** 0.000 - 17.034 W/m<sup>2</sup>(°C)

Glazing U-Factors entered here are used in the compliance calculations and are printed on the applicable compliance forms.



## 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**

When utilizing the Default option for either/or both the U-Factor and the SHGC the **Default Fenestration Properties** will allow one to tailor the inputs to adequately reflect the proposed glass construction. See [Table 110.6-B](#) .

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 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



### **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.



### **Pane Dividers**

Select if the glazing product has pane dividers.



### **Operable**

Check the Operable checkbox if the fenestration is operable (as opposed to fixed).

### **Door Has Automatic Closer**

Check the checkbox if the fenestration is a door and has an automatic closer. Standards Section 140.4(n) requires all directly conditioned spaces with 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.

---

# 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



---

# 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 by 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 *Directory of Certified Water Heaters*

([http://www.energy.ca.gov/appliances/appliance/excel\\_based\\_files/Water\\_Heaters/](http://www.energy.ca.gov/appliances/appliance/excel_based_files/Water_Heaters/)) and the GAMA *Consumers' Directory of Certified Water Heater Efficiency Ratings*. See Chapter 5 of the state's *Residential Manual* for additional information on these and related publications.

Access the CEC Equipment Directories from within the library edit dialog box by clicking Import, as explained below. Choose a specific directory: Gas Water Heater, Electric Water Heater, or Gas Boilers and the directory list will appear. Highlight the equipment you want, and then click **Select**. The entry will be added to your library

---

**Important Reminder:** When you select a water heater or boiler from a CEC Equipment Directory, **only the data displayed in the equipment directory listing will become part of your input for that unit.** For example, if you select a Gas Fired Water Heater, only the brand name, model number, volume, input rate, Thermal Efficiency, Energy Factor, and Standby Loss will be part of the Import maneuver. You will have to input the Pilot Loss and External Insulation value (R-Value), when appropriate.

---

- *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 rearrange 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

### **UEF-Rated**

Check the box if the unit has the new Uniform Energy Factor (UEF) rating. Then enter the UEF value into the Uniform Energy Factor field. EnergyPro automatically converts the UEF to the Energy Factor, which will be used in the simulation.

### **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 (Rate)**

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 new federal efficiency metric for water heaters, effective June 12, 2017. The UEF allows a direct comparison 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.

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 watts of the mini-tank from the CEC's appliance directory.



## 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 use of the pilot light, if one exists.



## 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

## Import

Access the CEC Equipment Directories from within the library edit dialog box by clicking Import. Choose a specific directory: Gas Fired Water Heaters, Electric Water Heaters, and Gas Fired Boilers. There is an alphabetical drop down list on the top left of the Import Library for Brands if you wish to search by company name. There is also a drop down list for Type (All, LPG, Natural Gas, and Oil). Highlight the manufacturer and the model you want, and then click **Select**. Once you have made a selection, the name and basic data will be filled in automatically for you. You must input additional pertinent data.

---

**Important Reminder:** When you select equipment from a CEC Equipment Directory, **only the data displayed in the equipment directory listing will become part of your input for that unit.** For example, if you select a Gas Fired Water Heater, only the brand name, model number, volume, input rate, Thermal Efficiency, Energy Factor, and Standby Loss will be part of the Import maneuver. You will need to input the Pilot Loss and External Insulation ( R-Value), when appropriate.

Note that the imported data will overwrite the data in the selected item. To create a new (additional) item in the library, click on the “+” button to create a new entry, then click Import.

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# Luminaire Library

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. All fixture types are normally defined in the Lighting Library before entering the Building Tree. Otherwise, you will not have the correct fixtures from which to select. Of course, you can 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.

All inputs (excluding the Light Fixture Name) are described further in the state's *Nonresidential Manual* in Section 5.3. The values input here are listed on the Lighting Compliance forms printed out by the program.

## Explanation of Lighting Inputs

### 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.

### 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

### Default Value

Check the box if using the default luminaire wattage from Reference Appendices, NA8: Luminaire Power. You must either use the NA8 default values or determine the luminaire wattage according to Section 130.0(c).





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# Chiller Library

[General Tab](#) [Gas Chiller Tab](#) [TES Chiller Tab](#) [Heat Recovery Chiller Tab](#) [Curves Tab](#)

In Libraries, located on the lower left hand side of the window, select the Chiller Library. All Chiller types are normally defined in the Chiller Library before entering the Building Tree. Then, as you work through the Building Tree, the chillers you need will be readily available. Of course, you can 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 **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 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 Nonresidential ACM Manual Section 5.8.2, is selected based upon the cooling load, as shown below.

<u>Total Cooling Plant Load</u>	<u>Standard Design Chiller Type</u>
≤ 300 tons	(1) water-cooled screw chiller
> 300 tons, < 600 tons	(2) water-cooled screw chillers, sized equally
≥ 600 tons	minimum of (2) water-cooled centrifugal chillers, sized to keep the unit size below 800 tons

Each chiller in the standard design operates to 90% capacity prior to the staging of the next chiller.

### **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.

#### 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.

## Gas Chiller Tab



### Efficiency

Enter the efficiency of the gas chiller at ARI conditions.

Range & Units: 0.50 - 10.00 COP (Coefficient of Performance) units N/A



### Burner Efficiency

Enter the burner efficiency for the gas absorption chiller.

Range & Units: 0.000 - 1.000 (units N/A)



### Idle Ratio

Enter the idle ratio for the gas engine driven chiller.

Range & Units: 0.000 - 1.000 (units N/A)



### Jacket Heat Recovery Efficiency

Enter the jacket heat recovery efficiency for the gas engine driven chiller.

Range & Units: 0.000 - 1.000 (units N/A)



### Exhaust Heat Recovery Efficiency

Enter the exhaust heat recovery efficiency for the gas engine driven chiller.

Range & Units: 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 (TOUT) and the entering condensing water temperature (TIN). Air-cooled chiller curves are functions of the chilled water supply temperature (TOUT) 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.



## 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 - 48°F

**SI (Metric):** 2.2 - 8.9°C



## 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 - 105°F

**SI (Metric):** 18.3 - 40.5°C



## 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.

Range & Units: 0 - 999,999.0 kW

---

# Tower Library

[General Tab](#) [Tower Fan Tab](#)

In Libraries, located on the lower left hand side of the window, select the Tower Library. Cooling Tower types are normally defined in the Cooling Tower Library before entering the Building Tree. Then, as you work through the Building Tree, the cooling tower you need will be readily available. Of course, you can 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 Tab, 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:

- Closed Circuit: Per the Definitions in the Standards, a closed circuit cooling tower is “a closed-circuit cooling tower that utilizes indirect contact between a heated fluid, typically water or glycol, and the cooling atmosphere to transfer the source heat load indirectly to the air, essentially combining a heat exchanger and cooling tower into one relatively compact device.”
- Open Circuit: An open-circuit cooling tower allows direct contact between the process cooling water or fluid and the atmosphere.



#### 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 - 100°F

**SI (Metric):** 0.0 - 37.8°C



## 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



### (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



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# Central System Library

[Heating System](#) [Cooling System](#) [Controls](#) [Outdoor Air](#) [Fans](#) [Evaporative Cooling](#) [Curves](#)

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. All equipment types are normally defined in the Central System Library before entering the Building Tree. Then, as you work through the Building Tree, the system you need will be readily available. Of course, you can access the Central System Library from 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 which come with the program.

## Importing Equipment from the CEC Equipment Directories

Access the CEC Equipment Directories from within the library editing window by clicking **Import**, as explained below. Choose a specific directory: Gas Furnace, Air Conditioner, or Heat Pump. Highlight the equipment you want, and then click **Select**. Once you have made a selection, the entry will be added to your library, along with the basic system data. You may be required to input additional pertinent data.

---

**Important Reminder:** When you select a system from a CEC Equipment Directory, **only the data displayed in the equipment directory listing will become part of your input for that system.**

Note that the imported data will overwrite the data in the selected item. To create a new (additional) item in the library, click on the “+” button to create a new entry, then click Import. You may use this feature to build a specific HVAC system by importing the furnace data, then the matching condenser.

---

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.

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.

Fan energy is accounted for in both load calculations and NR Performance simulations. 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**

### **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, a generic name such as Existing System may be used.

---

**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).

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#### **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
- Packaged DX
- Hydronic Heat Pump
- Packaged VAV
- Packaged Multi-Zone
- Built-Up Single Zone
- Built-Up VAV
- Built-Up MZ
- Dual Duct
- 4 Pipe Fan Coil
- Room PTAC
- Packaged DX Single Zone VAV
- Chilled Beam
- Evap Cooler
- Variable Refrigerant Flow
- Single Package Vertical Unit
- Built Up Single Zone VAV



### 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.

## Heating Coil



### Heating Type

Choose the Heating Type from one of five sources listed on the drop-down list:

- None
- Gas Furnace
- Electric Resistance
- Heat Pump
- Hot Water
- Gas Heat Pump

The heating type in some system types is pre-determined and cannot be altered. For example, a Hydronic 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.



### Furnace Type

Choose the Furnace Type from one of five types listed on the drop-down list:

- Central
- Fan Wall
- Gravity Wall
- Floor
- Room



### Coil Control

Choose a Coil Control for central air heating systems from one of the four controls in the drop-down list. Proposed and Reference design supply air temperature control strategies are modeled identically in all compliance calculations. 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 typical pneumatic control systems for which zone reset is problematic, control may be by outdoor air reset schedule.

For simple control systems, heating supply setpoint may 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 47°F (8.3°C) 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 17°F

If the system is a heat pump, enter the rated heating capacity at 17°F for the heat pump compressor to be installed. EnergyPro automatically sizes the backup electric resistance heat for use in the simulation

Range & Units:

**Imperial (US):** 0 - 9,999,999 Btu/hr

**SI (Metric):** 0.0 - 29,310 kW



## Electrical Power

For electric heat pumps systems, enter the amount of auxiliary electric resistance heating (strip heat), in kW.

For Gas Heat Pump Systems, enter the amount of Auxiliary kW required to run the Pumps, Controls and Condenser Fans on the system. Do not include the supply (evaporator) and return fan power.

Range & Units: 0.0 - 9,999.0 kW



## Supply Temperature

Enter the temperature to which air is heated before being distributed through a building. A standard default value for heating supply air temperature is 105°F (40.6°C).

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 *Listing of Gas and Oil Fan Type Central Furnaces Sorted by Brand and Type*. 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)

## **Preheat Coils**



### **Preheat Source**

Choose a preheat source to define the type of preheat coil (if present) on built-up systems. 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 Source**

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.

Choose a reheat source to define the type of coils used in systems with zonal level reheating of air. The choices are: None, Electric, and Hot Water.



### **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 Source

### Baseboard Heat

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. Proposed and Reference design supply air temperature control strategies are modeled identically in all compliance calculations. 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 typical pneumatic control systems for which zone reset is problematic, control may be by outdoor air reset schedule (although this is not very efficient).

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).



When importing data from the CEC Equipment Directories, the program automatically inserts a Sensible Output equal to 70% of the total Cooling Output. If the project has a cooling system, 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. A typical value for cooling supply air temperature is 55°F (12.8°C).

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

Enter the SEER for systems that include a SEER rating. If you are unsure of the exact equipment to be installed, or if no cooling equipment is being installed, use the minimum SEER value for the type and size of the anticipated equipment.

Range & Units: 0.5 - 22.0 SEER (or COP depending on equipment type)



### 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.

## Performance at ARI Conditions

Enter the Energy Efficiency Ratio (EER) and IEER or the Compressor/Condenser electrical demand to specify the cooling system performance rating at ARI conditions. For most smaller packaged systems, the EER is

easily obtained from the manufacturer's catalog. However, in some cases, larger packaged systems do not have readily available EER listings. Therefore, you may enter the Compressor/Condenser electrical demand to more accurately model these systems. The cyclical degradation coefficient for compliance calculations is fixed at 0.03 for both the proposed and reference designs.

Equipment ratings are available in 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.



### **Energy Efficiency Ratio (EER)**

Enter the ARI-rated Energy Efficiency Ratio of the air conditioning or heat pump system.

EER 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 seasonal energy efficiency ratio that 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 EER 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.

***If no cooling system is being installed in the building or zone, use the EER default value.***

Range & Units: 6.0 - 20.0 EER



### **Compressor/Condenser Power**

Enter the Compressor/Condenser power consumption at ARI conditions (not at design conditions).

Compressor / condenser electrical demand includes compressor and condenser energy use at ARI testing conditions. This number does not include supply fan energy use. In all cases, you must specify the supply fan data on the Fans tab.

If the condenser is air-cooled, the input must include condenser fan energy.

If the condenser is water-cooled, and is a central water-cooled condenser (one condenser/tower serving 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, the input must include pump energy.

If the condenser is evaporatively pre-cooled, enter the condenser pump energy consumption at design conditions in the inputs provided on this tab.

Range & Units: 0.0 - 999.0 kW



### **Room AC and Heat Pump Side Louvers**

Check the box if the room air conditioner or heat pump contains side louvers. This input is a factor in determining the standard system efficiency.

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*NOTE: The standard efficiency for units with cooling capacity > 8,000 Btu/hr without side louvers is lower than for units with side louvers.*

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## **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) typically are 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)
- Ice Storage A/C
- Res Absorption

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 design conditions 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.**

If the condenser utilizes delayed cooling strategies such as Ice Storage to provide the cooling, select the approved ice storage A/C from the drop down list.

If the system definition is a gas absorption heat pump choose Res Absorption from the Condenser Type down list. All unnecessary inputs will gray out.



### **Ice Storage A/C**

If the Condenser Type selected is Ice Storage A/C, the list of certified Ice Bear energy storage modules will become available. Select the unit specified by the engineer or manufacturer to best suit the project's cooling needs.



### **Evap Pre-Cooled Condenser (PCC) Effectiveness**

Enter a fractional value to define evaporative effectiveness if the condensing unit has an evaporative pre-cooler. A typical value is 0.80.

Range & Units: 0.00 - 1.00 (units N/A)



## **(Evap PCC Pump Motor) Design Power**

### **Pump Motor**

Enter the power output of the condenser 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.

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.



### **Optimum Start/Stop Capability**

Check the box if the system includes optimum start/stop controls, as required for systems with DDC to the zone level. Optimum start/stop controls are an energy-saving technique where the HVAC system determines the optimum time to turn on or turn off the HVAC system so that the space reaches the appropriate temperature during occupied hours only.



### **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.

## **VRF Heat Recovery**



### **Heat Exchanger Mode**

Select the heat exchanger operational mode from the drop-down list. Options include: None, Supply DHW Load, Supply HW Load, Supply DHW Load, then HW Load, Supply HW Load, then DHW Load.



### **Number of Heat Exchangers**

Enter the number of heat exchangers in the system.



## Heat Exchanger Model

Select the heat exchanger model from the drop-down list.



## Booster Unit Mode

Select the booster unit operational mode from the drop-down list. Options include: None, Supply DHW Load, Supply HW Load, Supply DHW Load, then HW Load, Supply HW Load, then DHW Load.



## Number of Booster Units

Enter the number of Booster Units in the system.

# 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. If the economizer is non-integrated, this value is automatically set to 60°F (15.6°C). If the economizer is an integrated type, the temperature may be set to any value between 60°F and 78°F (15.6°C - 25.6°C).

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 does not provide specific credit for energy recovery systems, but does allow some exceptions to other requirements 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.



### **Heat Recovery Effectiveness**

Enter the effectiveness of the exhaust air heat recovery equipment associated with this HVAC System. ASHRAE 90.1-2007 requires a recovery system with a minimum 50% energy recovery effectiveness.

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



### **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**

### **Supply Fan**



## 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 7 of the Nonresidential 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 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 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%.

Range & Units: 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 7 of the Nonresidential 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 *Nonresidential Manual, Section 1.7.15*, evaporative cooling 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:

$$\% \text{ Adiabatic Efficiency} = (DB_{\text{entering}} - DB_{\text{leaving}}) / (DB_{\text{entering}} - WB_{\text{entering}})$$

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

## Curves Tab

Curves are only used in compliance calculations for systems with capacities that exceed 135,000 Btuh. Central system efficiency varies at various load conditions, thus you may specify custom curves for equipment that operates more efficiently at part-load than the default system. If you do not specify custom curve coefficients for the heating or cooling system, EnergyPro will use the default performance curves specified in the Nonresidential ACM Manual.

Section 2.5.2.6 of the NR ACM Manual states:

“The hourly performance of air-to-air air conditioners and heat pumps varies with the outdoor temperature, the loading conditions, the wetbulb temperature of the air returning to the indoor coil, and other factors. The reference method takes account of these factors through a set of equipment performance curves that modify the efficiency or the capacity of the equipment with changes in part-load ratio, outside dry bulb temperature and wet bulb temperature of the return air (across the indoor coil).

If custom HVAC performance curves are used, the compliance software shall print a warning note in the Special Features section of the Performance Summary form, PERF-1, indicating that custom HVAC performance curves have been used.

The four reference method performance curves specified here include.

COOL-CAP-FT Cooling capacity as a function of outdoor drybulb and return wetbulb air temperatures.

COOL-EIR-FT Cooling efficiency as a function of outdoor drybulb and return wetbulb temperatures.

HEAT-EIR-FT Heating efficiency as a function of outdoor drybulb and return wetbulb temperatures.

HEAT-CAP-FT Heating capacity as a function of outdoor drybulb temperature and the return wetbulb temperature. This curve adjusts the capacity of the heat pump as the ODB changes. This is an important curve for heat pumps as an electric resistance element comes on to provide heat when the heat pump has inadequate capacity.

MAX-HP-SUPP-T This parameter is the outside drybulb temperature below which the heat pump supplemental heating is allowed to operate. This parameter shall be set to 70°F.”



### Use Custom Heating Curve Coefficients

Check the box to use custom heating curve coefficients in the simulation. Furnace part load efficiency curves are fixed for Title 24 compliance calculations. Default data is shown in Table 45: Furnace Efficiency Curve Coefficients, in the NR ACM Reference Manual.



### Performance at 70°F Indoor Drybulb

When specifying the performance data, the manufacturer's data should be taken at the 70°F indoor wet bulb condition.



### Use Custom Cooling Curve Coefficients

Nonresidential modeling procedures allow the use of optional data describing the efficiency of the Cooling compressor for some systems. Default data is shown in Table 37: Cooling Capacity Curve Coefficients in the NR ACM Reference Manual.



### Performance at 67°F Indoor Wetbulb

When specifying the performance data, the manufacturer's data should be taken at the 67°F indoor wet bulb condition.

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# Zonal Library

[General Tab](#) [Fan Tab](#) [Outside Air Tab](#)

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



#### 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. The default (0.3) is applicable to systems with inlet vanes or discharge dampers, but the value may be set to 0.10 for systems with variable speed drives or vane-axial fans with variable pitch blades. The minimum position must be no smaller than the minimum ventilation quantity.

Range & Units: 0.00 - 1.00 (units N/A)



### Zone is Heated

Indicate the presence (checked) or absence (unchecked) of a reheating coil.



### 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.



### ECM Motor

Check if the zonal system has a qualifying Electronically Commutated Motor (ECM). ECM motors shall have a motor efficiency of at least 70% when rated with NEMA Standard MG-1-1998 (Rev. 2).



### Flow Rate

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



### (Fan Motor) Design Power

Enter the power output of the zonal 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.

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%.

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

## Outside Air Tab

Use this tab to specify the characteristics 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.



---

# Schedule Library

## [Utility Rates](#)

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.

---

## ***Use of Schedules***

The software ignores all schedules (sets all hourly data to 100%) to establish lighting, people, equipment, etc., levels for nonresidential loads calculations, unless you choose a specific design day schedule for the program to use. Subtle differences between schedules do not produce significantly different results. However, major schedule differences based on occupancy type should be modeled because they can account for major effects.

Use the NR Performance module for non-Title 24 compliance calculations.

## **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 5 contains an external database of gas and electric utility rates from utilities throughout California. Select the Import button at the top of the Schedule Library 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 list titled Design Day for Schedules \(where the default is "Ignore"\), where you may select your specific design day \(Monday through Sunday\).](#)

***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.

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 Dialog

### 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 multiplying 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.

### **CO2**

Enter the number of pounds of CO2 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

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**



### **State**

Enter the name of the state in which the city is located.



### **City**

Enter the name of the city.

## **Geographical Data**



### **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 (feet)**

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. Climate zones for several thousand specific California cities, towns and other locations are listed in Reference Appendices, JA2. You may obtain a full listing as well as look up locations via Google Earth on the California Energy Commission web site at ([http://www.energy.ca.gov/maps/renewable/building\\_climate\\_zones.html](http://www.energy.ca.gov/maps/renewable/building_climate_zones.html)).



### 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\EnergyPro 6\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. This information will be used by the software to perform incentive calculations for nonresidential buildings. Based upon this selection, the program will select the correct incentive levels for CA utilities and produce a form UTIL-1 report the documents the incentive for the appropriate Utility.



## Utility – Natural Gas

Select the Utility that provides natural gas to this location. This information will be used by the software to perform incentive calculations for nonresidential buildings. Based upon this selection, the program will select the correct incentive levels for CA utilities and produce a form UTIL-1 report the documents the incentive for the appropriate Utility.

## Seasonal Data Tab

### Summer Conditions

Three boxes require input for Summer Conditions: 0.5%, 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% 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% temperature.



### (Summer Conditions) Design Dry Bulb

Enter the design summer dry bulb temperature (temperature of air) of the location.

Range & Units:

**Imperial (US):** 40 - 150°F

**SI (Metric):** 4.4 - 55.6°C



### (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 - 90°F

**SI (Metric):** 4.4 - 32.2°C



### (Summer Conditions) Design Wet Bulb



Enter the summer design wet bulb temperature of the location.

Range & Units:

**Imperial (US):** 40 - 90°F

**SI (Metric):** 4.4 - 32.2°C



## Winter Conditions

One box requires input for Winter Conditions: Enter the temperature for Median 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 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 - 90°F

**SI (Metric):** -72.8 - 32.2°C



## (Winter Conditions) Design (0.2%)

Enter the design winter dry bulb temperature of the location.

Range & Units:

**Imperial (US):** -99 - 90°F

**SI (Metric):** -72.8 - 32.2°C



## (Winter Conditions) Design (0.6%)

Enter the design winter dry bulb temperature of the location.

Range & Units:

**Imperial (US):** -99 - 90°F

**SI (Metric):** -72.8 - 32.2°C



## Summer Daily Temperature Range

The outdoor daily range of summer dry bulb temperatures of the location.

