Zero Net Energy Cookbook

With 2019 Residential New Construction Fact Sheets and Technical Report



Zero Net Energy Cookbook
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Prepared by Southern California Edison

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Dedication

This Code and Standards summary report is presented with a special dedication.

> “Do. Or do not. There is no try.”
> *The Empire Strikes Back*
>
> This report is dedicated to Will Vicent — an inspirer, a maverick, a game-changer, and most of all, a friend. Through this report and so much of Will’s work, he signals his steady commitment to minimizing the negative impacts of the built environment in exchange for building designs and systems that give back to the occupants, the community, and the world. William and Xander, your dad is leaving his mark by making the world a better place for you and for all of us!
>
> Keep being the doer that you are, Will!

— Michelle Thomas, Principal Manager for Building Electrification

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Version History

An initial version of this document was produced with limited distributed in September 2020. This revised version (January 2021) includes corrections and clarifications in fact sheets, including footnotes.

Executive Summary

The Zero Net Energy (ZNE) Cookbook project aims to help the residential new construction (RNC) community identify least cost feature packages that could meet a high-performance goal while complying with the California 2019 Residential Building Energy Efficiency Standards. A wide range of building energy features were assembled into a feature pool; features were combined to generate candidate whole building feature packages; and then candidate packages were evaluated via energy modeling and filtered to select the optimal, compliant package. The optimal feature packages are compiled in ninety-six (96) easy-to-adopt Fact Sheet one-pagers, each for a distinct combination of building type, CEC climate zone, and fuel type. The individual Fact Sheets can be used like recipes; hence the name “Cookbook”.

In addition to baseline packages for comparison purposes, each Fact Sheet presents two high-performance packages:

1. ZNE high-performance package — a design that meets the ZNE level of performance and out of all candidate packages, provides the lowest annualized life cycle cost to the resident.
2. Zero Net Carbon (ZNC) high-performance package — out of all the candidate packages, the design that achieves the greatest possible carbon savings through energy efficiency features alone, then meets the ZNC level of performance.

The ZNE Cookbook and Fact Sheets are intended to help the RNC market comply with and exceed California’s energy code by outlining example packages that can be used to achieve these high-performance goals. The packages, or recipes, include a vast amount of prototypical design data such as incremental first costs, annual utility bill estimates, and annualized energy related costs. This data can help inform energy-related decisions very early in the design process. The Fact Sheets can be used by a variety of California stakeholders, including builders, design teams, homebuyers, local jurisdictions, public program administrators, even regulators, and so on.

Following the Fact Sheets, this document includes a technical report to detail the data-driven process and methods based on building energy modeling that were followed to develop optimal feature packages and Fact Sheets.

The process followed in developing the packages involved creating a pool of various energy efficiency measures commonly installed in the RNC, collecting the initial and replacement costs of these measures over 30 year life the houses by surveying the builder community, modeling the energy savings over minimum code complaint building and corresponding annualized life cycle cost using energy modeling and optimization tool (BEopt), selecting the least first cost, ZNE and ZNC packages, and post processing to increase the minimum solar PV size to achieve ZNE based on TDV factors and ZNC based on carbon emissions factors. The ZNE design approach used a sequential process whereby energy efficiency measures were optimized for cost, followed by adding renewable energy measures. This process is scalable to other building types,

construction types such as retrofit of existing building of various vintages and other definitions of ZNE such as based on source energy and ZNC.

A few important observations were drawn from the output results for ZNE packages, comparing all-electric and mixed-fuel options. Net utility bills show a clear trend: each all-electric ZNE package has lower utility bills compared to the same package with a mixed-fuel option. In terms of estimated incremental first costs, there is only a small difference between all-electric and mixed-fuel packages. Annualized energy related cost also shows a trend for single-family homes: typically, each all-electric ZNE package comes with a lower cost than the same package with mixed-fuel options. From these three observations, if a ZNE package is desired, it appears that all financial metrics favor the all-electric option over the mixed-fuel option, at least for single-family homes.

Fact Sheet Quick Guide

Here are some key highlights for reference when browsing the fact sheets.

How were the feature packages created?

The project started with development of a feature pool of standard features and energy efficiency upgrades for energy related building features for the three residential building types. This was followed by conducting an industry-wide survey to gather the material and labor costs for the commonly installed energy efficiency upgrades. The pool of energy features and associated costs were input to National Renewable Energy Laboratory's (NREL) BEopt energy modeling and optimization software tool. BEopt then iterated through all possible combinations of whole building design packages and, for each candidate package, generated a Building Energy Model (BEM). The outputs from the BEM include net energy usage as well as several cost metrics. Users of the 2019 Residential New Construction Fact Sheets are encouraged to refer to the Technical Report, included in this document following the fact sheets, for a more comprehensive background on the methodology and technical assumptions used to generate the fact sheets.

What is a Fact Sheet?

Each fact sheet is specific to a distinct combination of the following setup parameters:

- One of three (3) residential building types — The California Energy Commission building prototype models were used as a basis for the building types in these fact sheets.
    - The one story single-family home assumes 2,100 ft² of conditioned area.
    - The two story single-family home assumes 2,700 ft² of conditioned area.
    - The multi-family home represents an average dwelling unit in a two story building with a total of eight units, four of which have 960 ft² of conditioned area and the other four have 780 ft² of conditioned area.
- One of sixteen (16) CEC climate zones
- One of two (2) utility service configurations (a.k.a. fuel type) — These are the most common configurations for service by CPUC regulated utilities to a residential home:
    - A building with all-electric service
    - A building with mixed-fuel service (electric plus natural gas)

For a given building type a climate zone, fact sheet users can compare packages from both fuel types to make informed decisions in selecting the building features and in choosing between fuel type. Each fact sheet includes these four (4) design variations. Here are the labels that identify each package in the fact sheet:

- Prescriptive Compliance Path — The prescriptive standard package meets the minimum mandatory and prescriptive code requirements but is not optimized. The other three packages typically comply with standards under the performance path.

- Least Cost Performance Compliance Path — The least-cost baseline package is a basic, code-compliant design. Out of all the code-compliant candidate packages generated from the feature pool, this one has the lowest first cost.
- ZNE Performance Compliance Path — A high-performance design. Considering the first cost and operating cost of energy efficiency features alone, this package provides the lowest annualized life cycle cost to the resident out of all candidate packages. The package also includes the total solar PV capacity that brings the package to a ZNE level of performance.
- ZNC Performance Compliance Path — A high-performance design. Considering the carbon savings due to energy efficiency features alone, this design that achieves the greatest carbon savings out of all the candidate packages. The package also includes the total solar PV capacity that brings the package up to the ZNC level of performance.

For each package, the fact sheet displays the building features in these categories:

- Walls
- Ceiling and roof
- Windows and doors
- Space conditioning
- Mechanical ventilation
- Water heating
- Lighting
- Appliances and fixtures
- Solar PV capacity (kW)

All packages assume by default: a constant cooling setpoint of 78 °F and heating setpoint of 68 °F, nominal hot water usage of 6.25 gallons/day at sink, 7 gallons/day at shower and 7 gallons/day at bath, infiltration of 5 air changes per hour at 50 pascal, and no natural ventilation.