Range & Units:

**Imperial (US):** 0 - 99°F

**SI (Metric):** 0.0 - 55.0°C

## 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. Place a check in 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 are to be run ([Options](#)), running the calculations ([Calculate](#)), displaying calculation results and diagnostic messages ([Results](#)),

To access the Calculations functions, select Calculations from the list in the lower left window pane.

## **Modules**

- [Res T24 Prescriptive](#)
- [Res T24 Performance](#)
- [Res GreenPoint Rated](#)
- [Res Performance](#)
- [Res Loads](#)
- [NR T24 Prescriptive](#)
- [NR T24 Performance](#)
- [NR ASHRAE 90.1 Performance](#)
- [NR Performance \(non-T24 compliance\)](#)
- [NR Loads](#)

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## **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**

### **Residential Calculations:**

- [Res T24 Performance](#)
- [Res GreenPoint Rated](#)
- [Res Performance](#)
- [Res Loads](#)

Res T24 Performance, Res Performance, and Res Loads calculations are only performed on zones which are designated as low-rise residential occupancies (Single Family or Multi-Family). The software ignores any nonresidential, hotel/motel and high-rise residential occupancies when you select a low-rise residential calculation.

### Nonresidential Calculations:

[NR T24 Prescriptive](#)

[NR T24 Performance](#)

[NR ASHRAE 90.1 Performance](#)

[NR Performance](#)

[NR Loads](#)

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## Calculate

You may run selected calculations by clicking on the Calculate button in the toolbar. EnergyPro runs all the calculations 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 they will not include any calculation results. Instead, the report will print a message stating that “Calculated Results Are Not Current”.

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## Results

EnergyPro displays the most recent 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

#### Residential Calculations:

[Res T24 Prescriptive](#)

[Res T24 Performance](#)

[Res GreenPoint Rated Results](#)

[Res Performance](#)

[Res Loads](#)

#### Nonresidential Calculations:

[NR Prescriptive](#)

[NR T24 Performance](#)

[NR ASHRAE 90.1 Performance Results](#)

[NR Performance Results](#)

[NR Loads](#)

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**NOTE:** The Results function does not perform calculations. If you have made changes to the file, you must recalculate (select Calculate again) to update the results and view or print reports.

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# Res T24 Prescriptive Calculation

The **Res T24 Prescriptive** module is a computerized version of the Residential Prescriptive method for additions and alterations. The module automatically ascertains if a project meets the prescriptive requirements and 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, or weighted average U-factors.

Information about the prescriptive requirements is contained throughout the Residential Manual, depending on the scope of the specific project. Residential additions and alterations are covered in Chapter 9.

## **Res T24 Prescriptive Results**

As noted above, the Res T24 Prescriptive module does not perform a simulation of the building so the results pane for this module is very simple. Results are displayed 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.

## **Res T24 Prescriptive Reports**

EnergyPro's Res T24 Prescriptive module creates the forms required for HERS registration (if necessary) and for submittal to the building department.

You may create a Res T24 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 Res T24 Prescriptive report contains one of the following compliance forms, depending on the project scope:

- CF1R-ADD-01-E – Additions 1,000 ft<sup>2</sup> or less

- CF1R-ADD-02-E – Additions 300 ft<sup>2</sup> or less, or Additions that do not require HERS verification

- CF1R-ALT-01-E – Alterations

- CF1R-ALT-05-E – Alterations that do not require HERS verification

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.

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# Res T24 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 2013 Compliance Manager, the simulation and compliance rule implementation software required by the Commission. This new 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 Residential Title 24 compliance will need to have internet access to generate the final Title 24 reports for building department submittal.

## Res T24 Performance Calculation Options

The **Res T24 Performance** calculation is a state-approved alternative compliance method (performance simulation), as described in Chapter 8 of the Residential Manual. ***The building complies when the Proposed Total TDV Energy Use is equal to or less than the Standard Total TDV Energy Budget.***

### Compliance Calculations

**Run Standard:** Runs the Standard Design which sets the energy budget for the residential building as explained in Chapter 8 of the *Residential Manual*.

**Run Proposed:** Runs the Proposed Design whose energy use is compared to the Standard energy budget as explained in Chapter 8 of the *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.

**Domestic Hot Water:** Runs residential domestic hot water (DHW) calculations. It is normally selected for all new low-rise residential buildings, and generally not selected with additions or alterations if no new water heater is being installed.

**Single Category Alteration:** Check this box if the alteration is limited to one building component, as defined in Section 150.2.

**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.

**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.

**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.

**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).

**California Advanced Home Program (CAHP) Incentives:** The project must enroll with the program and meet all program requirements to be eligible for incentives.

EnergyPro will automatically calculate the CAHP program incentive based on the Energy Design Rating (EDR) achieved using energy efficiency measures alone (without the PV system compliance credit), which must be at least three (3) points lower than the Standard Design EDR. There are additional incentives available (kickers) for projects that include specific measures, such as LED lighting, a home energy management system, PV system installation, high performance fenestration, or are DOE Zero Energy Ready homes.

## Res T24 Performance Results

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.

The performance calculation includes the following components: Space Heating, Space Cooling, IAQ Ventilation, Water Heating, and Photovoltaic Offsets. Interior and Exterior Lighting, Appliances, and Receptacle energy use are not part of the compliance calculation.

To demonstrate compliance, the Proposed Total must be **equal to or less than** the Standard Total. See Chapter 8 in the Residential Manual for a detailed discussion of the Performance Method.

### Components of the Res T24 Performance Calculation Results

**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 the “Run Four Orientations” box 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.

**Fans:** Lists the annual space cooling TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

**Renewables:** Lists the annual renewable TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs. Note that Renewables results for the proposed design will be negative, as the renewable generation contribution yields a compliance credit under certain circumstances.

**DHW:** Lists the annual domestic hot water system TDV energy (in TDV kBtu/sf-yr) for the Standard and/or Proposed designs.

**Standard Total:** The total predicted (TDV) energy use of the standard design, in TDV kBtu/sqft-yr.

**Proposed Total:** The total predicted TDV energy use of the proposed building, in TDV kBtu/sqft-yr.

**Savings:** The energy savings (percent) with respect to the baseline or standard building. If this value is negative, the project does not comply with the Title 24 Standards. Note that while the Standard and



Proposed Total TDV energy use includes all end-use categories, the savings percentage is based only on categories included in compliance calculations.

## Res T24 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 the 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 provides additional forms for your convenience should you wish to include them in the report. EnergyPro Res T24 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

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**NOTE:** All pages of the performance report show the date and time the report was produced. For all low-rise residential 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.

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## Basis and Capabilities of the Res T24 Performance Calculation

**Res T24 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 Residential Title 24 calculations use the CEC 2016 Compliance Manager, the simulation and compliance rule implementation software required by the Commission. This new 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 Residential Title 24 compliance will need to have 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 8.0 of the *Residential Manual*.]

*The method works by calculating the time-dependent valuation (TDV) energy use of the proposed design and comparing it to the TDV energy use of the standard design (the budget). The standard design is a building with the same surface areas as the proposed*

*design but incorporates all the features of Prescriptive Package A. The energy budget includes water heating, space heating, space cooling, and indoor air quality (IAQ) fan energy. Lighting energy is not included in the performance calculations because all residential lighting measures are mandatory and therefore not eligible to be traded-off using the performance method. If the proposed design uses equal or less TDV energy than the standard design, then the building complies.*

*Computer programs used for compliance are approved by the Energy Commission as being capable of calculating space-conditioning and water-heating energy use in accordance with a detailed set of rules. The computer programs model the thermal behavior of buildings by calculating heat flows into and out of the various thermal zones of the building. The computer programs approved by the Energy Commission must demonstrate accuracy in analyzing annual space-conditioning and water-heating energy use of different building conservation features, levels and techniques. This method provides maximum flexibility because the building designer may trade-off the energy performance of different building components and design features to achieve compliance.*

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

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 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.

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NOTE: Use of a computer method may require special documentation associated with particular features such as radiant barriers or photovoltaic systems. Refer to the relevant sections in the Residential 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.

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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 *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 [http://www.energy.ca.gov/title24/2016standards/2016\\_computer\\_prog\\_list.html](http://www.energy.ca.gov/title24/2016standards/2016_computer_prog_list.html).

### **Combined Energy Budget: Excerpt from Standards, Section 150.1(b)**

**Performance Standards.** *A building complies with the performance standard if the energy budget calculated for the Proposed Design Building under Subsection 2 is no greater than the energy budget calculated for the Standard Design Building under Subsection 1.*

1. **Energy Budget for the Standard Design Building.** The energy budget for a Standard Design Building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, mechanical ventilation and water heating.
2. **Energy Budget for the Proposed Design Building.** The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, mechanical ventilation and water heating. The energy budget for the Proposed Design Building is reduced if on-site renewable energy generation is installed, according to methods established by the Commission in the Residential ACM Reference Manual.
3. **Calculation of Energy Budget.** The TDV energy for both the Standard Design Building and the Proposed Design Building shall be computed by Compliance Software certified for this use by the Commission. The processes for Compliance Software approval are documented in the Residential ACM Approval Manual.
4. **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 TDV energy use from depletable energy sources does not exceed the combined water-heating and space-conditioning energy budgets for the applicable Climate Zone.

**EXCEPTION to Section 150.1(b)4A: Multiple Orientation:** A permit applicant may demonstrate compliance with the energy budget requirements of Section 150.1(a) 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 of installed features, materials, components, manufactured devices and system performance 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, in accordance with the following requirements when applicable:
    - i. **SEER Rating.** When performance compliance requires installation of space a conditioning system with a SEER rating that is greater than the minimum SEER rating required by TABLE 150.1-A, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.
    - ii. **EER Rating.** When performance compliance requires installation of a space conditioning system that meets or exceeds a specified EER rating, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.
    - iii. **Low Leakage Air Handler.** When performance compliance requires installation of a low leakage air-handling unit that meets the qualifications in Reference Joint Appendix JA9, the installed air handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

### **Combined Energy Budget: Space Conditioning and Water Heating Energy Use**

Each approved computer method uses the Compliance Manager to automatically generate an **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 A, in the Standards, Table 150.1-A. There are two basic components to the energy budget: space conditioning and water heating. Space conditioning is further divided into space heating, space cooling, fans, and pumps. The budget also includes interior and exterior lighting and appliance energy use, however, they are considered “compliance-neutral”, as they are fixed for compliance and modeled identically in both the Standard and Proposed Designs. A building complies with the Standards if the predicted TDV **energy use** of the **proposed design** is the same or less than the combined annual TDV energy budget of the standard design.

Since the energy budget for 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

All 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 Package A requirements and are not accessible for modification by program users.

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**NOTE:** You should always have copies of the Standards and Residential Manual at hand for reference when using the Res T24 Performance calculation.

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## Building Features Modeled by Res T24 Performance

Res T24 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 (not available as of January 2016)
- Water heaters
- Water heating distribution system
- Solar thermal collectors
- Ventilation Cooling: Whole House Fans

- Unconditioned zones
- Photovoltaic systems

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# GreenPoint Rated Module

EnergyPro now offers a Residential 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. As with all other residential modules, you may also evaluate [alternative energy-savings measures](#), either individually, or as a cumulative package.

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.

**Miscellaneous:** Lists the annual miscellaneous TDV energy usage (in TDV kBtu/sf-yr) for each design.

**Renewables:** 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.

**Pumps:** Lists the annual space cooling TDV energy (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 2013 Title 24 by at least 10% (and meet ALL other requirements) to be eligible for GreenPoint Rated certification.

**Points:** Lists the number of GreenPoints for the Rated Home and each design alternative earned in the Energy category. A new home must earn at least 30 points in the Energy category (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.

### 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 GreenPoint Rated 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.

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# Res Performance Calculation Module

Use the Res Performance Module to simulate the energy performance of a project that doesn't involve a particular Standard. Res Performance performs an hourly simulation on the building to calculate annual energy consumption and energy cost.

The Res Performance simulation includes additional energy end-uses beyond those considered in Title 24, including: interior and exterior lights, appliances, and energy generated by on-site renewable energy systems. 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.

## Res 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.



## Res 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) for the Proposed design.

**Cooling:** Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

**Interior Lights:** Lists the annual interior lighting energy (in kBtu/sf-yr) for the Proposed design.

**Exterior Lights:** Lists the annual exterior lighting energy (in kBtu/sf-yr) for the Proposed design.

**Appliances:** Lists the annual appliances energy (in kBtu/sf-yr) for the Proposed design.

**Miscellaneous:** Lists the annual miscellaneous energy usage (in kBtu/sf-yr) for each design.

**Renewables:** Lists the annual energy (in kBtu/sf-yr) generated by the renewable system for the Proposed design (subtracted from the total energy use).

**Fans:** Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

**Pumps:** Lists the annual space cooling energy (in kBtu/sf-yr) for the Proposed design.

**DHW:** Lists the annual domestic hot water system energy (in kBtu/sf-yr) for the Proposed design.

**Total:** The total predicted energy use of the home, and each Alternative Measure design, in kBtu/sqft-yr.

### 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.

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# Res Loads Calculation

Section 150.0 of the *Standards* describes mandatory features and devices for low-rise residential buildings, including the 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 Residential Loads method, refer directly to the ASHRAE publications mentioned above. Also see Sections 4.2 and 4.3 in the Residential 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 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 7\Results folder under the project name with a .csv extension.

The **Res Loads** calculation is a computerized version of the residential ASHRAE heating and cooling loads methodology.

## Res Loads Results

### Components of the Res 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.

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# NR T24 Prescriptive Calculation

The **NR Prescriptive** calculation is a computerized version of the Nonresidential Prescriptive Envelope, Indoor Lighting, Mechanical, and Outdoor Lighting methods. The calculation provides a display of key aspects of Envelope, Lighting and Mechanical compliance of the building with the Nonresidential Prescriptive standards. Refer to Chapters 3-10 (depending on the topic) of the Nonresidential Manual for additional details about the Prescriptive approach.

## ***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 and 140.3-C.

See the Standards, Section 140.3 and the Nonresidential 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 and compares it to the Complete Building or Area Category values selected according to the occupancy type of each zone. Refer to the Standards, Section 140.6 and to Chapter 5 in the Nonresidential 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. The program sums installed wattage for all outdoor luminaires 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 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 54,000 Btuh (15.8 kW) may require an integrated economizer (see Standards, Section 140.4(e) and *Nonresidential Manual*, Section 4.5.2).
- Fan systems over 25 horsepower (18.7 kW) at design conditions may need to meet specific fan 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.

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**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 Manual to make sure the project meets all applicable Prescriptive Mechanical requirements.

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## 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 <i>Nonresidential Manual</i>
Mechanical	Runs the nonresidential Prescriptive Mechanical calculations.

The **NR T24 Prescriptive** calculation is a computerized version of the Nonresidential Prescriptive Envelope, Lighting, Mechanical, and Outdoor Lighting methods. 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 and/or HVAC). 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.

There are three groups of 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)

Each group contains various forms for each end-use, including:

- Commissioning
- Disaggregation of Electrical Circuits
- Envelope
- Indoor Lighting
- Outdoor Lighting

- Sign Lighting
- Mechanical
- Plumbing
- Process
- Solar-Ready, and
- Solar, Thermal Heating.

Refer to the CEC web site or Nonresidential Manual, Appendix A for a complete list of forms.

## 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 to be submitted with the application for a building permit, the applicable Certificate of Compliance documents shall be incorporated into the building design plans."*

*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 Component Envelope approach. The calculation results display a statement that the envelope complies or does not comply. EnergyPro identifies any components that don't meet the prescriptive requirements and displays error messages listing the proposed value and the minimum requirement for each component. The project complies with the Title 24 Standards if each component meets the prescriptive requirement listed in Standards Table 140.3-B or 140.3-C. For additional details, see Chapter 3 of the Nonresidential Manual.

### Lighting

Prescriptive Lighting calculations include up to three separate components depending on the building design: Indoor Conditioned Lighting Power Density (LPD), Indoor Unconditioned LPD, and Outdoor Lighting Power.

NR Prescriptive Lighting calculations results display the total indoor lighting power density in Watts per square foot of 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 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 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*.

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# NR T24 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 Title 24 Performance Module runs the simulation via the CEC 2016 Compliance Manager (CBECC-Com version 2016.2.0), 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 Title 24 compliance will need internet access to generate the final Title 24 reports for building department submittal.

The program performs a NR T24 Performance compliance analysis of the building when you select the NR 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 11 of the *Nonresidential Manual*, the Standard Design TDV Energy Budget sets the standard for the building. 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; and,
- Has a mechanical system size which is appropriate for the design heating and cooling loads of the Standard Design.

Full details on the assumptions used to generate the Standard Design building are contained in the *Nonresidential Alternative Calculation Method (ACM) Reference Manual for the 2016 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 T24 Performance Options

### Calculations



**Run Standard:** Runs the Standard Design which sets the energy Performance budget for the building as explained in Chapter 11 of the Nonresidential Manual.

**Run Proposed:** Runs the Proposed Design whose energy use is compared with the energy Performance budget as explained in Chapter 11 of the Nonresidential Manual.

**Scope:** Sets the project 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.

## NR T24 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.

**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*.

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**NOTE:** You should have a copy of the current Standards and Nonresidential 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.

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The simulation time required to complete a NR T24 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)

## NR T24 Performance Compliance Reports

The program can print either prescriptive or performance Title 24 reports, or both. See [Printing Reports](#) for basic instructions. Select Reports from the options in the lower-left window pane to select the appropriate report, and the pages for a report. Refer to Appendix A in the *Nonresidential 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.

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**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, it will not print a report if changes were made but no re-calculation was run. EnergyPro displays a message on-screen noting that the calculations are out of date and the report cannot be printed.

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The software compliance documentation for the NR T24 Performance approach for envelope, lighting, and HVAC includes:

- Cover Sheet (optional)
- Table of Contents (optional)

### Nonresidential Title 24 Performance Compliance Forms (NRCC)

- Form PRF-01-E      Performance Certificate of Compliance, Parts 1, 2, and 3

- 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)
  - Processes (PRC)
  - Solar Ready (SRA)
  - HVAC System, Zone, and Room Heating and Cooling Load Summary (optional)
  - Energy Use and Cost Summary (optional)

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**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.

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## Energy Conservation Measures Modeled by NR T24 Performance

The NR T24 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
- Glazing area in each roof/ceiling, *except 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 T24 Performance

NR T24 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 Sidesfins are defined in the Overhang and/or Sidesfin 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 is found in the CEC equipment directories 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 T24 Performance. These include:

- Packaged and Split DX Systems
- Packaged Single-Zone VAV
- Hydronic Heat Pump
- Packaged Variable Air Volume
- Packaged Multi Zone
- Built-Up Single Zone
- Built-Up Variable Air Volume
- Built-Up Multi Zone
- Dual Duct
- Four-Pipe Fan Coil
- Room Packaged Terminal Air Conditioner (PTAC)
- Four Pipe Induction
- Evaporative Cooler
- Variable Refrigerant Flow
- Single Packaged Vertical Unit
- Built Up Single Zone VAV

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## 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: 2013, 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 2013 version is the commercial building reference standard for state building energy codes under the federal Energy Policy Act of 2005.

### 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 as well as 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 90.1-2013 Standard.

ASHRAE Policy Statement

## ASHRAE 90.1 Performance Results

When the calculation is complete, the display summarizes the results of the NR 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:

<b>Heating:</b>	Annual energy used for space heating
<b>Cooling:</b>	Annual energy used for space cooling
<b>Lighting:</b>	Annual energy used for electric lights
<b>Process Lighting:</b>	Annual energy used in process lighting input within the program
<b>Outdoor:</b>	Annual energy used for outdoor lighting
<b>Receptacle:</b>	Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.
<b>Renewables:</b>	Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.
<b>Fans:</b>	Annual energy used for fans moving conditioned air
<b>Heat Rejection:</b>	Annual energy used for cooling tower operation
<b>Pumps:</b>	Annual energy used pumps for hot water, chilled water, and condenser water piping systems
<b>Process:</b>	Annual energy used in process loads input within the program
<b>DHW:</b>	Annual energy used for domestic (service) hot water
<b>Total:</b>	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.

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**NOTE:** You should have a copy of the appropriate ASHRAE 90.1 Standard available for reference when using the NR 90.1 Performance module.

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## 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:** Sets the project 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.

**DOE-2 Reports:** You may select specific DOE-2 output reports in the [Utility Tab](#) of the Building Element. If you do not make any selection, the DOE-2 output will contain only the [default DOE-2 reports](#).

**WARNING:** You must instruct EnergyPro to save the DOE files after the run in order to access the DOE-2 reports. Remove the check mark from the Delete Temporary Files After Simulation is Complete checkbox.

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.

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**NOTE:** This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

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**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.

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## 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

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**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.

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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.

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**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.

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## 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 [Using NR Performance as a DOE-2 BDL and Report Generator](#).

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**NOTE:** This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

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## NR Performance Options (non-T24 compliance)

### Calculations

**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 6\Results folder under the project name with a .csv extension.

**Reports:** You may select specific DOE-2 output reports in the [Utility Tab](#) of the Building Element. If you do not make any selection, the DOE-2 output will contain only the [default DOE-2 reports](#).

**WARNING:** In order to have any DOE-2 reports available, you must instruct the software to save the temporary files. Remove the check mark from the Delete Temporary Files After Simulation is Complete checkbox.

The NR Performance calculation uses the U. S. Department of Energy's DOE-2.1E calculation engine (v124), which is a comprehensive hourly building energy simulation program.

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**NOTE:** This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

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**NOTE:** 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.

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## 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:

<b>Heating:</b>	Annual energy used for space heating
<b>Cooling:</b>	Annual energy used for space cooling
<b>Lighting:</b>	Annual energy used for electric lights
<b>Process Lighting:</b>	Annual energy used in process lighting input within the program
<b>Outdoor:</b>	Annual energy used for outdoor lighting
<b>Receptacle:</b>	Annual energy used to meet equipment (receptacle) load. This value is fixed for compliance by occupancy.
<b>Renewables:</b>	Annual energy provided by renewable systems. This value is negative and is subtracted from the total proposed energy use.
<b>Exceptional:</b>	Annual Energy saved from reducing process loads. This value is only used for LEED projects.
<b>Fans:</b>	Annual energy used for fans moving conditioned air
<b>Heat Rejection:</b>	Annual energy used for cooling tower operation
<b>Pumps:</b>	Annual energy used pumps for hot water, chilled water, and condenser water piping systems
<b>Process:</b>	Annual energy used in process loads input within the program
<b>DHW:</b>	Annual energy used for domestic (service) hot water
<b>Total:</b>	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

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**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.

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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.

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**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.

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## 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 may not 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.

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**NOTE:** This software is not endorsed, authorized, or associated with the U.S. Department of Energy.

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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*)

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**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.

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**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.

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**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

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## 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.

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**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.

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## 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.

**Heat Load:** The design block heating load of all the Zones served by the System, in Btu/hr.

**Heat 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.

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## 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.*

Residential Performance Modules generate project input files (.inp) for all selected simulations, including alternative runs. The NR T24 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.

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## Alternatives Tab

Use the Alternatives Tab to select energy-savings measures to simulate the effect on a residential project's energy use, GreenPoint Rated score, or Ygrene results. 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.

Some of the Alternative Measures DO NOT apply to all calculations. For example, Indoor Lighting is a mandatory measure in residential Title 24, thus alternatives will not change the project's compliance results.

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 Combined Alternative Measures in the appropriate [Options Tab](#).

Note that the Measure Cost fields are used only to generate cost-effective measure recommendations for a HERS report. You may click either the Select Button  to select the measure cost from the HERS database, or check the User Defined checkbox and enter a custom measure cost. You must [export](#) the project data, and 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.

## **Cost Data**

### **Marginal Cost Data is User Defined**

Check the checkbox to enter custom (user-defined) cost data.

### **Select Cost Data from Cost Database**

Click the Select button to select a measure from the HERS database.

### **Description for Report**

Enter a description of the recommended upgrade measure. The description will appear on the Recommendations page of the Home Energy Performance Report.

## **Upgrade Measures**

**Roof Insulation:** Select the upgraded Roof assembly from the [Assembly Library](#)

**Wall Insulation:** Select the upgraded Wall assembly from the Assembly Library.

**Floor Insulation:** Select the upgraded Floor 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, and select the Billing Data Start Date from the drop-down calendar. 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

The following is a list of potential error messages produced by the Compliance Manager:

1. pszCSEEXEPath doesn't exist
2. pszCSEWeatherPath doesn't exist
3. pszDHWDLLPath doesn't exist
4. One or more missing files (CSE, ASHWAT or T24\*(DHW/ASM32/TDV/UNZIP/WTNR) DLLs)
5. pszBEMBasePathFile doesn't exist
6. pszRulesetPathFile doesn't exist
7. Error initializing BEMProc (database & rules processor module)
8. Error initializing compliance ruleset
9. Invalid project log file name (too long)
10. Error writing to project log file
11. Building model input/project file not found
12. Error reading/initializing model input/project file
13. Error evaluating ProposedInput rules
14. Error retrieving CSE weather file name (from Proj:WeatherFileName)
15. Energy (CSE) simulation weather file not found
16. Error retrieving DHW weather file name (from Proj:DHWWthrFileName)
17. DHW simulation weather file not found
18. Error retrieving required data: Proj:RunID and/or Proj:RunAbbrev
19. Analysis processing path too long
20. Error evaluating ProposedInput rules
21. Error evaluating PostProposedInput rules
22. Error evaluating BudgetConversion rules
23. Error evaluating ProposedModelCodeCheck rules
24. Unable to create or access analysis processing directory
25. Unable to open/delete/write simulation output file (.csv or .rep)
26. Unable to open/delete/write simulation weather file
27. Error copying simulation weather file to processing directory
28. Unable to open/delete/write simulation input (.cse) file
29. Error writing simulation input (.cse) file
30. CSE simulation not successful - error code returned
31. DHW simulation not successful
32. Error encountered loading CSE DLL(s)
33. Error evaluating ProposedModelCodeCheck rules
34. Error evaluating ProposedModelSimulationCheck rules
35. Error evaluating ProposedModelCodeAdditions rules
36. User aborted analysis via progress dialog 'Cancel' button

37. Error evaluating ProposedInput rules
38. Error performing range and/or error checks on building model
39. Error evaluating CSE\_SimulationCleanUp rules
40. Error generating model report
41. Error evaluating ProcessResults rules
42. Error evaluating ProposedCompliance rules
43. Error(s) encountered reading building model (project) file
44. Error(s) encountered evaluating rules required analysis to abort
45. Unable to write compliance report file (.pdf or .xml)
46. Error(s) encountered generating compliance report file (.pdf or .xml)
47. Error setting up check of weather file hash
48. Error evaluating CheckFileHash rules
49. Weather file hash failed consistency check



# 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:

[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.

[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](#). How mandatory measures relate to the compliance calculations that the program performs.

[Covered Processes](#) The 2016 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 7 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 of additions alone or 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 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.

[California Advanced Homes](#). An energy efficiency incentive program available to residential new construction projects in many parts of CA.

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# 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:

[Dwelling Units](#)

[Modeling Interior Surfaces](#)

[Dividing the Building into Zones and Systems](#)

[Zonal Controls](#)

[No Setback Thermostats](#)

[Underground Walls, Floors, and Conditioned Spaces](#)

[Heating and Cooling Distribution Systems](#)

[Hydronic Systems](#)

[No Cooling Installed](#)

[Calculating All Four Orientations](#)

[Unconditioned Zones](#)

[Attached Sunspaces and Garages](#)

[Measures that Require HERS Verification](#)

[HERS Registration](#)

[Radiant Barriers](#)

[Cool Roofs](#)

[Pool and Spa Equipment](#)

[Photovoltaic System Credit](#)

[Energy Design Rating](#)

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## 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 Chapter 3 in the Residential ACM Reference 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, Multi Family, or High-Rise Residential Living), or if compliance is documented using the Addition Alone method. In addition, EnergyPro performs the calculation on-screen based on the data input here. However, for some calculations, the software overrides the data on the Dwelling Unit tab.

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.

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:  $\text{Area of addition} / (\text{Area of existing} + \text{addition})$ .

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).

Multi Family: For low-rise residential projects, EnergyPro uses the Floor Area, Number of Units, and 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.

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.

---

## 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 residential 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 Room level for all other assemblies. In most cases, the Floor Elevation of your Interior Surface will be equal to the Floor Elevation in the [Room](#).

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 Room.

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## 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?

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**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 cover a number of 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, simply drag one (or more) of the zones to a new system.
- Since zonal control credit is available within the residential compliance calculations, you may wish to divide a residential building into a Living Zone and a Sleeping Zone, consistent with the minimum zonal control credit requirements. Refer to the Residential Manual, Sections 4.4.1.17, 4.4.1.18, 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. 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 to be used, separate Systems with separate Zones will properly model the performance of the Systems for both compliance and design purposes.

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## 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 heat pump heating 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 ft<sup>2</sup>. 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 RA3.3 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  $\leq 0.58$  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.*

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## 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). 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

---

## 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.

---

## 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. The Attic is the default location, with no associated credits or penalties.

- 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.

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## 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 ([Package A](#)) value for that climate zone, and the duct location to Attic.

---

## **Calculating All Four Orientations**

You may show compliance for a home plan so that it may be built in any orientation (as explained in the Residential Manual, Section 8.5 on Subdivisions and Master Plans), by calculating compliance of the unit in all four orientations. To do this within the program:

Input the unit plan, set the Front Orientation to due north and the Rotation to zero.

When you run [Res T24 Performance](#), check the Run Four Orientations box in the Options tab of the Calculations. 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 CF1R.



**Multifamily Buildings:** In some situations, you may also use this feature to document compliance of individual dwelling units in multifamily buildings. Refer to Section 8.4.3 of the Residential Manual for additional details.

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**NOTE:** Do not select Four Orientations if you are performing an Existing-plus-Addition calculation.

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## Attached Sunspaces and Garages

Most often, sunspaces and garages are unconditioned spaces. Like other [unconditioned zones](#) in the 2016 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 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, 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.

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## 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 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 *Residential Compliance Manual*, Section 2.1.1). The installation contractor must complete Certificates of Installation (CF2R) forms, and provide the CF2R forms to the HERS Rater. The HERS Rater completes the Certificates of Verification (CF3R) confirming the installed measures meet all requirements.

The following features require field verification and/or diagnostic testing:

### Envelope Measures

- High Quality Insulation Installation (QII)
- Quality Insulation Installation for Spray Polyurethane Foam
- Building Envelope Air Leakage

### HVAC Systems

- Refrigerant Charge in Ducted Split System and Ducted Packaged Unit Air Conditioners and Heat Pumps, and Mini-Split Systems
- Refrigerant Charge Indicator Display (CID)
- Verified System Airflow
- Air Handler Fan Efficacy
- Verified Energy Efficiency Ratio (EER)
- Verified Seasonal Energy Efficiency Ratio (SEER)
- Maximum Rated Total Cooling Capacity
- Evaporatively Cooled Condensers

Ice Storage Air Conditioners

#### HVAC Distribution Systems

Duct Sealing  
Supply Duct Location, Surface Area and R-Value  
Low Leakage Ducts in Conditioned Space  
Low Leakage Air Handlers  
Verification of Return Duct Design  
Verification of Air Filter Device Design  
Verification of Bypass Duct Prohibition

#### Ventilation for Indoor Air Quality

Continuous Whole-Building Mechanical Ventilation Airflow  
Intermittent Whole-Building Mechanical Ventilation Airflow  
Central Fan Integrated Ventilation Cooling Systems

#### Domestic Hot Water Systems

Verified Pipe Insulation Credit  
Verified Parallel Piping  
Verified Compact Hot Water Distribution System  
Verified Point of Use  
Demand Recirculation: Manual Control  
Demand Recirculation: Sensor Control  
Multiple Recirculation Loop Design for DHW Systems Serving Multiple Dwelling Units

#### Renewables

PV Field Verification Protocol

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## HERS Registration Requirements

The 2016 Title 24 Standards require Title 24 documentation authors to register nearly all low-rise residential new construction projects with a HERS Provider. The Standards include a mandatory requirement that new homes and additions larger than 1,000 ft<sup>2</sup> 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.

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## Attic Radiant Barriers

Options A and C of the prescriptive requirements specify a radiant barrier in Climate Zones 2 through 15, those zones with high cooling loads. Prescriptive Option B allows designers to substitute the radiant barrier for insulation installed at the roof deck (minimum R-18) in addition to ceiling insulation. If you specify a radiant barrier, it will be listed in the Required Special Features section of Form CF1R-PRF-01-E (page 2).

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 3.8.2 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.”*

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## 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 2016 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:

Asphalt Shingles: Aged Solar Reflectance = 0.08, Emittance = 0.75

All Others: Aged Solar Reflectance = 0.10, Emittance = 0.75

If the certified Aged Solar Reflectance isn't available, use the equation in Section 3.6.1.7 of the Residential Manual to calculate it.

Refer to Section 3.6.1.7 of the Residential Manual for additional information about the mandatory requirements for residential roofing products and Section 3.6.2 for prescriptive requirements, which vary depending on the climate zone and roofing material. Also refer to Section 3.7 in the Nonresidential Manual for details regarding nonresidential requirements.

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## Pool and Spa Equipment

Sections 110.4 and 110.5 of the Standards describe the mandatory requirements for pool and spa heating equipment. All requirements are mandatory and cannot be used for achieving compliance using the performance path. 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 Residential Manual.

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## Photovoltaic System Credit

There is compliance credit available for photovoltaic systems installed in single family and multifamily projects in all Climate Zones excluding Zones 6 and 7. The system must be at least 2 kWdc for single family and 1kWdc for multifamily projects to be eligible for the credit. Refer to Section 2.2.3 of the Residential ACM Reference Manual for additional information regarding the PV system credit.

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## Energy Design Rating (EDR)

The following text is an excerpt from the Residential ACM Reference Manual, Chapter 3: Energy Design Rating.

*The software can calculate an energy design rating (EDR) as required in the CALGreen energy provisions (Title 24, Part 11). The EDR implementation is limited to newly constructed single- and multi-family dwellings.*

*The EDR is an alternate way to express the energy performance of a home using a scoring system where 100 represents the energy performance of a reference design building meeting the envelope requirements of the 2006 International Energy Conservation Code (IECC). The EDR is similar to the energy rating index in the 2015 IECC and the 2014 Residential Energy Services Network (RESNET) standard. Combining high levels of energy efficiency with generating renewable energy, a score of zero or less can be achieved.*

*Buildings complying with the current Building Energy Efficiency Standards are more efficient than the 2006 IECC, so most newly constructed buildings will have EDR scores below 100. Buildings with renewable generation like photovoltaics (PV) can achieve a negative score. If an EDR is calculated for an older inefficient home, the score would likely be well over 100.*

*Additional inputs are required specifying more details about PV systems, and the EDR is reported on the CF1R. EDR-specific inputs and calculations are not used for compliance calculations.*

In the 2016 cycle, the Energy Design Rating is not used for compliance, but is available in preparation for the next code cycle. The software calculates two EDR scores: one that includes efficiency measures only, and one for that also includes the impacts from a PV system. The EDR credit for the PV system is essentially capped when the PV system size is large enough to offset the estimated electricity usage. If the system includes battery storage equal to 6kWh or more, one may decrease the size of the PV system. In

addition, the EDR will include credits for a larger system, up to 1.6 times the estimated electricity usage for use in reach codes.

The battery storage component has two options: basic/default or advanced controls. Advanced controls assume the system is controlled by the utility or another aggregator to maximize the TDV value of the system.

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# 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](#)
- [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](#)
- [Exhaust Fans](#)
- [Nonresidential Fenestration](#)
- [Cool Roofs](#)
- [Duct Sealing in Nonresidential](#)

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## 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.

### What Envelope Surfaces To Model

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.

## Entering Envelope Surface Data

See the [Building Tree](#) for detailed descriptions of all surface data inputs. Also refer to the applicable Special Topics later in this section.

## Written Justification For Exceptional Conditions

The program prints a Certificate of Compliance (PERF-1C) form with every performance (NR T24 Performance) report. At the end of the PERF-1C form is a section entitled Exceptional Conditions Compliance Checklist which flags important conservation measures modeled in the calculation of the proposed design energy use.

You must provide appropriate written justification and additional documentation on the plans and in the specifications for each of the items listed under this heading. For example, if Premium Efficiency supply fan motors are claimed as an energy conservation measure, cut sheets and/or other data on the fan motors must be submitted to document the intended installation of the more efficient fan motors.

## 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, smoking lounges 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 ACM Approval Manual (Nonresidential).

## 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.

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## 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.

### 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 the envelope 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 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.

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**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).

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## 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.

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## 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 ft (27.9 m), 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<sup>2</sup>-°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.

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**NOTE:** The standard design which sets the energy budget for the building uses exactly the same zoning and interzone surfaces as the proposed design.

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**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.

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## Standard HVAC System According To Proposed System Type

Based on the proposed HVAC system entered, the program chooses a standard default system for the standard design which is run to set the annual energy budget. [Tables 4](#) and [5](#) from the 2016 Nonresidential ACM Reference Manual list 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.

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## 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

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# 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 an unconditioned space at the settings for 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](#).

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**NOTE:** Include Demising Partitions as part of the adjacent conditioned space, not part of the unconditioned space.

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## 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.

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**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.

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## 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.

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## 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.

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## T-Bar Ceilings

Placing insulation directly over suspended ceilings is not permitted as a means of compliance, except for in limited applications. The following excerpt from Section 110.8(e)3 of the Standards describes the conditions under which placing insulation over suspended ceilings is allowed for Title 24 compliance.

*“EXCEPTION to Section 110.8(e)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 3.3.1 of the Nonresidential Compliance Manual for additional information regarding insulating a ceiling with removable panels.

---

## Process Loads

The 2016 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 7 includes a Process module that will assist you in completing the required compliance documentation for all covered processes.

Process loads (i.e., sensible and/or latent process loads) are input 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.

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## Tailored and Process Ventilation

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 4-14](#) 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).

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## 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](#).

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## Nonresidential Fenestration

[Manufactured](#)

[Site-Built](#)

[Field-Fabricated](#)

[NFRC CMA Program](#)

[Mixed Types](#)

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-BUILT*** 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 1,000 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 NA6-2016. 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 NA6-2016.

Projects with more than 1,000 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 3.2.1 of the Nonresidential Manual:

*“NFRC has developed the CMA to make the rating process quicker and simpler and serve as an energy ratings certification program for windows and other fenestration products used in non-residential (commercial) projects. Launched in January 2008 specifically for California’s Title 24 Part 6, the CMA Software Tool, also called CMAST, allows users to assemble fenestration products in a virtual environment. CMAST draws data for NFRC-approved components from online libraries choosing from pre-approved glazing, frame and spacer components. CMA users are able to obtain preliminary ratings for various configurations of their designs. CMA is fair, accurate and a credible method based on NFRC 100 and 200 program documents, which are verified by third-party rating procedures.*

*Architects and others can use this tool to:*

- 1. Help design energy-efficient windows, curtain wall systems and skylights for high performance building projects;*
- 2. Determine whether a product meets a project’s specifications and local/state building energy codes;*
- 3. Model different fenestration designs to compare energy performance.*

*Once the user is satisfied with the product, he or she creates a Bid Report containing the data for all fenestration products to be reviewed. This report can serve as an initial indication that the products comply with the project’s energy-related requirements and building energy codes. The physical 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) then a license agreement is signed with NFRC. At this point, NFRC issues a CMA Label Certificate for the project. This Label Certificate, unlike NFRC’s residential window label that is applied to individual units, is a single 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 single 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.”*

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 3.2.2 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.

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## Duct Sealing in Nonresidential Occupancies

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).**

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## Tailored Lighting Calculations

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.

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## **Title 24 Daylighting Requirements**

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.

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.

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.

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## Mandatory Measures

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*.

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## 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. **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. 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 either the mandatory minimum requirements, or proposed efficiency level of the component. 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).

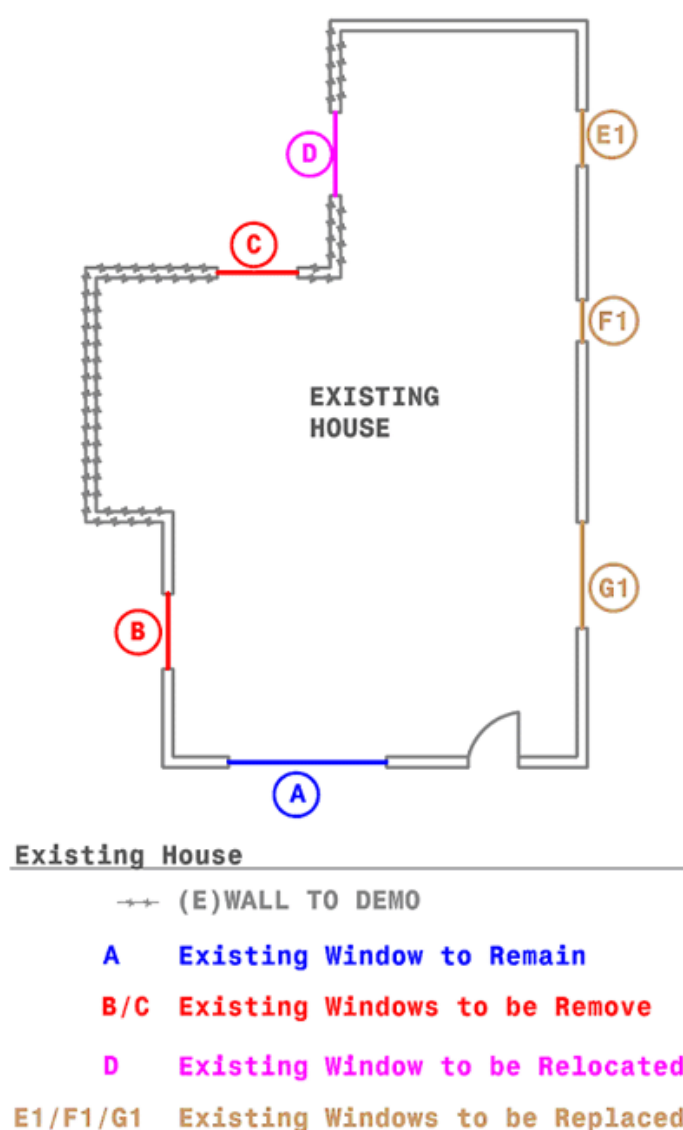
Refer to Standards Section 150.2 and [Table 150.2-C](#), and Section 9.4 in the Residential Manual for additional details regarding additions and alterations.

**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](#).

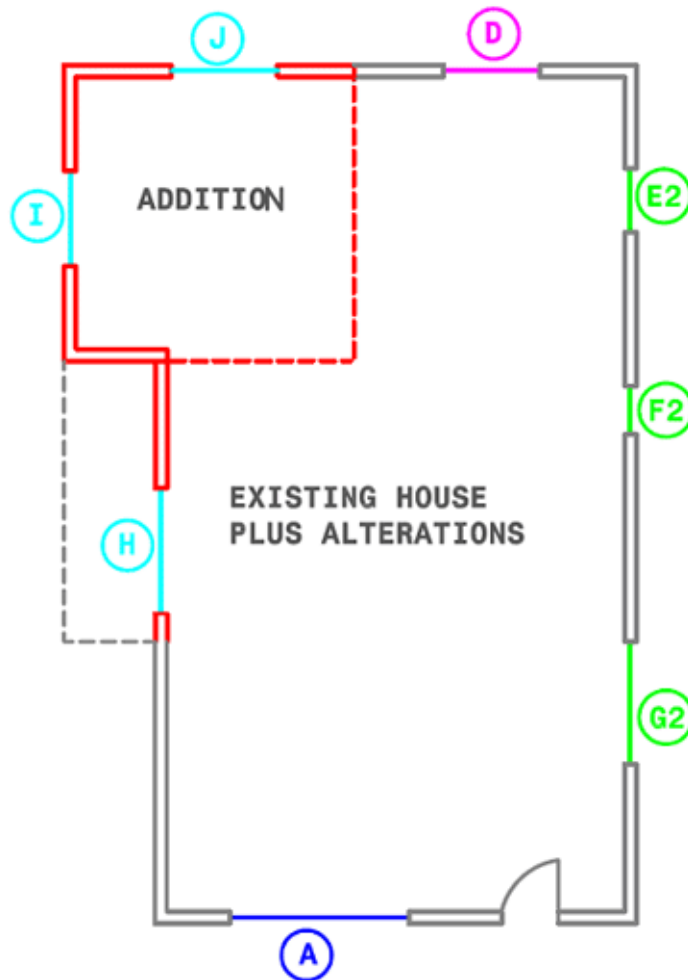
You may view a sample EnergyPro file of the existing plus addition plus alteration method. From the File menu, open the Existing+Alteration+Addition.bld file located in the Projects folder. The following two diagrams show the existing house and the house as it will be permitted.

**Figure A. Existing House**



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**



#### Existing + Alterations + Addition

— New Wall

A Existing Window (Unchanged)

D Relocated Existing Window

E2/F2/G2 Replacement Windows

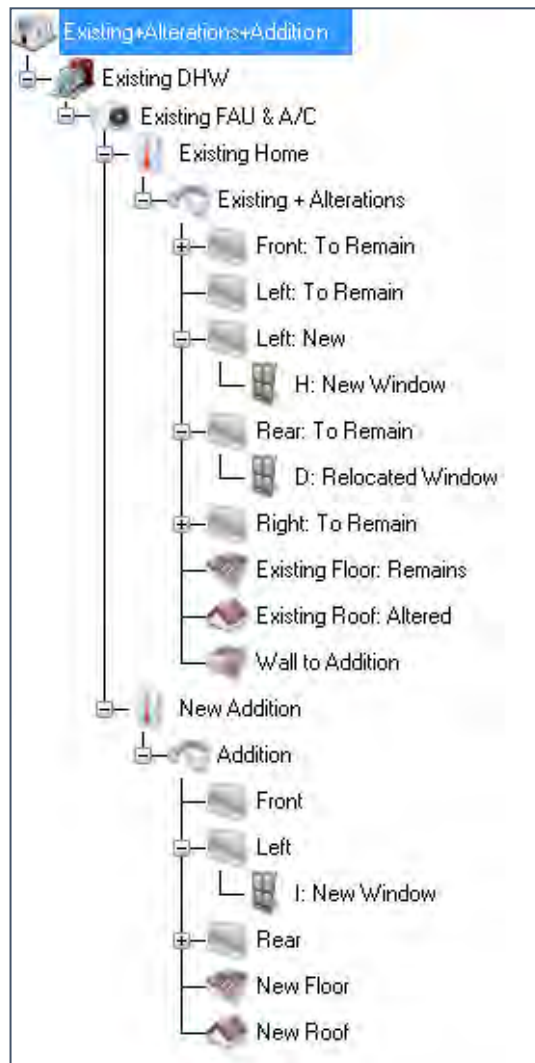
H/I/J New Windows

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**

Name: R-38 Roof

Area: 500 ft<sup>2</sup>

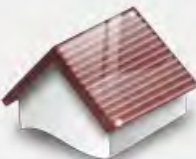
Surface Type: New

New Assembly: R-38 Roof Attic

Orientation: 0

Slope: 4 / 12

☐ Replacing > 50% of Roof Surface for > 2,000 sqft Nonres or  
≥ 1,000 sqft Res)



	U-Factor	Reflectance
T-24 Standard:	0.029	0.20
90.1 Baseline:	0.032	0.25
Proposed:	0.025	0.1
Layers:	0.033	0.1

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. 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 take into account all changes in all walls, floors, roofs and glazing which are altered, or added to the existing house 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

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 ft (929 m) of nonresidential space and a 2,500 ft (139.4 m) 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.



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# Mechanical Systems

**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](#)

[Default Mechanical Systems](#)

[Zonal Systems](#)

[Chillers and Cooling Towers](#)

[Space Heating Boilers](#)

[HVAC Distribution Systems](#)

[Case Studies](#)

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## 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.

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## 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.

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## **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.

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## **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](#).

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## 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.

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## 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

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.

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## 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.

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## 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.

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**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.

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## Case Study 3: Packaged VAV without Reheat

A one-story, 5,600 ft (520.2 m) 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.

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## Case Study 4: Built-Up VAV with Reheat

A ten-story, 56,000 ft (5,202.4 m) 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.

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## California Advanced Homes Program

The [CA Advanced Homes program](#) is a publicly-funded program that provides financial incentives for new homes that meet minimum energy efficiency performance requirements. For information regarding program eligibility requirements, or other program-related questions, please contact the appropriate utility, as determined by the project location. The program is implemented by [PG&E](#), [SCE](#), [SCG](#), and [SDGE](#).

You may use EnergyPro to generate an estimate of the potential utility incentive available for a residential new construction project participating in the Advanced Homes program. In the Incentives section of the Res T24 Performance Calculation Options screen, select the applicable options if the home meets the program requirements. Additional details are below. After the simulation is complete, include Form UTIL-1R in your report when you create it.

Refer to the program administrator's web sites for additional information and program rules and requirements.

NSHP Incentive: The project may be eligible for an incentive by qualifying for the Tier II incentives in the CEC's New Solar Homes Partnership (NSHP) program. Refer to the CEC website to obtain the most current information regarding program eligibility.

<http://www.gosolarcalifornia.org/about/nshp.php>

***Note that incentive estimates produced by EnergyPro are NOT GUARANTEED. All projects must meet all program requirements to qualify.***





**Table 4-14: Required Minimum Ventilation Rate per Occupancy**

	Occupancy	Use	CBC Occupancy Load (ft <sup>2</sup> /occ)	CMC Occupancy Load (occ/1000 ft <sup>2</sup> ) <sup>6</sup>	CMC Based Ventilation (cfm/ft <sup>2</sup> ) <sup>7</sup>	Ventilation from Table 121-A (cfm/ft <sup>2</sup> )	Required Ventilation (larger of CBC or Table 121-A) (cfm/ft <sup>2</sup> )
1)	Aircraft Hangars		500	2	0.12	0.15	0.15
2)	Auction Rooms		See Section 1004.7	50		0.15	0.15
3)	Assembly Areas (Concentrated Use)						
		Auditoriums	See Section 1004.7	150	0.06	0.15	0.15
		Bowling Alleys	5 persons per lane	40	0.12	0.15	0.15
		Churches & Chapels (Religious Worship)	7	120	0.06	0.15	0.15
		Dance Floors	5	100	0.06	0.15	1.50
		Lobbies	15	150	0.06	0.15	0.15
		Lodge Rooms	7	120	0.06	0.15	0.15
		Reviewing Stands	15	40	0.06	0.15	0.15
	„	Stadiums	See Section 1004			0.15	0.15
		Theaters - All	See Section 1004			0.15	0.15
		Waiting Areas	15	150	0.06	0.15	0.15
4)	Assembly Areas (Nonconcentrated Use)						
		Conference & Meeting Rooms <sup>1</sup>	15	50	0.06	0.15	0.15
		Dining Rooms/Areas	15	70	0.18	0.15	0.18
		Drinking Establishments <sup>2</sup>	15	100	0.18	0.2	0.18
		Exhibit/Display Areas	15	40	0.06	0.15	0.15
		Gymnasiums/Sports Arenas	15		0.30	0.15	0.30
		Lounges	15	100	0.18	0.2	0.18
		Stages	15	70	0.06	0.15	0.15
		Gaming, Keno, Slot Machine and Live Games Areas	11	120	0.18	0.2	0.18
5)	Auto Repair Workshops		100	15	0.12	1.5	1.50
6)	Barber & Beauty Shops		100	25	0.12	0.4	0.40
7)	Children's Homes & Homes for Aged		120	25	0.06	0.15	0.15
8)	Classrooms (AGES 5-8)		20	25	0.12	0.15	0.15
9)	Courtrooms		40	25	0.19	0.15	0.19
10)	Dormitories		50	20	0.06	0.15	0.15

11)	Dry Cleaning (Coin-Operated)		100	20	0.06	0.3	0.30
12)	Dry Cleaning (Commercial)		100	15	0.12	0.45	0.45
13)	Garage, Parking		200			0.15	0.15
14)	Healthcare Facilities:	Sleeping Rooms	120			0.15	0.15
		Treatment Rooms	240			0.15	0.15
15)	Hotels and Apartments						
		Hotel Function Area <sup>3</sup>	7	120	0.06	0.15	0.15
		Hotel Lobby	100	30	0.06	0.15	0.15
		Hotel Guest Rooms (<500 ft <sup>2</sup> )	200	20	0.06	Footnote <sup>5</sup>	Footnote <sup>5</sup>
		Hotel Guest rooms (>=500 ft <sup>2</sup> )	200	20	0.06	0.15	0.15
		Highrise Residential	200	Footnote <sup>9</sup>	0.06	Footnote <sup>6</sup>	n.a.
16)	Kitchen(s)		200			0.15	0.15
17)	Library:	Reading Rooms	50	10	0.12	0.15	0.15
		Stack Areas	100	10	0.12	0.15	0.15
18)	Locker Rooms		50			0.15	0.15
19)	Manufacturing		200			0.15	0.15
20)	Mechanical Equipment Room		300	2	0.06	0.15	0.15
21)	Nurseries for Children - Day Care		35	25	0.18	0.15	0.18
22)	Offices:	Office	100	5	0.06	0.15	0.15
		Bank/Financial Institution	100				0.15
		Medical & Clinical Care	100				0.15
23)	Retail Stores (See Stores)						
24)	School Shops & Vocational Rooms		50	20	0.18	0.15	0.18
25)	Skating Rinks:	Skate Area	50			0.15	0.15
		On Deck	15		0.48	0.15	0.48
26)	Stores:	Retail Sales, Wholesale Showrooms	30	15	0.12	0.2	0.2
		Basement and Ground Floor	30	15	0.12	0.2	0.2
		Upper Floors	60	15	0.12	0.2	0.20
		Grocery	30	8	0.06	0.2	0.2
		Malls, Arcades, & Atria	30	40	0.18	0.2	0.2
27)	Swimming Pools:	Pool Area	50		0.48	0.15	0.48
		On Deck	15		0.48	0.15	0.48
28)	Warehouses, Industrial & Commercial Storage/Stockrooms		500	2	0.12	0.15	0.15
29)	All Others -- Including Unknown		100	10	0.06	0.15	0.15

	Corridors, Restrooms, & Support Areas	100	10	0.06	0.15	0.15
	Commercial & Industrial Work	100	10	0.18	0.15	0.18
Footnotes:			Equations used to find:			
1. Convention, Conference, Meeting Rooms 2. Bars, Cocktail & Smoking Lounges, Casinos			3. Number of People Equation: $\text{Number of People} / 1,000 \text{ ft}^2 = \frac{1000}{\text{ft}^2 / \text{occupant}}$			
4. See Conference Rooms or Dining Rooms 5. Guestrooms less than 500 ft <sup>2</sup> use 30 cfm/guestroom 6. High-rise Residential See 2010 CMC 8. Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas. Net occupant load of 7. 9. Default occupancy for dwelling units shall be two persons for studio and one-bedroom units, with one additional person for each additional bedroom.			7. CBC Based Equation: $\text{CBC Based Ventilation (cfm / ft}^2\text{)} = 15 \text{ cfm} \times \frac{\left( \frac{\text{Occupants per 1000 ft}^2}{1000} \right)}{2}$			

**Table 4: HVAC System Map (NR ACM)**

Table 4: HVAC System Map (NR ACM)	
Building Type	Standard Design
Residential or hotel/motel guestrooms in a building with 3 or fewer floors	System 1 - PTAC
Residential or Hotel/motel Guestrooms in a building with 4 or more floors	System 2 - FPFC
Warehouse and light manufacturing space types (per the Appendix 5.4A Schedule column) that do not include cooling in the proposed design	System 9 - HEATVENT
Covered Process	See Table 6 –System Map for Covered Processes
All other space types	See Table 5 – Non-Residential Spaces (not including covered processes)

**Table 5: Nonresidential Spaces (not including covered processes) (NR ACM)**

<b>Table 5: Nonresidential Spaces (not including covered processes) (NR ACM)</b>			
<b>Building Area</b>	<b>Floors</b>	<b>Standard Design</b>	<b>Description</b>
$\leq 10,000 \text{ ft}^2$	1 floor	PSZ	Packaged Single Zone
$10,000 \text{ ft}^2 - 150,000 \text{ ft}^2$	>1 floor	PVAV	Packaged VAV Unit
	Any	PVAV	Packaged VAV Unit
$>150,000 \text{ ft}^2$	1 floor	SZVAV	Single-zone VAV Unit
	>1 floor	VAVS	Built-up VAV Unit

**Table 6: System Map for Covered Processes (NR ACM)**

<b>Table 6: System Map for Covered Processes (NR ACM)</b>		
<b>Building Type or Space Type</b>	<b>Floors</b>	<b>Baseline System</b>
Total computer room design cooling load is over 3,000,000 Btu/h Note: if the user chooses computer room for the space type and enters a receptacle load less than 20 W/ft <sup>2</sup> then the proposed and baseline shall use a receptacle load of 20 W/ft <sup>2</sup> .	Any	System 10 – CRAH Unit
Computer rooms that do not meet the conditions for System 10, CRAH	Any	System 11 – CRAC Unit
Laboratory Space	Any	System 12 – LAB
Restaurant Kitchen	Any	System 13 – KITCH

# Table D-4: Central System Inputs by System Type

Table D-4 Central System Inputs by System Type																					
	Split FAU- A/C	Packaged FAU-A/C	Split Heat Pump	Pkaged Heat Pump	Split Electric – A/C	Pkged Electric-A/C	Hydron.Heat Pump	Packaged VAV	Packaged MZ	Built-Up SZ	Built-Up VAV	Built-Up MZ	Dual Duct (SglFan)	4-Pipe Fan Coil	Furnace-Room A/C	Electric-Room A/C	Room Heat Pump	Packaged VVT	4 Pipe Induction	FAU-Evap. Cooling	Elec Evap. Cooling
System Name																					
System Type																					
Heating																					
Heating Coil																					
Heating Type																					
Furnace Type																					
Coil Control																					
Total Output																					
Electrical Power ( kW)																					
Supply Temperature																					
Efficiency																					
Pre-Heat Coils																					
Pre-heat Source																					
Setpoint																					
Reheat Coils																					

Reheat Source	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Delta T	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Baseboard Heat																				
Baseboard Heat Source	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cooling																				
Cooling Coil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coil Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Output	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Sensible	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Supply Temperature	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Efficiency	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fan Heat Included in Output	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Performance at ARI Cond.																				
EER	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comp/Condenser Power	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Condenser																				
Condenser Type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ice Storage A/C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Evap. Pre-Cooled Cond. Eff.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pump Motor Inputs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Room A/C & Heat Pump																				
Side Louvers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Controls																				
Fan Operation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cycle System on @ Night	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DDC Controls to Zone Level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fault Detection & Diagnostic Controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maximum Humidity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Outdoor Air																				
Air Economizer Characteristics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economizer Type	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Limit Temperature	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Water Side Economizer	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Exhaust Air Heat Recovery																				
Energy Recovered																				
Heat Recovery Effectiveness																				
Min. Delta T req. for Heat Recovery																				
Electrical Energy Use																				
Pump/Motor runs only when Heat Recovery is in Bypass Mode																				
Fan Savings when Heat Recovery is in Bypass Mode																				
Exhaust Air Stream Evap Cooling Effectiveness																				
Fans																				
Induction Ratio																				
Supply Fan																				

[illegible]

Output DB																				
Capacity																				
Input kW																				

**Table 140.6-E: Mounting Height Multipliers**

<b>Table 140.6-E: Adjustments for Mounting Height Above Floor</b>	
Height in feet above finished floor and bottom of luminaire(s)	Floor Display or Wall Display- Multiply by
<12'	1.00
12' to 16'	1.15
>16'	1.30

**Table 110.6-A: Default Fenestration Product U-Factors**

<b>Table 110.6-A Default Fenestration Product U-Factors</b>				
Frame	Product Type	Single Pane U-Factor	Double Pane U-Factor <sup>1</sup>	Glass Block U-Factor <sup>2</sup>
<b>Metal</b>	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/Garden Window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
<b>Metal, Thermal Break</b>	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/Garden Window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
<b>Nonmetal</b>	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Greenhouse/Garden Window	1.94	1.06	N.A.
	Doors	0.99	0.53	N.A.
	Skylight	1.47	0.84	N.A.

1. For all dual-glazed fenestration products, adjust the listed U-factors as follows:
  - a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide
  - b. Add 0.05 to any product with true divided lite (dividers through the panes.)
2. Translucent or transparent panels shall use glass block values when not rated by NFRC 100
3. Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6
4. Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table

**Table 110.6-B Default Solar Heat Gain Coefficient**

<b>Table 110.6-B Default Solar Heat Gain Coefficient (SHGC)</b>					
<b>Frame Type</b>	<b>Product</b>	<b>Glazing</b>	<b>Total Window SHGC</b>		
			<b>Single Pane</b>	<b>Double Pane</b>	<b>Glass Block<sup>1</sup></b>
<b>Metal</b>	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
<b>Metal, Thermal Break</b>	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
<b>Nonmetal</b>	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.
<ol style="list-style-type: none"> <li>1. Translucent or transparent panels shall use glass block values</li> <li>2. Visible Transmittance (VT) shall be calculated using Reference Nonresidential Appendix NA6</li> <li>3. Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table</li> </ol>					

## Nonresidential Appendix NA6-2013 Tables

## Appendix NA6: Alternate Default Fenestration Procedure to Calculate Thermal Performance

### NA6.2: Default U-Factor

The default U-Factor shall be determined using the following equation:

Equation NA6-1

$$U_T = C_1 + (C_2 \times U_C)$$

Where:

$U_T =$	The fenestration product U-Factor (incl glass and frame)
$C_1 =$	Coefficient selected from Table NA6-5
$C_2 =$	Coefficient selected from Table NA6-5
$U_C =$	Center of glass U-Factor in accordance with NFRC 100 Section 4.5.3.1 <a href="http://www.nfrc.org/software.aspx">http://www.nfrc.org/software.aspx</a>

Table NA6-5: U-Factor Coefficients

Product Type	Frame Type	C1	C2
Site-Built Vertical Fenestration	Metal	0.311	0.872
	Metal, Thermal Break	0.202	0.867
	Non-Metal	0.202	0.867
Skylights with a Curb	Metal	0.711	1.065
	Metal, Thermal Break	0.437	1.229
	Non-Metal	0.437	1.229
Skylights with no Curb	Metal	0.195	0.882
	Metal, Thermal Break	0.310	0.878
	Non-Metal	0.310	0.878

### NA6.3: Default Solar Heat Gain Coefficient

The SHGC of the fenestration product shall be calculated using the following equation:

Equation NA6-2

$$SHGC_T = 0.08 + (0.86 \times SHGC_C)$$

Where:

$SHGC_T =$	SHGC for the fenestration including glass and frame
$SHGC_C =$	SHGC for the center of glass in accordance with NFRC 200 Section 4.5.1.1 <a href="http://www.nfrc.org/software.aspx">http://www.nfrc.org/software.aspx</a>

### NA6.4: Default Visible Transmittance

The VT of the fenestration product shall be calculated using the following equation:

Equation NA6-3 VT of Center of Glass (COP) calculation

$$VT_T = VT_F \times VT_C$$

Where:

$VT_T =$	The Total Performance of the fenestration including glass and frame
$VT_F =$	0.53 for projecting windows, such as casement and awning windows
$VT_C =$	0.67 for operable or sliding windows

	$VT_F =$	0.77 for fixed or non operable windows
	$VT_F =$	0.88 for curtain wall/storefront, Site-built and manufactured non-curb mounted skylights
	$VT_F =$	1.0 for Curb Mounted manufactured Skylights
	$VT_c =$	Center of glass VT is calculated in accordance with NFRC 200, Section 4.5.1.1 or NFRC 202 for Translucent Products, or NFRC 203 for Tubular Daylighting Devices and Hybrid Tubular Daylighting Devices or ASTM E972 <a href="http://www.nfrc.org/software.aspx">http://www.nfrc.org/software.aspx</a>

**Table 6-2 Scope of the Outdoor Lighting Requirements**

<b>Table 6-2 Scope of the Outdoor Lighting Requirements</b>		
<b>Lighting Applications Covered</b>		<b>Lighting Applications Not Regulated (only as detailed in § 140.7)</b>
<b>General Hardscape (tradeoffs permitted)</b>	<b>Specific Applications (tradeoffs not permitted)</b>	
<p>The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), bridge(s), tunnel(s) and other improved area(s) that are illuminated.</p>	Canopies: Sales and Non-sales	Temporary
	Drive-Up Windows	Required & regulated by FAA Required & regulated by the Coast Guard
	Emergency Vehicle Facilities	For public streets, roadways, highways and traffic signage lighting, and occurring in the public right-of-way
	Building Entrances or Exits	For sports and athletic fields, and children's playground
	Building Façades	For industrial sites
	Guard Stations	For public monuments
	Hardscape Ornamental Lighting	Signs regulated by §130.3 and §140.8
	Outdoor Dining	For stairs, wheelchair elevator lifts
	Primary Entrances for Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities	For ramps that are other than parking garage ramps
	Outdoor Sales Frontage and Lots	Landscape lighting
	Special Security Lighting for Retail Parking and Pedestrian Hardscape	For themes and special effects in theme parks
	Student Pick-up/Drop off zone	For theatrical and other outdoor live performances
	Vehicle Service Station : Canopies, Hardscape, and Uncovered Fuel Dispenser ATM Machine Lighting	For qualified historic buildings

Other outdoor lighting applications that are not included in Standards Tables 140.7-A, or 140.7-B are assumed to be not regulated by these Standards. This includes decorative gas lighting and emergency lighting powered by an emergency source as defined by the California electrical code. The text in the above list of lighting applications that are not regulated has been shortened for brevity. Please see Section 6.1.2 B of the Nonresidential Manual for details about lighting applications not regulated.		

**Table 7: Rules for Determining Luminaire (Lighting Fixture) Count  
(CEC HERS Technical Manual)**

<b>Table 7: Rules for Determining Luminaire (Lighting Fixture) Count</b>		
<b>Luminaire Type</b>	<b>Examples/Description</b>	<b>Method of Counting</b>
Track Lighting	Line-voltage or low-voltage track	Larger of: One luminaire for each 3 feet of track length rounded up to 3 foot multiple, or Actual number of track heads installed.
Linear Fluorescent (see Note 1)	Linear fluorescent luminaire, factory-installed ballast	One luminaire per individual factory- made luminaire, regardless of number of lamps per luminaire
LED (see Note 2)	Single diodes or clusters of diodes	One luminaire per cluster
	Linear row of diodes	One luminaire for each 3 foot length, rounded up to 3 foot multiple.

Chandeliers with non-medium based sockets	Chandeliers with candelabra or pin-based sockets	Count = 1 for luminaires with one lamp or one socket Count = 1 luminaire for every ten sockets, rounded up to the nearest whole number, for luminaires with multiple lamps or sockets.
All Other	Incandescent luminaires including low-voltage or line-voltage	Count = 1 for luminaires with one lamp or one socket Count = 1 luminaire for every two sockets, rounded up to the nearest whole number, for luminaires with multiple lamps or sockets.

Note 1: A factory-made luminaire is a complete lighting unit consisting of lamps and the parts designed to distribute the light, to position and protect the lamps, and to connect the lamp to the power supply.

Note 2: LED system, no screw bases, includes optics and power supply.

**Table 8: Permanently Installed Luminaire Types (CEC HERS Technical Manual)**

Table 8 Permanently Installed Luminaire Types	
Classification	Definition
Permanently Installed High Efficacy	Meets the requirements of §150.2(k). Includes luminaires that can accept only linear fluorescent, compact fluorescent or LED lamps.
Low Efficacy	Any luminaire that accepts any type of incandescent lamp, and that has incandescent lamps installed
Screw-in High Efficacy	Any luminaire that accepts screw-based incandescent lamps, but that has screw-based compact fluorescent or screw-based LED installed. Any track lighting track that accepts medium screw-based incandescent lamps, but that has medium screw-based track head with screw-in CFL, CFL track heads with factory installed ballast, or LED track heads.



## Table 2-3: Measures Requiring Acceptance Testing

**Table 2-3 Measures Requiring Acceptance Testing**

Category	Measure
<b>Envelope</b>	
Fenestration Acceptance	Site-Built Fenestration – Label Certificate Verification
<b>Mechanical</b>	
Outdoor Air	Variable Air Volume Systems Outdoor Air Acceptance Constant Volume System Outdoor Air Acceptance
HVAC Systems	Constant Volume Single Zone, Unitary A/C and Heat Pumps
Air Distributions Systems	Air Distribution Acceptance
Air Economizer Controls	Economizer Acceptance
Demand Control Ventilation (DCV) Systems	Packaged Systems DCV Acceptance
Variable Frequency Drive Systems	Supply Fan Variable Flow Controls
Hydronic System Controls Acceptance	Valve Leakage Test Hydronic Variable Flow Controls Supply Water Temperature Reset Controls
Mechanical Systems	Automatic Demand Shed Control Acceptance Fault Detection & Diagnostics for Packaged DX Units Automatic Fault Detection & Diagnostics for Air Handling & Zone Terminal Units Distributed Energy Storage DX AC Systems Test Thermal Energy Storage (TES) Systems Supply Air Temperature Reset Controls Condenser Water Supply Temperature Reset Controls Energy Management Control System
<b>Indoor Lighting</b>	
Indoor Lighting Control Systems	Automatic Daylighting Controls Acceptance <ul style="list-style-type: none"> <li>• Occupancy Sensor Acceptance</li> <li>• Manual Daylighting Controls Acceptance</li> <li>• Automatic Time Switch Control Acceptance</li> </ul> Demand Responsive Controls
<b>Outdoor Lighting</b>	
Outdoor Lighting Control	Outdoor Motion Sensor Acceptance Outdoor Lighting Shut-off Controls <ul style="list-style-type: none"> <li>• Outdoor Photocontrol</li> <li>• Astronomical Time Switch</li> <li>• Standard (non-astronomical) Time Switch</li> </ul>
<b>Covered Processes</b>	
Compressed Air Systems	Compressed Air System Acceptance
Commercial Kitchens	Commercial Kitchen Exhaust System Acceptance
Enclosed Parking Garages	Ventilation System Acceptance Testing

Refrigerated Warehouses	Evaporators and Evaporator Fan Motor Variable Speed Controls Condensers and Condenser Fan Motor Variable Speed Controls Air-Cooled Condensers and Condenser Fan Motor Variable Speed Controls Variable Speed Screw Compressors Electric Resistance Underslab Heating Systems
Commercial Refrigeration	Air-Cooled Condensers and Fluid Coolers Evaporative Condensers, Fluid Coolers and Cooling Towers Compressor Floating Suction Controls Liquid Subcooling Display Case Lighting Controls Refrigeration Heat Recovery
Elevators	Elevator Lighting and Ventilation Controls
Escalators and Moving Walkways	Escalators & Moving Walkways Speed Control

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**TABLE 28: STANDARD DESIGN FOR SPACE CONDITIONING SYSTEMS (Residential ACM)**

**TABLE 28: STANDARD DESIGN SPACE CONDITIONING SYSTEMS**

Proposed Design Space Conditioning System Type	Standard Design Based on Proposed Space Conditioning Status		
	Added	Altered	Verified Altered
Heating System:	See Section 2.4 and 2015 Federal Appliance Standards based on fuel source and equipment type	Same as Addition.	Existing heating fuel type, equipment type/efficiency
Cooling System:	See Section 2.4 and 2015 Federal Appliance Standards based on equipment type.	Same as Addition.	Existing cooling equipment fuel type/efficiency
Refrigerant Charge	Climate Zones 2, 8-15: Yes Climate Zones 1, 3-7: No	Same as Addition	Existing
Whole House Fan (WHF) applies only if addition >1,000 ft <sup>2</sup>	CZ8-14, 1.5 cfm/sf		Existing condition. To count as Existing the WHF must be $\geq 1.5$ cfm/sf and be CEC-rated
Indoor Air Quality applies only if addition >1,000 ft <sup>2</sup>	Meet mandatory ventilation for entire dwelling	N/A	N/A

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**Table 5: RESNET Reference Home Dishwasher Assumptions**

Table 5: RESNET Reference Home Dishwasher Assumptions		
Occupants	Cycles / year	Reference Dishwasher kWh/year
2	154	90
3	214	126
4	247	145
5	296	174
6 or more	345	203

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**Table 6: Daily Lighting Hours - Interior**

<b>Table 6: Daily Lighting Hours – Interior</b>	
<b>Location</b>	<b>Daily Hours</b>
Small Closet	0.5
Bedroom / Walk In Closet	1.4
Hall Entry / Stairs / Other	2.0
Living	2.6
Utility / Laundry	2.6
Kitchen / Dining / Nook	3.4

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**Table 10: Daily Lighting Hours - Exterior**

Table 10: Daily Lighting Hours – Exterior	
Location	Daily Hours
Indoor Garage	2.3
Outdoor – Front Entry	6.0
Outdoor – Other (side/back)	2.0

**TABLE 150.0-A: Classification of High Efficacy Light Sources**

<b>TABLE 150.0-A: Classification of High Efficacy Light Sources</b>	
High Efficacy Light Sources	
Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy:	
Light sources in this column other than those installed in ceiling recessed downlight luminaires are classified as high efficacy and are not required to comply with Reference Joint Appendix JA8.	Light sources in this column shall be certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked as meeting JA8.
<ol style="list-style-type: none"> <li>1. Pin-based linear or compact fluorescent light sources using electronic ballasts.</li> <li>2. Pulse-start metal halide.</li> <li>3. High pressure sodium.</li> <li>4. GU-24 sockets containing light sources other than LEDs<sup>a,b</sup>.</li> <li>5. Luminaires with hardwired high frequency generator and induction lamp.</li> <li>6. Inseparable SSL luminaires that are installed outdoors.</li> <li>7. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.</li> </ol> <p>Note: Adaptors which convert an incandescent lamp holder to a high-efficacy luminaire shall not be used to classify a luminaire as high efficacy.</p>	<ol style="list-style-type: none"> <li>1. All light sources in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C.</li> <li>9. GU-24 sockets containing LED light sources.</li> <li>10. Any light source not otherwise listed in this table and certified to the Commission as complying with Joint Appendix 8.</li> </ol>
<p>Notes:</p> <ol style="list-style-type: none"> <li>a. GU-24 sockets containing light sources such as compact fluorescent lamps and induction lamps.</li> <li>b. California Title 20 Section 1605(k)3 does not allow incandescent light sources to have a GU-24 base.</li> </ol>	

**TABLE 150.2-C: Standard Design For An Altered Component**



**TABLE 150.2-B: Standard Design For An Altered Component**

<b>Altered Component</b>	<b>Standard Design Without Third Party Verification of Existing Conditions Shall be Based On</b>	<b>Standard Design With Third Party Verification of Existing Conditions Shall be Based On</b>
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	The U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed U-factor is $\leq 0.40$ and SHGC value is $\leq 0.35$ , the standard design shall be based on the existing U-factor and SHGC values as verified. Otherwise, the standard design shall be based on the U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Table 110.6-A and Table 110.6-B.
Space-Heating and Space-Cooling Equipment	The requirements of TABLE 150.1-A.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Section 150.2(b)1D.	
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.1(b)1 without the solar water heating requirements.	The existing efficiency energy factor.
Roofing Products	The requirements of Section 150.2(b)1H.	
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

**TABLE 4-6: Minimum Cooling Efficiencies for Central Air Conditioners and Heat Pumps**

<b>TABLE 4-6: Minimum Cooling Efficiencies for Central Air Conditioners and Heat Pumps</b>			
Appliance	Type	SEER Eff 1/1/2015	EER Eff 1/1/2015
Central Air Conditioners <sup>1</sup>	Split System <45,000 Btuh	14	12.2
	Split System ≥45,000 Btuh	14	11.7
	Single Package	14	11.0
Central Air Source Heat Pumps	Split System	14	NR
	Single Package	14	NR
Space Constrained Air Conditioner	Split System	12	NR
	Single Package	12	NR
Space Constrained Heat Pump	Split System	12	NR
	Single Package	12	NR
Small Duct, High Velocity Air Conditioner	All	12	NR
Small Duct, High Velocity Heat Pump	All	12	NR
1. Central split system air conditioners and central single package air conditioners <i>installed</i> on or after January 1, 2015 must comply with the minimum SEER and EER requirements of this table regardless of date of manufacture.			

**TABLE 4-14: Continuous Whole Building Ventilation Rate (cfm) (from ASHRAE 62.2, Table 4.1a (I-P))**

<b>TABLE 4-14: Continuous Whole Building Ventilation Rate (cfm) (from ASHRAE 62.2, Table 4.1a (I-P))</b>					
<b>Conditioned Floor Area (ft<sup>2</sup>)</b>	<b>Bedrooms</b>				
	<b>0-1</b>	<b>2-3</b>	<b>4-5</b>	<b>6-7</b>	<b>&gt;7</b>
≤1,500	30	45	60	75	90
1,501 - 3,000	45	60	75	90	105
3,001 - 4,500	60	75	90	105	120
4,501 - 6,000	75	90	105	120	135
6,001 - 7,500	90	105	120	135	150
>7,500	105	120	135	150	165

**TABLE 9-4: Modeling Rules for Existing + Addition + Alterations**

The table summarizes basic rules for a low-rise residential building using the Existing + Addition + Alterations performance approach. For more detailed information, see Section 9.7 of the Residential ACM Reference Manual.

<b>TABLE 9-4: Modeling Rules for Existing + Addition + Alterations</b>		
<b>Type of Component or System Modeled</b>	<b>Standard Design Without Third Party Verification of Existing Conditions</b>	<b>Standard Design With Third Party Verification of Existing Conditions</b>
<i>"EXISTING" -- Components or Systems That Remain Unchanged</i>	<i>Model each component or system as "Existing"</i>	<i>Model each component or system as "Existing"</i>
<i>"ALTERED" -- Components or Systems Being Changed/Replaced</i>	<i>Model each altered component or system as "Altered" but do not model the "Pre-Altered Existing" conditions</i>	<i>Model each component or system as "Altered" and also model the "Pre- Altered Existing" conditions</i>
<i>"NEW" -- Components or Systems Being Added</i>	<i>Model each component or system as "New"</i>	<i>Model each component or system as "New"</i>
<i>"REMOVED" -- Components or Systems Being Removed and Not Replaced</i>	<i>These components and systems are omitted entirely from the model</i>	<i>These components and systems are omitted entirely from the model</i>

## Table 150.1-A Component Package-A

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

						Climate Zone															
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Roofs/Ceilings	Option A (meets §150.1(c) PA)	Commons Insulation Above Roof Rafters	Roofing Type	No Air Space <sup>1</sup>	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
					With Air Space <sup>2</sup>	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation			R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
			Below Roof Deck Insulation <sup>3</sup>	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18
					With Air Space	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13
		Option B (meets §150.1(c) PA)	Ceiling Insulation			R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR
		Option C (meets §150.1(c) PB)	Ceiling Insulation			R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR

## SECTION 150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR LOW-RISE RESIDENTIAL BUILDINGS

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Walls	Above Grade	Framed <sup>4</sup>	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
			Mass Wall Insulation <sup>5</sup>	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17
			Mass Wall Exterior <sup>6</sup>	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.1025 R 8.0	U 0.125 R 8.0	U 0.070 R 13
		Below Grade	Below Grade Interior <sup>7</sup>	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15
			Below Grade Exterior <sup>8</sup>	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19
	Floors	Slab Perimeter		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
		Raised		U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
		Concrete Raised		U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0
Building Envelope	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
	Steep Sloped		Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
Building Envelope	Fenestration	Maximum U-factor		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

## SECTION 150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR LOW-RISE RESIDENTIAL BUILDINGS

CONTINUED: TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

			Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
HVAC SYSTEM	Space Heating	Electric-Resistance Allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
		If gas, AFUE		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		If Heat Pump, HSPF <sup>9</sup>		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
	Space cooling	SEER		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Whole House Fan <sup>10</sup>		NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	NR
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
	Ducts <sup>12</sup>	Roof/Ceiling Options A & B	Duct Insulation	R-5	R-5	R-6	R-5	R-6	R-5	R-6	R-5	R-5	R-5	R-5	R-5	R-5	R-5	R-5	R-5
			§150.1(c)9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Roof/Ceiling Option C	Duct Insulation	R-5	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6
			§150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ

Water Heating	All Buildings:		System Shall meet Section 150.1(c)8															



Footnote requirements to TABLE 150.1-A:

1. Install the specified R-value with no air space present between the roofing and the roof deck.
2. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to meet the required maximum U-factor.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. HSPF means "heating seasonal performance factor."
10. When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHFs whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
11. A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.



# Appendices

Appendix 1: CEC EnergyPro v7 Approval

[Residential Compliance, January 13, 2016](#)

[Nonresidential Compliance, February 10, 2016](#)

Appendix 2: Sample CF1R-PRF-01-E Forms

[New Construction](#)

[Existing Plus Addition Plus Alteration](#)

Appendix 3: Sample NRCC-PRF-01-E Form

[Nonresidential Performance Form \(NRCC-PRF-01-E\), New Construction](#)

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## Appendix 1: CEC Official Notice of EnergyPro v7 Approval

EnergyPro version 7, developed by EnergySoft, LLC, is a software program which may be used for demonstrating compliance with the 2016 Title 24, Part 6 (*Building Energy Efficiency Standards*), effective January 1, 2017.

Residential Compliance: EnergyPro version 7.0 was approved by the CEC on January 13, 2016. The low-rise residential standards apply to single family dwellings (R-3 occupancy group) and to multi-family buildings (R-1 or R-2) with three stories or less. Hotels, motels, and multi-family buildings with four or more stories are outside the scope of the low-rise standards.

EnergyPro version 7.2 includes the new CBECC-Res version 2016.3.0 compliance manager, approved by the Commission on July 12, 2017.

Nonresidential Compliance: EnergyPro version 7.0 was approved by the CEC on February 10, 2016. EnergyPro's NR T24 Performance module uses the CEC's CBECC-Com (version 2016.2.0) compliance manager, which is based upon the EnergyPlus simulation engine.

## Appendix 2: Form CF1R-PRF-01-E Sample – New Construction (Page 1)

[CF1R-PRF-01-E, Page 2](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 1 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rdbd16x

GENERAL INFORMATION					
01	Project Name	Residential Example			
02	Calculation Description	Title 24 Analysis			
03	Project Location	7188 Pleasant Way			
04	City	San Bernardino	05	Standards Version	Compliance 2017
06	Zip Code	90000	07	Compliance Manager Version	BEMcmpMgr 2016.1.0 (401)
08	Climate Zone	CZ10	09	Software Version	EnergyPro 7.0
10	Building Type	Single Family	11	Front Orientation (deg/Cardinal)	90
12	Project Scope	Newly Constructed	13	Number of Dwelling Units	1
14	Total Cond. Floor Area (ft²)	2000	15	Number of Zones	2
16	Slab Area (ft²)	1200	17	Number of Stories	2
18	Addition Cond. Floor Area	N/A	19	Natural Gas Available	Natural Gas (Natural gas available)
20	Addition Slab Area (ft²)	N/A	21	Glazing Percentage (%)	19.5%

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

ENERGY USE SUMMARY				
04	05	06	07	08
Energy Use (kTDV/ft²-yr)	Standard Design	Proposed Design	Compliance Margin	Percent Improvement
Space Heating	5.81	5.23	0.58	10.0%
Space Cooling	22.32	31.56	-9.24	-41.4%
IAQ Ventilation	1.15	1.15	0.00	0.0%
Water Heating	9.37	7.92	1.45	15.5%
Photovoltaic Offset	---	-9.24	9.24	---
Compliance Energy Total	38.65	36.62	2.03	5.3%

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-11192015-401

HERS Provider:

Report Generated at: 2015-12-23 08:44:03

## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 2)

[CF1R-PRF-01-E, Page 1](#)

[CF1R-PRF-01-E, Page 3](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 2 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.ribd16x

#### REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- PV System: 2.0 kW

#### 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 components tables below.

##### Building-level Verifications:

- IAQ mechanical ventilation

##### Cooling System Verifications:

- Minimum Airflow
- Verified SEER
- Refrigerant Charge
- Fan Efficacy Watts/CFM

##### HVAC Distribution System Verifications:

- Duct Sealing
- Ducts located entirely in conditioned space

##### Domestic Hot Water System Verifications:

- -- None --

#### BUILDING - FEATURES INFORMATION

01	02	03	04	05	06	07
Project Name	Conditioned Floor Area (ft <sup>2</sup> )	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 (ft <sup>2</sup> )	Avg. Ceiling Height	Water Heating System 1	Water Heating System 2
1st Floor Zone	Conditioned	Res HVAC1	1200	8	DHW Sys 1	
2nd Floor Zone	Conditioned	Res HVAC1	800	8	DHW Sys 1	

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-11192015-401

HERS Provider:

Report Generated at: 2015-12-23 08:44:03

## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 3)

[CF1R-PRF-01-E, Page 2](#)

[CF1R-PRF-01-E, Page 4](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 3 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

OPAQUE SURFACES							
01	02	03	04	05	06	07	08
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft²)	Window & Door Area (ft²)	Tilt (deg)
Front Wall	1st Floor Zone	R-19 Wall	0	Right	320	81	90
Left Wall	1st Floor Zone	R-19 Wall	90	Front	240	40	90
Back Wall	1st Floor Zone	R-19 Wall	180	Left	320	88.7	90
Right Wall	1st Floor Zone	R-19 Wall	270	Back	240	32	90
Wall to Garage	1st Floor Zone>> __Garage__	R-13 Wall			100	20	
R-38 Roof	1st Floor Zone	R-38 Roof Attic			500		
Front Wall 2	2nd Floor Zone	R-19 Wall	0	Right	320	80	90
Left Wall 2	2nd Floor Zone	R-19 Wall	90	Front	240	24	90
Back Wall	2nd Floor Zone	R-19 Wall	180	Left	320	70	90
Right Wall 2	2nd Floor Zone	R-19 Wall	270	Back	240	32	90
R-38 Roof 2	2nd Floor Zone	R-38 Roof Attic			800		
Floor over Garage	2nd Floor Zone>> __Garage__	R-19 Floor No Crawl Space			100		
GarageWallFront	__Garage__	Garage Ext Wall	0	Right	180	128	90
GarageWallLeft	__Garage__	Garage Ext Wall	90	Front	198		90
GarageWallRight	__Garage__	Garage Ext Wall	270	Back	108		90
GarageRoof	__Garage__	R-30 Roof Attic			340		

ATTIC							
01	02	03	04	05	06	07	08
Name	Construction	Type	Roof Rise	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof
Attic __Garage__	Attic Garage Roof Cons	Ventilated	4	0.1	0.85	No	No
Attic 1st Floor Zone	Attic Roof1st Floor Zone	Ventilated	4	0.1	0.85	Yes	No
Attic 2nd Floor Zone	Attic Roof2nd Floor Zone	Ventilated	4	0.1	0.85	Yes	No

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-11192015-401

HERS Provider:

Report Generated at: 2015-12-23 08:44:03



## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 4)

[CF1R-PRF-01-E, Page 3](#)

[CF1R-PRF-01-E, Page 5](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 4 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

WINDOWS									
01	02	03	04	05	06	07	08	09	10
Name	Type	Surface (Orientation-Azimuth)	Width (ft)	Height (ft)	Multiplier	Area (ft <sup>2</sup> )	U-factor	SHGC	Exterior Shading
Front Windows	Window	Front Wall (Right-0)	----	----	1	60.0	0.34	0.33	Insect Screen (default)
Left Windows	Window	Left Wall (Front-90)	----	----	1	40.0	0.34	0.33	Insect Screen (default)
Back Windows	Window	Back Wall (Left-180)	----	----	1	72.0	0.34	0.33	Insect Screen (default)
Right Windows	Window	Right Wall (Back-270)	----	----	1	32.0	0.34	0.33	Insect Screen (default)
Front Windows 2	Window	Front Wall 2 (Right-0)	----	----	1	60.0	0.34	0.33	Insect Screen (default)
Left Windows 2	Window	Left Wall 2 (Front-90)	----	----	1	24.0	0.34	0.33	Insect Screen (default)
Back Windows 2	Window	Back Wall (Left-180)	----	----	1	70.0	0.34	0.33	Insect Screen (default)
Right Windows 2	Window	Right Wall 2 (Back-270)	----	----	1	32.0	0.34	0.33	Insect Screen (default)

DOORS			
01	02	03	04
Name	Side of Building	Area (ft <sup>2</sup> )	U-factor
Entry Door	Front Wall	21.0	0.50
Back Door	Back Wall	16.7	0.50
Door	Wall to Garage	20.0	0.50
GarageCarDoorFront	GarageWallFront	128.0	0.70

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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HERS Provider:

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## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 5)

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[CF1R-PRF-01-E, Page 6](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 5 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

OPAQUE SURFACE CONSTRUCTIONS						
01	02	03	04	05	06	07
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Winter Design U-value	Assembly Layers
Garage Ext Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	none	0.361	<ul style="list-style-type: none"> <li>• Inside Finish: Gypsum Board</li> <li>• Cavity / Frame: no insul. / 2x4</li> <li>• Exterior Finish: 3 Coat Stucco</li> </ul>
R-30 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 30	0.032	<ul style="list-style-type: none"> <li>• Inside Finish: Gypsum Board</li> <li>• Cavity / Frame: R-9.1 / 2x4</li> <li>• Over Ceiling Joists: R-20.9 insul.</li> </ul>
Attic Garage Roof Cons	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> <li>• Cavity / Frame: no insul. / 2x4 Top Chrd</li> <li>• Roof Deck: Wood Siding/sheathing/decking</li> <li>• Roofing: Light Roof (Asphalt Shingle)</li> </ul>
Attic Roof1st Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> <li>• Cavity / Frame: no insul. / 2x4 Top Chrd</li> <li>• Roof Deck: Wood Siding/sheathing/decking</li> <li>• Roofing: Light Roof (Asphalt Shingle)</li> </ul>
R-38 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 38	0.025	<ul style="list-style-type: none"> <li>• Inside Finish: Gypsum Board</li> <li>• Cavity / Frame: R-9.1 / 2x4</li> <li>• Over Ceiling Joists: R-28.9 insul.</li> </ul>
R-19 Wall	Exterior Walls	Wood Framed Wall	2x6 @ 16 in. O.C.	R 19	0.072	<ul style="list-style-type: none"> <li>• Inside Finish: Gypsum Board</li> <li>• Cavity / Frame: R-19 / 2x6</li> <li>• Exterior Finish: 3 Coat Stucco</li> </ul>
R-13 Wall	Interior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	R 13	0.092	<ul style="list-style-type: none"> <li>• Inside Finish: Gypsum Board</li> <li>• Cavity / Frame: R-13 / 2x4</li> <li>• Other Side Finish: Gypsum Board</li> </ul>
Attic Roof2nd Floor Zone	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> <li>• Cavity / Frame: no insul. / 2x4 Top Chrd</li> <li>• Roof Deck: Wood Siding/sheathing/decking</li> <li>• Roofing: Light Roof (Asphalt Shingle)</li> </ul>
R-0 Floor No Crawlspc	Interior Floors	Wood Framed Floor	2x12 @ 16 in. O.C.	none	0.196	<ul style="list-style-type: none"> <li>• Floor Surface: Carpeted</li> <li>• Floor Deck: Wood Siding/sheathing/decking</li> <li>• Cavity / Frame: no insul. / 2x12</li> <li>• Ceiling Below Finish: Gypsum Board</li> </ul>
R-19 Floor No Crawlspc	Interior Floors	Wood Framed Floor	2x6 @ 16 in. O.C.	R 19	0.048	<ul style="list-style-type: none"> <li>• Floor Surface: Carpeted</li> <li>• Floor Deck: Wood Siding/sheathing/decking</li> <li>• Cavity / Frame: R-19 / 2x6</li> <li>• Ceiling Below Finish: Gypsum Board</li> </ul>

Registration Number:

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## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 6)

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[CF1R-PRF-01-E, Page 7](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 6 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

SLAB FLOORS						
01	02	03	04	05	06	07
Name	Zone	Area (ft <sup>2</sup> )	Perimeter (ft)	Edge Insul. R-value & Depth	Carpeted Fraction	Heated
Covered Slab	1st Floor Zone	1200	90	None	0.8	No
Garage Slab	Garage	440	54	None	0	No

BUILDING ENVELOPE - HERS VERIFICATION			
01	02	03	04
Quality Insulation Installation (QII)	Quality Installation of Spray Foam Insulation	Building Envelope Air Leakage	CFM50
Not Required	Not Required	Not Required	---

WATER HEATING SYSTEMS					
01	02	03	04	05	06
Name	System Type	Distribution Type	Water Heater	Number of Heaters	Solar Fraction (%)
DHW Sys 1 - 1/1	DHW	Standard	DHW Heater 1	1	0%

WATER HEATERS							
01	02	03	04	05	06	07	08
Name	Heater Element Type	Tank Type	Tank Volume (gal)	Energy Factor or Efficiency	Input Rating	Tank Exterior Insulation R-value	Standby Loss (Fraction)
DHW Heater 1	Gas	Small Instantaneous	0	0.97	180000-Btu/hr	0	0

WATER HEATING - HERS VERIFICATION						
01	02	03	04	05	06	07
Name	Pipe Insulation	Parallel Piping	Compact Distribution	Point-of Use	Recirculation Control	Central DHW Distribution
DHW Sys 1 - 1/1	---	---	---	---	---	---

SPACE CONDITIONING SYSTEMS					
01	02	03	04	05	06
SC Sys Name	System Type	Heating Unit Name	Cooling Unit Name	Fan Name	Distribution Name
Res HVAC1	Other Heating and Cooling System	Heating Component 1	Cooling Component 1	HVAC Fan 1	Air Distribution System 1

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 7)

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[CF1R-PRF-01-E, Page 8](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 7 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

HVAC - HEATING UNIT TYPES		
01	02	03
Name	Type	Efficiency
Heating Component 1	CntrlFurnace - Fuel-fired central furnace	94.1 AFUE

HVAC - COOLING UNIT TYPES						
01	02	03	04	05	06	07
Name	System Type	Efficiency		Zonally Controlled	Multi-speed Compressor	HERS Verification
		EER	SEER			
Cooling Component 1	SplitAirCond	11.8	16	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	Verified SEER	Verified Refrigerant Charge
Cooling Component 1-hers-cool	Required	350	Not Required	Required	Required

HVAC - DISTRIBUTION SYSTEMS						
01	02	03	04	05	06	07
Name	Type	Duct Leakage	Insulation R-value	Duct Location	Bypass Duct	HERS Verification
Air Distribution System 1	DuctsInAll	Sealed and tested	8	Conditioned zone	None	Air Distribution System 1-hers-dist

HVAC DISTRIBUTION - HERS VERIFICATION							
01	02	03	04	05	06	07	08
Name	Duct Leakage Verification	Duct Leakage Target (%)	Verified Duct Location	Verified Duct Design	Buried Ducts	Deeply Buried Ducts	Low-leakage Air Handler
Air Distribution System 1-hers-dist	Required	6.0	Required	Not Required	Not Required	Not Required	---

HVAC - FAN SYSTEMS			
01	02	03	04
Name	Type	Fan Power (Watts/CFM)	HERS Verification
HVAC Fan 1	Single Speed PSC Furnace Fan	0.58	HVAC Fan 1-hers-fan

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## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 8)

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[CF1R-PRF-01-E, Page 9](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 8 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

HVAC FAN SYSTEMS - HERS VERIFICATION					
01	02		03		
Name	Verified Fan Watt Draw		Required Fan Efficiency (Watts/CFM)		
HVAC Fan 1-hers-fan	Required		0.58		

IAQ (Indoor Air Quality) FANS					
01	02	03	04	05	06
Dwelling Unit	IAQ CFM	IAQ Watts/CFM	IAQ Fan Type	IAQ Recovery Effectiveness(%)	HERS Verification
SFam IAQVentRpt	50	0.25	Default	0	Required

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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HERS Provider:

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## Appendix 2: Form CF1R-PRF-01-E Sample New Construction (Page 9)

### [CF1R-PRF-01-E, Page 8](#)

#### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Residential Example

Calculation Date/Time: 08:43, Wed, Dec 23, 2015

Page 9 of 9

Calculation Description: Title 24 Analysis

Input File Name: Res Sample.rbd16x

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: Not Valid for Use	Signature Date: 1/10/2016
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. 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:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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HERS Provider:

Report Generated at: 2015-12-23 08:44:03

## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 1)

[CF1R-PRF-01-E, Page 2](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:26, Fri, Feb 05, 2016

Page 1 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

GENERAL INFORMATION					
01	Project Name	Existing+Alterations+Addition			
02	Calculation Description	Title 24 Analysis			
03	Project Location	123 Main St.			
04	City	Sacramento	05	Standards Version	Compliance 2017
06	Zip Code	92990	07	Compliance Manager Version	BEMCompMgr 2016.1.0 (401)
08	Climate Zone	CZ12	09	Software Version	EnergyPro 7.0
10	Building Type	Single Family	11	Front Orientation (deg/Cardinal)	0
12	Project Scope	Addition and/or Alteration		13	Number of Dwelling Units
14	Total Cond. Floor Area (ft <sup>2</sup> )	1455	15	Number of Zones	2
16	Slab Area (ft <sup>2</sup> )	225	17	Number of Stories	1
18	Addition Cond. Floor Area	405	19	Natural Gas Available	Natural Gas (Natural gas available)
20	Addition Slab Area (ft <sup>2</sup> )	225	21	Glazing Percentage (%)	13.2%

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

ENERGY USE SUMMARY				
04	05	06	07	08
Energy Use (kTDV/ft <sup>2</sup> -yr)	Standard Design	Proposed Design	Compliance Margin	Percent Improvement
Space Heating	43.64	37.26	6.38	14.6%
Space Cooling	53.82	59.26	-5.44	-10.1%
IAQ Ventilation	0.00	0.00	0.00	0.0%
Water Heating	30.92	27.58	3.34	10.8%
Photovoltaic Offset	—	0.00	0.00	—
Compliance Energy Total	128.38	124.10	4.28	3.3%

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-11192015-401

HERS Provider:

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 2)

[CF1R-PRF-01-E, Page 1](#)

[CF1R-PRF-01-E, Page 3](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 2 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

#### REQUIRED SPECIAL FEATURES

The following are features that must be installed as condition for meeting the modeled energy performance for this computer analysis.

- Cathedral Ceiling

#### 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 components tables below.

##### Building-level Verifications:

- Verified Existing Conditions

##### Cooling System Verifications:

- Minimum Airflow
- Verified EER
- Verified SEER
- Refrigerant Charge
- Fan Efficacy Watts/CFM

##### HVAC Distribution System Verifications:

- Verified low-leakage ducts located entirely in conditioned space

##### Domestic Hot Water System Verifications:

- – None –

#### ENERGY DESIGN RATING

This is the sum of the annual TDV energy consumption for energy use components included in the performance compliance approach for the Standard Design Building (Energy Budget) and the annual TDV energy consumption for lighting and components not regulated by Title 24, Part 6 (such as domestic appliances and consumer electronics) and accounting for the annual TDV energy offset by an on-site renewable energy system.

	Reference Energy Use	Energy Design Rating	Margin	Percent Improvement
Total Energy (kTDV/ft <sup>2</sup> -yr)*	187.10	182.82	4.28	2.3%

\* includes calculated Appliances and Miscellaneous Energy Use (AMEU)

#### BUILDING - FEATURES INFORMATION

01	02	03	04	05	06	07
Project Name	Conditioned Floor Area (ft <sup>2</sup> )	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	6	2	0	2

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 3)

[CF1R-PRF-01-E, Page 2](#)

[CF1R-PRF-01-E, Page 4](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 3 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

ZONE INFORMATION						
01	02	03	04	05	06	07
Zone Name	Zone Type	HVAC System Name	Zone Floor Area (ft <sup>2</sup> )	Avg. Ceiling Height	Water Heating System 1	Water Heating System 2
Existing Home	Conditioned	Altered FAU & A/C1	1050	9		DHW Sys 2
New Addition	Conditioned	Altered FAU & A/C1	405	9		DHW Sys 2

OPAQUE SURFACES									
01	02	03	04	05	06	07	08	09	10
Name	Zone	Construction	Azimuth	Orientation	Gross Area (ft <sup>2</sup> )	Window & Door Area (ft <sup>2</sup> )	Tilt (deg)	Status	Verified Existing Condition
Front: To Remain	Existing Home	R-0 Wall	0	Front	180	70	90	Existing	No
Left: To Remain	Existing Home	R-0 Wall	90	Left	135		90	Existing	No
Left: New	Existing Home	R-15 Wall	90	Left	135	30	90	New	N/A
Rear: To Remain	Existing Home	R-0 Wall	180	Back	135	20	90	Existing	No
Right: To Remain	Existing Home	R-0 Wall	270	Right	405	42	90	Existing	No
Existing Roof: Altered 2	Existing Home	R-38 Roof Attic			1048			Altered	Yes
Existing Floor: Remains	Existing Home	R-0 Floor Crawlspace			1050			Existing	No
Front	New Addition	R-15 Wall	0	Front	54		90	New	N/A
Left	New Addition	R-15 Wall	270	Right	135	20	90	New	N/A
Rear	New Addition	R-15 Wall	180	Back	135	20	90	New	N/A
New Roof 2	New Addition	R-38 Roof Attic			219			New	N/A

OPAQUE SURFACES – Cathedral Ceilings													
01	02	03	04	05	06	07	08	09	10	11	12	13	
Name	Zone	Type	Orientation	Area (ft <sup>2</sup> )	Skylight Area (ft <sup>2</sup> )	Roof Rise (x in 12)	Roof Pitch	Roof Tilt(deg)	Roof Reflectance	Roof Emittance	Framing Factor	Status	Verified Existing Condition
Existing Roof: Altered	Existing Home	R-38 Roof Attic1	Front	4.1	4	4	0.33	18.43	0.1	0.85	0.07	Altered	Yes
New Roof	New Addition	R-38 Roof Attic1	Front	6.1	6	4	0.33	18.43	0.1	0.85	0.07	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 4)

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[CF1R-PRF-01-E, Page 5](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 4 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.ribd16x

ATTIC									
01	02	03	04	05	06	07	08	09	10
Name	Construction	Type	Roof Rise	Roof Reflectance	Roof Emittance	Radiant Barrier	Cool Roof	Status	Verified Existing Condition
Attic Existing Home	Attic RoofExisting Home	Ventilated	4	0.1	0.85	No	No	Altered	No
Attic New Addition	Attic RoofNew Addition	Ventilated	4	0.1	0.85	No	No	New	No

WINDOWS										
01	02	03	04	05	06	07	08	09	10	11
Name	Surface (Orientation-Azimuth)	Width(ft)	Height (ft)	Multiplier	Area (ft²)	U-factor	SHGC	Exterior Shading	Status	Verified Existing Condition
A: Window to Remain	Front: To Remain (Front-0)	----	----	1	50.0	1.04	0.76	Insect Screen (default)	Existing	No
H: New Window	Left: New (Left-90)	----	----	1	30.0	0.34	0.25	Insect Screen (default)	New	N/A
D: Relocated Window	Rear: To Remain (Back-180)	----	----	1	20.0	1.04	0.76	Insect Screen (default)	New	N/A
E2/F2/G2: Replacements	Right: To Remain (Right-270)	----	----	1	42.0	0.34	0.25	Insect Screen (default)	Altered	N/A
Skylight	Existing Roof: Altered (Front-0)	----	----	1	4.0	0.55	0.87	None	New	N/A
I: New Window	Left (Right-270)	----	----	1	20.0	0.34	0.25	Insect Screen (default)	New	N/A
J: New Window	Rear (Back-180)	----	----	1	20.0	0.34	0.25	Insect Screen (default)	New	N/A
Skylight 2	New Roof (Front-0)	----	----	1	6.0	0.55	0.87	None	New	N/A

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	0.50	Existing	No

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 5)

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CF1R-PRF-01-E, Page 6

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 5 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rdb16x

OPAQUE SURFACE CONSTRUCTIONS								
01	02	03	04	05	06	07		
Construction Name	Surface Type	Construction Type	Framing	Total Cavity R-value	Winter Design U-value	Assembly Layers		
Attic RoofExisting Home	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> <li>Cavity / Frame: no insul. / 2x4 Top Chrd</li> <li>Roof Deck: Wood Siding/sheathing/decking</li> <li>Roofing: Light Roof (Asphalt Shingle)</li> </ul>		
R-0 Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	none	0.361	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: no insul. / 2x4</li> <li>Exterior Finish: 3 Coat Stucco</li> </ul>		
R-15 Wall	Exterior Walls	Wood Framed Wall	2x4 @ 16 in. O.C.	R 15	0.095	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: R-15 / 2x4</li> <li>Exterior Finish: 3 Coat Stucco</li> </ul>		
R-0 Floor Crawlspace	Floors Over Crawlspace	Wood Framed Floor	2x12 @ 16 in. O.C.	none	0.216	<ul style="list-style-type: none"> <li>Floor Surface: Carpeted</li> <li>Floor Deck: Wood Siding/sheathing/decking</li> <li>Cavity / Frame: no insul. / 2x12</li> </ul>		
R-19 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 19	0.049	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: R-9.1 / 2x4</li> <li>Over Ceiling Joists: R-9.9 insul.</li> </ul>		
R-38 Roof Attic	Ceilings (below attic)	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 38	0.025	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: R-9.1 / 2x4</li> <li>Over Ceiling Joists: R-28.9 insul.</li> </ul>		
R-19 Roof Attic1	Cathedral Ceilings	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 19	0.057	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: R-19 / 2x4</li> <li>Roof Deck: Wood Siding/sheathing/decking</li> <li>Roofing: Light Roof (Asphalt Shingle)</li> </ul>		
R-38 Roof Attic1	Cathedral Ceilings	Wood Framed Ceiling	2x4 @ 24 in. O.C.	R 38	0.036	<ul style="list-style-type: none"> <li>Inside Finish: Gypsum Board</li> <li>Cavity / Frame: R-38 / 2x4</li> <li>Roof Deck: Wood Siding/sheathing/decking</li> <li>Roofing: Light Roof (Asphalt Shingle)</li> </ul>		
Attic RoofNew Addition	Attic Roofs	Wood Framed Ceiling	2x4 Top Chord of Roof Truss @ 24 in. O.C.	none	0.644	<ul style="list-style-type: none"> <li>Cavity / Frame: no insul. / 2x4 Top Chrd</li> <li>Roof Deck: Wood Siding/sheathing/decking</li> <li>Roofing: Light Roof (Asphalt Shingle)</li> </ul>		

SLAB FLOORS								
01	02	03	04	05	06	07	08	09
Name	Zone	Area (ft <sup>2</sup> )	Perimeter (ft)	Edge Insul. R-value	Carpeted Fraction	Heated	Status	Verified Existing Condition
Slab-on-Grade	New Addition	225	40	None	0.8	No	New	No

Registration Number:

Registration Date/Time:

HERS Provider:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 6)

[CF1R-PRF-01-E, Page 5](#)

[CF1R-PRF-01-E, Page 7](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

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Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

BUILDING ENVELOPE - HERS VERIFICATION			
01	02	03	04
Quality Insulation Installation (QII)	Quality Installation of Spray Foam Insulation	Building Envelope Air Leakage	CFM50
Not Required	Not Required	Not Required	---

WATER HEATING SYSTEMS							
01	02	03	04	05	06	07	08
Name	System Type	Distribution Type	Water Heater	Number of Heaters	Solar Fraction (%)	Status	Verified Existing Condition
DHW Sys 1	DHW	Standard	DHW Heater 1	1	Annual	Existing	No
DHW Sys 2	DHW	Standard	DHW Heater 2	1	Annual	New	No

WATER HEATERS							
01	02	03	04	05	06	07	08
Name	Heater Element Type	Tank Type	Tank Volume (gal)	Energy Factor or Efficiency	Input Rating	Tank Exterior Insulation R-value	Standby Loss (Fraction)
DHW Heater 1	Gas	Small Storage	50	0.6 EF	40000-Btu/hr	0	0
DHW Heater 2	Gas	Small Instantaneous	0.1	0.85 EF	175000-Btu/hr	0	0

WATER HEATING - HERS VERIFICATION						
01	02	03	04	05	06	07
Name	Pipe Insulation	Parallel Piping	Compact Distribution	Point-of Use	Recirculation with Manual Control	Recirculation with Sensor Control
DHW Sys 1	n/a	n/a	n/a	n/a	n/a	n/a
DHW Sys 2	n/a	n/a	n/a	n/a	n/a	n/a

SPACE CONDITIONING SYSTEMS										
01	02	03		04		05	06	07	08	09
Name	System Type	Heating System		Cooling System		Distribution System	Fan System	Floor Area Served	Status	Verified Existing Condition
		Name	Ducted	Name	Ducted					
Altered FAU & A/C1	Other Heating and Cooling System	Heating Component 1	Yes	Cooling Component 1	Yes	Air Distribution System 1	HVAC Fan 1	1455	Altered	No

Registration Number:

CA Building Energy Efficiency Standards - 2016 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 7)

[CF1R-PRF-01-E, Page 6](#)

[CF1R-PRF-01-E, Page 8](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 7 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

HVAC - HEATING SYSTEMS		
01	02	03
Name	Type	Efficiency
Heating Component 1	CntrlFurnace - Fuel-fired central furnace	91 AFUE

HVAC - COOLING SYSTEMS						
01	02	03	04	05	06	07
Name	System Type	Efficiency		Zonally Controlled	Multi-speed Compressor	HERS Verification
EER	SEER					
Cooling Component 1	SplitAirCond - Split air conditioning system	12.5	16	No	No	Cooling Component 1-herc-cool

HVAC COOLING - HERS VERIFICATION					
01	02	03	04	05	06
Name	Verified Airflow	Airflow Target	Verified EER	Verified SEER	Verified Refrigerant Charge
Cooling Component 1-herc-cool	Required	350	Required	Required	Required

HVAC - DISTRIBUTION SYSTEMS									
01	02	03	04	05	06	07	08	09	10
Name	Type	Duct Leakage	Insulation R-value	Supply Duct Location	Return Duct Location	Bypass Duct	Status	Verified Existing Condition	HERS Verification
Air Distribution System 1	Ducts located entirely in conditioned space	Existing (not specified)	8.0	Conditioned Zone	Conditioned Zone	None	Existing	No	N/A

HVAC DISTRIBUTION - HERS VERIFICATION					
01	02	03	04	05	06
Name	Duct Leakage Verification	Duct Leakage Target (%)	Verified Duct Location	Verified Duct Design Return	Verified Duct Design Supply
Air Distribution System 1-herc-dist	N/A	---	Ducts located entirely in conditioned space	---	---

HVAC - FAN SYSTEMS & HERS VERIFICATION			
01	02	03	04
Name	Type	Fan Power (Watts/CFM)	HERS Verification
HVAC Fan 1	Single Speed PSC Furnace Fan	0.58	Required

Registration Number:

Registration Date/Time:

HERS Provider:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 8)

[CF1R-PRF-01-E, Page 7](#)

[CF1R-PRF-01-E, Page 9](#)

### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

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Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.rbd16x

IAQ (Indoor Air Quality) FANS				
01	02	03	04	05
Name	IAQ CFM	IAQ Fan Type	IAQ Recovery Effectiveness(%)	HERS Verification
SFam IAQVentRpt	0	Default	0	Not Required

### HERS RATER VERIFICATION OF EXISTING CONDITIONS

OPAQUE SURFACES - VERIFIED & ALTERED				
01	02	03	04	05
Name	Zone	Existing Construction	Surface Type	Total Cavity R-value
Existing Roof: Altered	Existing Home	R-19 Roof Attic1	Wood Framed Ceiling	R 19
Existing Roof: Altered 2	Existing Home	R-19 Roof Attic	Wood Framed Ceiling	R 19

Registration Number:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

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## Appendix 2: Form CF1R-PRF-01-E Sample – Additions and Alterations (Page 9)

### [CF1R-PRF-01-E, Page 8](#)

#### CERTIFICATE OF COMPLIANCE - RESIDENTIAL PERFORMANCE COMPLIANCE METHOD

CF1R-PRF-01

Project Name: Existing+Alterations+Addition

Calculation Date/Time: 16:28, Fri, Feb 05, 2016

Page 9 of 9

Calculation Description: Title 24 Analysis

Input File Name: Existing+Alterations+Addition.ribd16x

<b>DOCUMENTATION AUTHOR'S DECLARATION STATEMENT</b>	
1. I certify that this Certificate of Compliance documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company: Misti Bruceri & Associates, LLC	Signature Date: 2/5/2016
Address:	CEA/HERS Certification Identification (if applicable):
City/State/Zip:	Phone:
<b>RESPONSIBLE PERSON'S DECLARATION STATEMENT</b>	
I certify the following under penalty of perjury, under the laws of the State of California:	
<ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> </ol>	
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:

CA Building Energy Efficiency Standards - 2016 Residential Compliance

Registration Date/Time:

Report Version - CF1R-11192015-401

HERS Provider:

Report Generated at: 2016-02-05 16:29:23

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 1)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 1 of 21
Project Address:	1234 Main St. Sacramento 95800	Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

A. PROJECT GENERAL INFORMATION					
1.	Project Location (city)	Sacramento	8.	Standards Version	Compliance2016
2.	CA Zip Code	95800	9.	Compliance Software (version)	EnergyPro 7.0
3.	Climate Zone	12	10.	Building Orientation (deg)	(N) 0 deg
4.	Total Conditioned Floor Area	4,480 ft²	11.	Permitted Scope of Work	NewComplete
5.	Total Unconditioned Floor Area	800 ft²	12.	Building Type(s)	Nonresidential
6.	# of Stories (Habitable Above Grade)	2	13.	Gas Type	NaturalGas
7.	# of dwelling units	0			

B. COMPLIANCE RESULTS FOR PERFORMANCE COMPONENTS					\$ 140.1
BUILDING COMPLIES					
1. Energy Component	2. Standard Design (TDV)	3. Proposed Design (TDV)	4. Compliance Margin (TDV)	5. Percent Better than Standard	
Space Heating	16.8	26.1	-9.3	-55.4%	
Space Cooling	109.7	128.4	-18.7	-17.0%	
Indoor Fans	39.1	18.9	20.2	51.7%	
Heat Rejection	--	--	--	--	
Pumps & Misc.	1.9	--	1.9	--	
Domestic Hot Water	50.0	49.3	0.7	1.4%	
Indoor Lighting	83.3	73.4	9.9	11.9%	
COMPLIANCE TOTAL	300.8	296.1	4.7	1.6%	
Receptacle	77.1	77.1	0.0	0.0%	
Process	75.4	75.4	0.0	0.0%	
Other Ltg	--	--	--	--	
TOTAL	453.3	448.6	4.7	1.0%	



## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 2)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 2 of 21
Project Address:	1234 Main St. Sacramento 95800	Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

### C. PRIORITY PLAN CHECK/ INSPECTION ITEMS (in order of highest to lowest TDV energy savings)

1st	Indoor Fans: Check envelope and mechanical	<p><b>Compliance Margin By Energy Component (from Table B column 4)</b></p>
2nd	Indoor Lighting: Check lighting	
3rd	Pumps & Misc.: Check mechanical	
4th	Domestic Hot Water: Check mechanical	
5th	Heat Rejection: Check envelope and mechanical	
6th	Space Heating: Check envelope and mechanical	
7th	Space Cooling: Check envelope and mechanical	

### D. EXCEPTIONAL CONDITIONS

The aged solar reflectance and aged thermal emittance must be listed in the Cool Roof Rating Council database of certified products. For projects where initial reflectance is used, the initial reflectance must be listed, and the aged reflectance is calculated by the software program and used in the compliance model.

The general lighting exceptional method is employed for one or more spaces. Verify that the lighting allowances match the lighting installed on the plans and serve the areas within each space as identified in the compliance model.

The proposed building includes HVAC components that do not meet the mandatory efficiency requirements.

This project includes Domestic Hot Water in the analysis. Please verify that Domestic Hot Water is included in the design for the permitted scope of work.

### E. HERS VERIFICATION

This Section Does Not Apply

### F. ADDITIONAL REMARKS

Standard Building (Compliance)



## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 3)

Project Name:	Nonresidential Sample		NRCC-PRF-01-E	Page 3 of 21
Project Address:	1234 Main St. Sacramento 95800		Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete		Input File Name:	NonRes Sample.cibd16x

G. COMPLIANCE PATH & CERTIFICATE OF COMPLIANCE SUMMARY				
Identify which building components use the performance or prescriptive path for compliance. "NA"= not in project				
For components that utilize the performance path, indicate the sheet number that includes mandatory notes on plans.				
Building Component	Compliance Path	Compliance Forms (required for submittal)	Location of Mandatory Notes on Plans	
Envelope	<input checked="" type="checkbox"/> Performance	NRCC-PRF-ENV-DETAILS (section of the NRCC-PRF-01-E)		
	<input type="checkbox"/> Prescriptive	NRCC-ENV-01 / 02 / 03 / 04 / 05 / 06-E		
	<input type="checkbox"/> NA			
Mechanical	<input checked="" type="checkbox"/> Performance	NRCC-PRF-MCH-DETAILS (section of the NRCC-PRF-01-E)		
	<input type="checkbox"/> Prescriptive	NRCC-MCH-01 / 02 / 03 / 04 / 05 / 06 / 07-E		
	<input type="checkbox"/> NA			
Domestic Hot Water	<input checked="" type="checkbox"/> Performance	NRCC-PRF-PLB-DETAILS (section of the NRCC-PRF-01-E)		
	<input type="checkbox"/> Prescriptive	NRCC-PLB-01-E		
	<input type="checkbox"/> NA			
Lighting (Indoor Conditioned)	<input checked="" type="checkbox"/> Performance	NRCC-PRF-LTI-DETAILS (section of the NRCC-PRF-01-E)		
	<input type="checkbox"/> Prescriptive	NRCC-LTI-01 / 02 / 03 / 04 / 05-E		
	<input type="checkbox"/> NA			
Covered Process: Commercial Kitchens	<input type="checkbox"/> Performance	S2 (section of the NRCC-PRF-01-E)		
	<input checked="" type="checkbox"/> Prescriptive	NRCC-PRC-01/ 03-E		
	<input type="checkbox"/> NA			
Covered Process: Computer Rooms	<input type="checkbox"/> Performance	S3 (section of the NRCC-PRF-01-E)		
	<input checked="" type="checkbox"/> Prescriptive	NRCC-PRC-01/ 04-E		
	<input type="checkbox"/> NA			
Covered Process: Laboratory Exhaust	<input type="checkbox"/> Performance	S4 (section of the NRCC-PRF-01-E)		
	<input checked="" type="checkbox"/> Prescriptive	NRCC-PRC-01/ 09-E		
	<input type="checkbox"/> NA			

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 4)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 4 of 21
Project Address:	1234 Main St. Sacramento 95800	Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

G. COMPLIANCE PATH & CERTIFICATE OF COMPLIANCE SUMMARY							
The following building components are only eligible for prescriptive compliance. Indicate which are relevant to the project.				The following building components may have mandatory requirements per Part 6. Indicate which are relevant to the project.			
Yes	NA	Prescriptive Requirement	Compliance Forms	Yes	NA	Mandatory Requirement	Compliance Forms
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Lighting (Indoor Unconditioned) §140.6	NRCC-LTI-01 / 02 / 03 / 04 / 05-E	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Commissioning: §120.8 Simple Systems Complex Systems	NRCC-CXR-01 / 02 / 03 / 05-E NRCC-CXR-01 / 02 / 04 / 05-E
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Lighting (Outdoor) §140.7	NRCC-LTO-01 / 02 / 03-E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Electrical: §130.5	NRCC-ELC-01-E
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Lighting (Sign) §140.8	NRCC-LTS-01-E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Solar Ready: §110.10	NRCC-SRA-01 / 02-E
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Solar Thermal Water Heating: §140.5	NRCC-STH-01-E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Covered Process: §120.6 Parking Garage Commercial Refrigeration Warehouse Refrigeration Compressed Air Process Boilers	NRCC-PRC-01-E NRCC-PRC-02-E NRCC-PRC-05-E NRCC-PRC-06/07/08-E NRCC-PRC-10-E NRCC-PRC-11-E

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 5)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 5 of 21
Project Address:	1234 Main St. Sacramento 95800	Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

H. CERTIFICATE OF INSTALLATION, CERTIFICATE OF ACCEPTANCE & CERTIFICATE OF VERIFICATION SUMMARY (NRCI/NRCA/NRCV) – Documentation Author to indicate which Certificates must be submitted for the features to be recognized for compliance (Retain copies and verify forms are completed and signed to post in field for Field Inspector to verify). See Tables G. and H. in MCH and LTI Details Sections for Acceptance Tests and forms by equipment.		Confirmed	
Building Component	Compliance Forms (required for submittal)	Pass	Fail
Envelope	<input checked="" type="checkbox"/> NRCI-ENV-01-E - For all buildings	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-ENV-02-F- NFRC label verification for fenestration	<input type="checkbox"/>	<input type="checkbox"/>
Mechanical	<input checked="" type="checkbox"/> NRCI-MCH-01-E - For all buildings with Mechanical Systems	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-02-A- Outdoor Air	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-03-A – Constant Volume Single Zone HVAC	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-04-H- Air Distribution Duct Leakage	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-05-A- Air Economizer Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-06-A- Demand Control Ventilation	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-07-A – Supply Fan Variable Flow Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-08-A- Valve Leakage Test	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-09-A – Supply Water Temp Reset Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-10-A- Hydronic System Variable Flow Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-11-A – Auto Demand Shed Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-MCH-12-A- Packaged Direct Expansion Units	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-13-A- Air Handling Units and Zone Terminal Units	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-14-A- Distributed Energy Storage	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-15-A – Thermal Energy Storage	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-16-A- Supply Air Temp Reset Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-17-A – Condensate Water Temp Reset Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-MCH-18-A- Energy Management Controls Systems	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCV-MCH-04-H- Duct Leakage Test	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 6)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 6 of 21
Project Address:	1234 Main St. Sacramento 95800	Calculation Date/Time:	16:53, Fri, Feb 05, 2016
Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

H. CERTIFICATE OF INSTALLATION, CERTIFICATE OF ACCEPTANCE & CERTIFICATE OF VERIFICATION SUMMARY (NRCI/NRCA/NRCV) – Documentation Author to indicate which Certificates must be submitted for the features to be recognized for compliance (Retain copies and verify forms are completed and signed to post in field for Field Inspector to verify). See Tables G. and H. in MCH and LTI Details Sections for Acceptance Tests and forms by equipment.		Confirmed	
Building Component	Compliance Forms (required for submittal)	Pass	Fail
Plumbing	<input checked="" type="checkbox"/> NRCI-PLB-01-E - For all buildings with Plumbing Systems	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-PLB-02-E - required on central systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-PLB-03-E - Single dwelling unit systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-PLB-21-E - HERS verified central systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-PLB-22-E - HERS verified single dwelling unit systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCV-PLB-21-H - HERS verified central systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCV-PLB-22-H - HERS verified single dwelling unit systems in high-rise residential, hotel/motel application.	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-STH-01-E - Any solar water heating	<input type="checkbox"/>	<input type="checkbox"/>
Indoor Lighting	<input checked="" type="checkbox"/> NRCI-LTI-01-E - For all buildings	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-LTI-02-E - Lighting control system, or for an Energy Management Control System (EMCS)	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-LTI-03-E - Line-voltage track lighting integral current limiter, or for a supplementary overcurrent protection panel used to energize only line-voltage track lighting	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-LTI-04-E - Two interlocked systems serving an auditorium, a convention center, a conference room, or a theater	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCI-LTI-05-E - Lighting Control Credit Power Adjustment Factor (PAF)	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCI-LTI-06-E - Additional wattage installed in a video conferencing studio	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-LTI-02-A - Occupancy sensors and automatic time switch controls.	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-LTI-03-A - Automatic daylighting controls	<input type="checkbox"/>	<input type="checkbox"/>
Outdoor Lighting	<input type="checkbox"/> NRCA-LTI-04-A - Demand responsive lighting controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCI-LTO-01-E - Outdoor Lighting	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCI-LTO-02-E - EMCS Lighting Control System	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-LTO-02-A - Outdoor Lighting Control	<input type="checkbox"/>	<input type="checkbox"/>
Sign Lighting	<input type="checkbox"/> NRCI-LTS-01-E - Sign Lighting	<input type="checkbox"/>	<input type="checkbox"/>
Electrical	<input checked="" type="checkbox"/> NRCI-ELC-01-E - Electrical Power Distribution	<input type="checkbox"/>	<input type="checkbox"/>
Photovoltaic	<input type="checkbox"/> NRCI-SPV-01-E Photovoltaic Systems	<input type="checkbox"/>	<input type="checkbox"/>



### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 7)

Project Name:	Nonresidential Sample	NRCC-PRF-01-E	Page 7 of 21
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H. CERTIFICATE OF INSTALLATION, CERTIFICATE OF ACCEPTANCE & CERTIFICATE OF VERIFICATION SUMMARY (NRCI/NRCA/NRCV) – Documentation Author to indicate which Certificates must be submitted for the features to be recognized for compliance (Retain copies and verify forms are completed and signed to post in field for Field Inspector to verify). See Tables G. and H. in MCH and LTI Details Sections for Acceptance Tests and forms by equipment.		Confirmed	
Building Component	Compliance Forms (required for submittal)	Pass	Fail
Covered Process	<input type="checkbox"/> NRCI-PRC-01-E Refrigerated Warehouse	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-01-F- Compressed Air Systems	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-PRC-02-F- Kitchen Exhaust	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/> NRCA-PRC-03-F- Garage Exhaust	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-04-F- Refrigerated Warehouse- Evaporator Fan Motor Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-05-F- Refrigerated Warehouse- Evaporative Condenser Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-06-F- Refrigerated Warehouse- Air Cooled Condenser Controls	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-07-F- Refrigerated Warehouse- Variable Speed Compressor	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/> NRCA-PRC-08-F- Electrical Resistance Underslab Heating System	<input type="checkbox"/>	<input type="checkbox"/>

I. ENVELOPE GENERAL INFORMATION (See NRCC-PRF-ENV-DETAILS for more information)								
1.	Total Conditioned Floor Area	4,480 ft <sup>2</sup>	5.	Number of Floors Above Grade	2	Confirmed		
2.	Total Unconditioned Floor Area	800 ft <sup>2</sup>	6.	Number of Floors Below Grade	0	Pass	Fail	
3.	Addition Conditioned Floor Area	0 ft <sup>2</sup>						
4.	Addition Unconditioned Floor Area	0 ft <sup>2</sup>						
7. Opaque Surfaces & Orientation		8. Total Gross Surface Area		9. Total Fenestration Area		10. Window to Wall Ratio		
North Wall		800 ft <sup>2</sup>		320 ft <sup>2</sup>		40.0%		
East Wall		1,040 ft <sup>2</sup>		320 ft <sup>2</sup>		30.8%		
South Wall		2,000 ft <sup>2</sup>		260 ft <sup>2</sup>		13.0%		
West Wall		720 ft <sup>2</sup>		0 ft <sup>2</sup>		00.0%		
Total		4,560 ft <sup>2</sup>		900 ft <sup>2</sup>		19.7%		
Roof		2,880 ft <sup>2</sup>		0 ft <sup>2</sup>		00.0%		

## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 8)

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J. FENESTRATION ASSEMBLY SUMMARY								§ 110.6	Confirmed	
1.	2.	3.	4.	5.	6.	7.	8.	9.	Pass	Fail
Fenestration Assembly Name / Tag or I.D.	Fenestration Type	Certification Method <sup>1</sup>	Assembly Method	Area ft <sup>2</sup>	Overall U-factor	Overall SHGC	Overall VT	Status <sup>2</sup>		
Double Metal Tinted	Vertical Fenestration	Default Performance	Site Built	900	0.71	0.60	0.77	N	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> Newly installed fenestration shall have a certified NFRC Label Certificate or use the CEC default tables found in Table 110.6-A and Table 110.6-B. Site-built fenestration less than 1,000 ft<sup>2</sup>, or more than or equal to 1,000 ft<sup>2</sup> see Reference Nonresidential Appendix NA6.

<sup>2</sup> Status: N - New, A - Altered, E - Existing

Taking compliance credit for fenestration shading devices? (if "Yes", see NRCC-PRF-ENV-DETAILS for more information)	No
--	----

K. OPAQUE SURFACE ASSEMBLY SUMMARY							§ 120.7/ § 140.3	Confirmed	
1.	2.	3.	4.	5.	6.	7.	8.	Pass	Fail
Surface Name	Surface Type	Area (ft <sup>2</sup> )	Framing Type	Cavity R-Value	Continuous R-Value	U-Factor / F-Factor / C-Factor	Status <sup>1</sup>		
R-13 Wall10	Exterior Wall	4560	Wood	13	NA	U-Factor: 0.102	N	<input type="checkbox"/>	<input type="checkbox"/>
Slab On Grade16	Underground Floor	3680	NA	0	NA	F-Factor: 0.730	N	<input type="checkbox"/>	<input type="checkbox"/>
R-13 Wall101	Interior Wall	200	Wood	13	NA	U-Factor: 0.095	N	<input type="checkbox"/>	<input type="checkbox"/>
R-30 Roof Attic22	Roof	3680	Wood	30	NA	U-Factor: 0.038	N	<input type="checkbox"/>	<input type="checkbox"/>
R-0 Floor No Crawlspace49	Interior Floor	1280	NA	0	NA	U-Factor: 0.220	N	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> Status: N - New, A - Altered, E - Existing

L. ROOFING PRODUCT SUMMARY							§ 140.3	Confirmed	
1.	2.	3.	4.	5.	6.	7.		Pass	Fail
Product Type	Product Density (lb/ft <sup>2</sup> )	Aged Solar Reflectance	Thermal Emittance	SRI	Cool Roof Credit	Roofing Product Description			
R-30 Roof Attic22	4.65104	0.65	0.75	Not Provided	Yes	CRRC Prod. ID: R-30 Roof Attic		<input type="checkbox"/>	<input type="checkbox"/>

## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 9)

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M. HVAC SYSTEM SUMMARY (see NRCC-PRF-MCH-DETAILS for more information)											§ 110.1 / § 110.2		
Dry System Equipment <sup>1</sup> (Fan & Economizer info included below in Table N)											Confirmed		
1.	2.	3.	4.	5.	6.	7.	8.	9.		10.	11.	Pass	Fail
Equip Name	Equip Type	System Type (Simple <sup>3</sup> or Complex <sup>4</sup> )	Qty	Total Heating Output (kBtu/h)	Supp Heat Source (Y/N)	Supp Heat Output (kBtu/h)	Total Cooling Output (kBtu/h)	Efficiency		Acceptance Testing Required? (Y/N) <sup>5</sup>	Status <sup>6</sup>		
								Cooling	Heating				
Retail Mech. System3	SZVAVAC (Packaged3Phase)	Complex	1	92	No	0	69	EER-12.0	AFUE-81.0	Yes	N	<input type="checkbox"/>	<input type="checkbox"/>
Office Mech System23	SZVAVAC (Packaged3Phase)	Complex	1	61	No	0	69	EER-12.0	AFUE-81.0	Yes	N	<input type="checkbox"/>	<input type="checkbox"/>
Restaurant Mech Sys.36	SZVAVAC (Packaged3Phase)	Complex	1	148	No	0	154	EER-11.4	AFUE-82.0	Yes	N	<input type="checkbox"/>	<input type="checkbox"/>

Wet System Equipment <sup>2</sup>								Pumps					Confirmed	
12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	Pass	Fail
Equip Name	Equip Type	Qty	Vol (gal)	Rated Capacity (kBtu/h)	Efficiency	Standby Loss	Tank Ext. R Value	Qty	GPM	HP	VSD (Y/N)	Status <sup>6</sup>		
80 Gall2	Storage	1	80	80	Thrmf. Eff.: 0.780	0.0100	NA	NA	NA	NA	No	N	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> Dry System Equipment includes furnaces, air handling units, heat pumps, etc.

<sup>2</sup> Wet System Equipment includes boilers, chillers, cooling towers, water heaters, etc.

<sup>3</sup> Simple Systems must complete NRCC-CXR-03-E commissioning design review form

<sup>4</sup> Complex Systems must complete NRCC-CXR-04-E commissioning design review form

<sup>5</sup> A summary of which acceptance tests are applicable is provided in NRCC-PRF-MCH-DETAILS

<sup>6</sup> Status: N - New, A - Altered, E - Existing

Discrepancy between modeled and designed equipment sizing? (if "Yes", see Table F. "Additional Remarks" for an explanation)	No
---	----



### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 10)

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N. ECONOMIZER & FAN SYSTEMS SUMMARY <sup>1</sup>												\$ 140.4	Confirmed	
1.	2.	3.					4.					5.	Pass	Fail
Equip Name	Outside Air	Supply Fan					Return Fan					Economizer Type (if present)		
	CFM	CFM	HP	BHP	TSP (inch WC)	Control	CFM	HP	BHP	TSP (inch WC)	Control			
Retail Mech. System3	640	2400	1.200	1.200	1.90	VariableSpeedDrive	NA	NA	NA	NA	NA	DifferentialDryBulb	<input type="checkbox"/>	<input type="checkbox"/>
Office Mech System23	288	2400	1.140	1.140	1.81	VariableSpeedDrive	NA	NA	NA	NA	NA	DifferentialDryBulb	<input type="checkbox"/>	<input type="checkbox"/>
Restaurant Mech Sys.36	1280	5000	3.040	3.040	2.31	VariableSpeedDrive	NA	NA	NA	NA	NA	DifferentialDryBulb	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> Mechanical ventilation calculations and exhaust fans are included in the NRCC-PRF-MCH-DETAILS section.

Q. EQUIPMENT CONTROLS			\$ 120.2	Confirmed	
1.	2.	3.	Pass	Fail	
Equip Name	Equip Type	Controls			
Retail Mech. System3	SZVAVAC	1 Zones With CO2Sensor Vent. Control Differential Drybulb Economizer No Supply Air Temp. Control No Optimum Start	<input type="checkbox"/>	<input type="checkbox"/>	
Office Mech System23	SZVAVAC	No DCV Controls Differential Drybulb Economizer No Supply Air Temp. Control No Optimum Start	<input type="checkbox"/>	<input type="checkbox"/>	
Restaurant Mech Sys.36	SZVAVAC	1 Zones With CO2Sensor Vent. Control Differential Drybulb Economizer No Supply Air Temp. Control No Optimum Start	<input type="checkbox"/>	<input type="checkbox"/>	
Plant - DHW1 - SHW	Service Hot Water, Primary Only	Fixed Temperature Control, No DDC	<input type="checkbox"/>	<input type="checkbox"/>	



### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 11)

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P. SYSTEM DISTRIBUTION SUMMARY						§ 120.4/ § 140.4(I)	
		Dry System Distribution				Confirmed	
1.	2.	3.	4.	5.		Pass	Fail
Equip Name	Equip Type	Duct Leakage and Sealing Required per 140.4(I)	Duct Leakage will be verified per NA1 and NA2	Ducts			
				Insulation R-Value	Location		
Retail Mech. System3	SZVAVAC	No	No	8	Conditioned	<input type="checkbox"/>	<input type="checkbox"/>
Office Mech System23	SZVAVAC	No	No	8	Conditioned	<input type="checkbox"/>	<input type="checkbox"/>
Restaurant Mech Sys.36	SZVAVAC	No	No	8	Conditioned	<input type="checkbox"/>	<input type="checkbox"/>

Does the Project Include Zonal Systems? (if "Yes", see NRCC-PRF-MCH-DETAILS for system information)	No
Does the Project Include a Solar Hot Water System? (if "Yes", see NRCC-PRF-MCH-DETAILS for system information)	No
Multifamily or Hotel/ Motel Occupancy? (if "Yes", see NRCC-PRF-MCH-DETAILS for DHW system information)	No

Q. INDOOR CONDITIONED LIGHTING GENERAL INFO (see NRCC-PRF-LTI-DETAILS for more info) <sup>1</sup>						\$ 140.6	
						Confirmed	
1.	2.	3.	4.	5.		Pass	Fail
Occupancy Type <sup>1</sup>	Conditioned Floor Area <sup>2</sup> (ft <sup>2</sup> )	Installed Lighting Power (Watts)	Lighting Control Credits (Watts)	Additional (Custom) Allowance			
				Area Category Footnotes (Watts)	Tailored Method (Watts)	<input type="checkbox"/>	<input type="checkbox"/>
Retail Merchandise Sales, Wholesale Showroom	1,280	1,240	0	0	0	<input type="checkbox"/>	<input type="checkbox"/>
Office (Greater than 250 square feet in floor area)	1,920	1,674	0	0	0	<input type="checkbox"/>	<input type="checkbox"/>
Dining Area	1,280	1,580	0	640	0	<input type="checkbox"/>	<input type="checkbox"/>
Building Totals:	4,480	4,494	0	640	0		

<sup>1</sup> See Table 140.6-C

<sup>2</sup> See NRCC-LTI-01-E for unconditioned spaces

<sup>3</sup> Lighting information for existing spaces modeled is not included in the table



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R. INDOOR CONDITIONED LIGHTING SCHEDULE (Adapted from NRCC-LTI-01-E) <sup>1</sup>							§ 130.0	
Luminaire Schedule (includes all permanent installed lighting in conditioned space, and portable lighting over 0.3 w/ft <sup>2</sup> in offices)			Installed Watts (Conditioned)				Confirmed	
Name or Item Tag	Complete Luminaire Description (i.e., 3-lamp fluorescent troffer, F32T8, one dimmable electronic ballast)	Watts per luminaire	How Wattage is Determined		Total Number Luminaires	Installed Watts	Pass	Fail
			CEC Default from NA8	According to §130.0(c)				
F-1	(2) 4 ft Fluorescent T8 Rapid Start Elec	62	Yes	No	20	1,240	<input type="checkbox"/>	<input type="checkbox"/>
A-1	(2) 4 ft Fluorescent T8 Rapid Start Elec	62	Yes	No	27	1,674	<input type="checkbox"/>	<input type="checkbox"/>
L-1	(2) 13w Compact Fluorescent Twin 2 Pin	34	Yes	No	20	680	<input type="checkbox"/>	<input type="checkbox"/>
F-2	45w per ft Track Light	45	Yes	No	20	900	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> If lighting power densities were used in the compliance model Building Departments will need to check prescriptive forms for Luminaire Schedule details.

<b>S1. COVERED PROCESS SUMMARY – ENCLOSED PARKING GARAGES</b>	<b>§ 140.9</b>
This Section Does Not Apply	

<b>S2. COVERED PROCESS SUMMARY – COMMERCIAL KITCHENS</b>	<b>§ 140.9</b>
This Section Does Not Apply	

<b>S3. COVERED PROCESS SUMMARY – COMPUTER ROOMS</b>	<b>§ 140.9</b>
This Section Does Not Apply	

<b>S4. COVERED PROCESS SUMMARY – LABORATORY EXHAUSTS</b>	<b>§ 140.9</b>
This Section Does Not Apply	

<b>T. UNMET LOAD HOURS</b>
This Section Does Not Apply

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 13)

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U. 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	0.0	--	--	40.5	63.3	-22.8
Space Cooling	12.7	13.9	-1.2	--	--	--
Indoor Fans	6.3	3.1	3.2	--	--	--
Heat Rejection	--	--	--	--	--	--
Pumps & Misc.	0.5	--	--	--	--	--
Domestic Hot Water	--	--	--	135.2	133.4	1.8
Indoor Lighting	15.3	13.4	1.9	--	--	--
COMPLIANCE TOTAL	34.8	30.4	4.4	175.7	196.7	-21.0
Receptacle	13.7	13.7	0.0	--	--	--
Process	14.1	14.1	0.0	--	--	--
Other Ltg	--	--	--	--	--	--
TOTAL	62.6	58.2	4.4	175.7	196.7	-21.0

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 14)

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<b>DOCUMENTATION AUTHOR'S DECLARATION STATEMENT</b>		<b>§ 10-103</b>
I certify that this Certificate of Compliance documentation is accurate and complete.		
Documentation Author Name:	Signature:	
Company: Misti Bruceri & Associates, LLC		
Address:	Signature Date:	
City/State/Zip:	CEA Identification (if applicable):	
Phone:		

<b>RESPONSIBLE PERSON'S DECLARATION STATEMENT</b>		
I certify the following under penalty of perjury, under the laws of the State of California:		
1	I hereby affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code to sign this document as the person responsible for its preparation; and that I am licensed in the State of California as a civil engineer, mechanical engineer, electrical engineer, or I am a licensed architect.	
2	I affirm that I am eligible under the provisions of Division 3 of the Business and Professions Code by section 5537.2 or 6737.3 to sign this document as the person responsible for its preparation; and that I am a licensed contractor performing this work.	
3	I affirm that I am eligible under Division 3 of the Business and Professions Code to sign this document because it pertains to a structure or type of work described as exempt pursuant to Business and Professions Code Sections 5537, 5538 and 6737.1.	

Responsible Envelope Designer Name: Michael Gray	Signature:	
Company: Architectural Services		
Address: 440 Yuba Dr. Suite C	Date Signed:	
City/State/Zip: Sacramento CA 95833	Declaration Statement Type:	
Phone: (916) 555-5678	Title:	License #: C12344

Responsible Lighting Designer Name: Alan Lux	Signature:	
Company: Luminaire Design		
Address: 3030 Pine	Date Signed:	
City/State/Zip: Los Altos CA 92334	Declaration Statement Type:	
Phone: (916) 555-4321	Title:	License #: KS-3345

Responsible Mechanical Designer Name: Robert Harper, P.E	Signature:	
Company: Harper Associates		
Address: 4519 E. Hwy 20	Date Signed:	
City/State/Zip: Sacramento CA 95876	Declaration Statement Type:	
Phone: (916) 555-9245	Title:	License #: ML-2039



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### NRCC-PRF-ENV-DETAILS -SECTION START-

A. OPAQUE SURFACE ASSEMBLY DETAILS				Confirmed	
1.	2.	3.	4.	Pass	Fail
Surface Name	Surface Type	Description of Assembly Layers	Notes		
R-13 Wall10	ExteriorWall	Stucco - 7/8 in. Vapor permeable felt - 1/8 in. Wood framed wall, 16in. OC, 3.5in., R-13 Gypsum Board - 1/2 in.		<input type="checkbox"/>	<input type="checkbox"/>
Slab On Grade16	UndergroundFloor			<input type="checkbox"/>	<input type="checkbox"/>
R-13 Wall101	InteriorWall	Stucco - 7/8 in. Vapor permeable felt - 1/8 in. Wood framed wall, 16in. OC, 3.5in., R-13 Gypsum Board - 1/2 in.		<input type="checkbox"/>	<input type="checkbox"/>
R-30 Roof Attic22	Roof	Asphalt shingles - 1/4 in. Vapor permeable felt - 1/8 in. Plywood - 1/2 in. Air - Cavity - Wall Roof Ceiling - 4 in. or more Wood framed roof, 24in. OC, 3.5in., R-30 Gypsum Board - 1/2 in.		<input type="checkbox"/>	<input type="checkbox"/>
R-0 Floor No Crawlspace49	InteriorFloor	Plywood - 1/2 in. Carpet - 3/4 in.		<input type="checkbox"/>	<input type="checkbox"/>

B. OVERHANG DETAILS (Adapted from NRCC-ENV-02-E)					Confirmed	
1.	2.	3.		4.	Pass	Fail
Fenestration Tag/ID	Fenestration Orientation	Overhang Dimensions		Side fin		
		Horizontal Projection	Distance Above Window	Vertical Projection		
East Windows14	East	6.0 ft.	0.1 ft.	Left: 0 ft., Right: 0 ft.	<input type="checkbox"/>	<input type="checkbox"/>
East Windows29	East	6.0 ft.	0.1 ft.	Left: 0 ft., Right: 0 ft.	<input type="checkbox"/>	<input type="checkbox"/>
South Windows31	South	6.0 ft.	0.1 ft.	Left: 0 ft., Right: 0 ft.	<input type="checkbox"/>	<input type="checkbox"/>
South Windows46	South	6.0 ft.	0.1 ft.	Left: 0 ft., Right: 0 ft.	<input type="checkbox"/>	<input type="checkbox"/>

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 16)

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C. OPAQUE DOOR SUMMARY							Confirmed	
1.	2.	3.	4.	5.	6.	7.	Pass	Fail
Opaque Door Assembly Name / Tag or I.D.	Door Type	Certification Method	Operation	Area	Overall U-factor	Status <sup>1</sup>		
Wood Door34	WoodGreaterThanOrEqualTo1.75inThickDoor	DefaultPerformance	Swinging	24	0.500	N	<input type="checkbox"/>	<input type="checkbox"/>

<sup>1</sup> Status: N - New, A - Altered, E - Existing

#### NRCC-PRF-MCH-DETAILS -SECTION START-

A. MECHANICAL VENTILATION AND REHEAT (Adapted from 2013-NRCC-MCH-03-E)																	Confirmed	
1. DESIGN AIR FLOWS								2. VENTILATION (§ 120.1)									Pass	Fail
CONDITIONED ZONE NAME	HEATING / COOLING SYSTEM ID	DESIGN PRIMARY AIR FLOW (CFM)	DESIGN PRIMARY MINIMUM AIR FLOW (CFM)	MINIMUM PRIMARY AIR FLOW FRACTION	MAXIMUM HEATING AIR FLOW (CFM)	MAXIMUM HEATING AIR FLOW FRACTION	DDC CONTROL (Y/N)	VENT SYSTEM ID	CONDITIONED AREA (ft <sup>2</sup> )	MIN. VENT PER AREA (CFM/ft <sup>2</sup> )	DESIGN NUM. OF PEOPLE	MIN. VENT PER PERSON (CFM/person)	REQ'D VENT AIR FLOW (CFM)	DESIGN VENT AIR FLOW (CFM)	TRANSFER AIRFLOW (CFM)	DCV (Y/N)		
1-Retail Zone	Retail Mech. System3	2,400	600	0.25	NA	NA	N	Retail Mech. System3	1,280	NA	43	15.0	640	640	NA	Y	<input type="checkbox"/>	<input type="checkbox"/>
3-Office Zone	Office Mech System23	2,400	600	0.25	NA	NA	N	Office Mech System23	1,920	NA	19	15.0	288	288	NA	N	<input type="checkbox"/>	<input type="checkbox"/>
4-Restaurant Zone	Restaurant Mech Sys.36	5,000	1,200	0.24	NA	NA	N	Restaurant Mech Sys.36	1,280	NA	85	15.0	1,280	1,280	NA	Y	<input type="checkbox"/>	<input type="checkbox"/>
								TOTAL	5,280		NA		NA	NA	NA		<input type="checkbox"/>	<input type="checkbox"/>

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Compliance Scope:	NewComplete	Input File Name:	NonRes Sample.cibd16x

B. ZONAL SYSTEM AND TERMINAL UNIT SUMMARY													\$ 140.4	
1.	2.	3.	4.		5.	6.	7.			8.			Confirmed	
System ID	System Type	Qty	Rated Capacity (kBtu/h)		Economizer	Zone Name	Airflow (cfm)			Fan			Pass	Fail
			Heating	Cooling			Design	Min.	Min. Ratio	BHP	Cycles	ECM Motor		
Retail Zone5-TRM	VAVNoReheatBox	1	NA	NA	NA	1-Retail Zone	2400	600	0.25	NA	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Office Zone25-TRM	VAVNoReheatBox	1	NA	NA	NA	3-Office Zone	2400	600	0.25	NA	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Restaurant Zone38-TRM	VAVNoReheatBox	1	NA	NA	NA	4-Restaurant Zone	5000	1200	0.24	NA	NA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### C. EXHAUST FAN SUMMARY

This Section Does Not Apply

D. DHW EQUIPMENT SUMMARY – (Adapted from NRCC-PLB-01)												§ 110.3	Confirmed
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Pass	Fail
DHW Name	Fuel	Type	Qty	Distribution Type	Rated Input kBtu/h	Efficiency	Pilot Energy (Btu/h)	External Tank Insulation	Vol	Standby Loss	Vol. of Suppl. Storage Tank		
80 Gall2	Gas	Storage	1	Nonrecirculating	80	ThrmL. Eff.: 0.780	0	NA	80	0.01	NA	<input type="checkbox"/>	<input type="checkbox"/>

### E. MULTI-FAMILY CENTRAL DHW SYSTEM DETAILS

This Section Does Not Apply

### F. SOLAR HOT WATER HEATING SUMMARY (Adapted from NRCC-STH-01)

This Section Does Not Apply



### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 18)

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G. MECHANICAL HVAC ACCEPTANCE TESTS & FORMS (Adapted from 2013-NRCC-MCH-01-E)																			§ RA4	
Declaration of Required Acceptance Certificates (NRCA) – Acceptance Certificates that may be submitted. (Retain copies and verify forms are completed and signed to post in field for Field Inspector to verify).																				
Test Description		MCH-02A	MCH-03A	MCH-04A	MCH-05A	MCH-06A	MCH-07A	MCH-08A	MCH-09A	MCH-10A	MCH-11A	MCH-12A	MCH-13A	MCH-14A	MCH-15A	MCH-16A	MCH-17A	MCH-18A	Confirmed	
Equipment Requiring Testing or Verification	# of units	Outdoor Air	Single Zone Unitary	Air Dist. Ducts	Economizer Controls	DCV	Supply Fan VAV	Valve leakage	Supply Water Temp. Reset	Hyd. Variable Flow Control	Auto Demand Shed Control	FDD for DX Units	Auto FDD for Air & Zone	Dist. Energy Storage DX AC	TES Systems	Supply Air Temp. Reset	Condenser Water Reset Controls	ECMS	Pass	Fail
Plant - DHW1 - SHW	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<input type="checkbox"/>	<input type="checkbox"/>
Retail Mech. System3	1	X	X	-	X	X	X	-	-	-	-	X	-	-	-	-	-	-	<input type="checkbox"/>	<input type="checkbox"/>
Office Mech System23	1	X	X	-	X	-	X	-	-	-	-	X	-	-	-	-	-	-	<input type="checkbox"/>	<input type="checkbox"/>
Restaurant Mech Sys 36	1	X	X	-	X	X	X	-	-	-	-	X	-	-	-	-	-	-	<input type="checkbox"/>	<input type="checkbox"/>

#### NRCC-PRF-LTI-DETAILS -SECTION START-

A. INDOOR CONDITIONED LIGHTING CONTROL CREDITS (Adapted from NRCC-LTI-02-E)							§ 140.6		
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)				Control Credit Calculation			v If Acceptance Test Required	Confirmed	
Location in Building	Occupancy Type (must meet requirements of Table 140.6-A)	Type/Description of Lighting Control (i.e., partial on occupancy sensor, manual dimming, etc.)	# of Units	Watts of Controlled Lighting	Power Adjustment Factor	Control Credit Watts		Pass	Fail
5-1-Retail Zone	Retail Merchandise Sales, Wholesale Showroom	- none specified -	1		0.00	0		<input type="checkbox"/>	<input type="checkbox"/>

## Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 19)

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A. INDOOR CONDITIONED LIGHTING CONTROL CREDITS (Adapted from NRCC-LTI-02-E)							§ 140.6		
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)				Control Credit Calculation			v If Acceptance Test Required	Confirmed	
Location in Building	Occupancy Type (must meet requirements of Table 140.6-A)	Type/Description of Lighting Control (i.e., partial on occupancy sensor, manual dimming, etc.)	# of Units	Watts of Controlled Lighting	Power Adjustment Factor	Control Credit Watts		Pass	Fail
S-3-Office Zone	Office (Greater than 250 square feet in floor area)	- none specified -	1		0.00	0		<input type="checkbox"/>	<input type="checkbox"/>
S-4-Restaurant Zone	Dining Area	- none specified -	1		0.00	0		<input type="checkbox"/>	<input type="checkbox"/>
S-4-Restaurant Zone	Dining Area	- none specified -	1		0.00	0		<input type="checkbox"/>	<input type="checkbox"/>

B. INDOOR CONDITIONED LIGHTING MANDATORY LIGHTING CONTROLS (Adapted from NRCC-LTI-02-E)										§ 130.1	
This Section Does Not Apply											

§130.1(a) = Manual area controls; §130.1(b) = Multi Level; §130.1(c) = Auto Shut-Off; §130.1(d) = Mandatory Daylight; §130.1(e) = Demand Responsive

C. TAILORED METHOD CONDITIONED LIGHTING POWER ALLOWANCE SUMMARY AND CHECKLIST (Adapted from NRCC-LTI-04-E)							§ 140.6		
General lighting power (see Table D)							0		
General lighting power from special function areas (see Table E)							NA		
Additional "use it or lose it" (See Table G)							0		
Total watts							0		

D. GENERAL LIGHTING POWER (Adapted from NRCC-LTI-04-E)	§ 140.6-D
This Section Does Not Apply	

E. GENERAL LIGHTING FROM SPECIAL FUNCTION AREAS (Adapted from NRCC-LTI-04-E)							\$ 140.6(c) 3H	
Room Number	Primary Function Area	Illuminance Value (LUX)	Room Cavity Ratio (Table G)	Allowed LPD	Floor Area (ft²)	Allowed Watts	Confirmed	
							Pass	Fail
NA	NA	NA	NA	NA	NA	NA	<input type="checkbox"/>	<input type="checkbox"/>

Note: Tailored Method for Special Function Areas is not currently implemented

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 20)

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#### F. ROOM CAVITY RATIO (Adapted from NRCC-LTI-04-E)

Rectangular Spaces						
Room Number	Task/Activity Description	Room Length (ft)	Room Width (ft)	Room Cavity Height (ft)	RCR	Confirmed
						Pass Fail
NA	NA	NA	NA	NA	NA	<input type="checkbox"/> <input type="checkbox"/>

#### Non-Rectangular Spaces

This Section Does Not Apply

*Note: All applicable spaces are listed under the Non-Rectangular Spaces table*

#### G. ADDITIONAL "USE IT OR LOSE IT" (Adapted from NRCC-LTI-04-E)

1.	2.	3.	4.	Allowed Watts	Confirmed	
Wall Display	Combined Floor Display and Task Lighting	Combined Ornamental and Special Effects Lighting	Very Valuable Merchandise		Pass	Fail
0	0	0	0	0	<input type="checkbox"/>	<input type="checkbox"/>

#### 5. Wall Display

This Section Does Not Apply

#### 6. Floor Display and Task Lighting

This Section Does Not Apply

#### 7. Combined Ornamental and Special Effects Lighting

This Section Does Not Apply

#### 8. Very Valuable Merchandise

This Section Does Not Apply

### Appendix 3: Form NRCC-PRF-01-E Sample – New Construction (Page 21)

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H. INDOOR & OUTDOOR LIGHTING ACCEPTANCE TESTS & FORMS (Adapted from NRCC-LTI-01-E and NRCC-LTO-01-E)						§ 130.4	
Declaration of Required Acceptance Certificates (NRCA) –Acceptance Certificates that must be verified in the field. (Retain copies and verify forms are completed and signed to post in field for Field Inspector to verify).							
Test Description		Indoor			Outdoor	Confirmed	
		NRCA-LTI-02-A	NRCA-LTI-03-A	NRCA-LTI-04-A	NRCA-LTO-02-A	Pass	Fail
Equipment Requiring Testing or Verification	# of units	Occ Sensors / Auto Time Switch	Auto Daylight	Demand Responsive	Outdoor Controls		
Occupant Sensors	0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Automatic Time Switch	1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Automatic Daylighting	12	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Demand Responsive	0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Outdoor Controls	1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

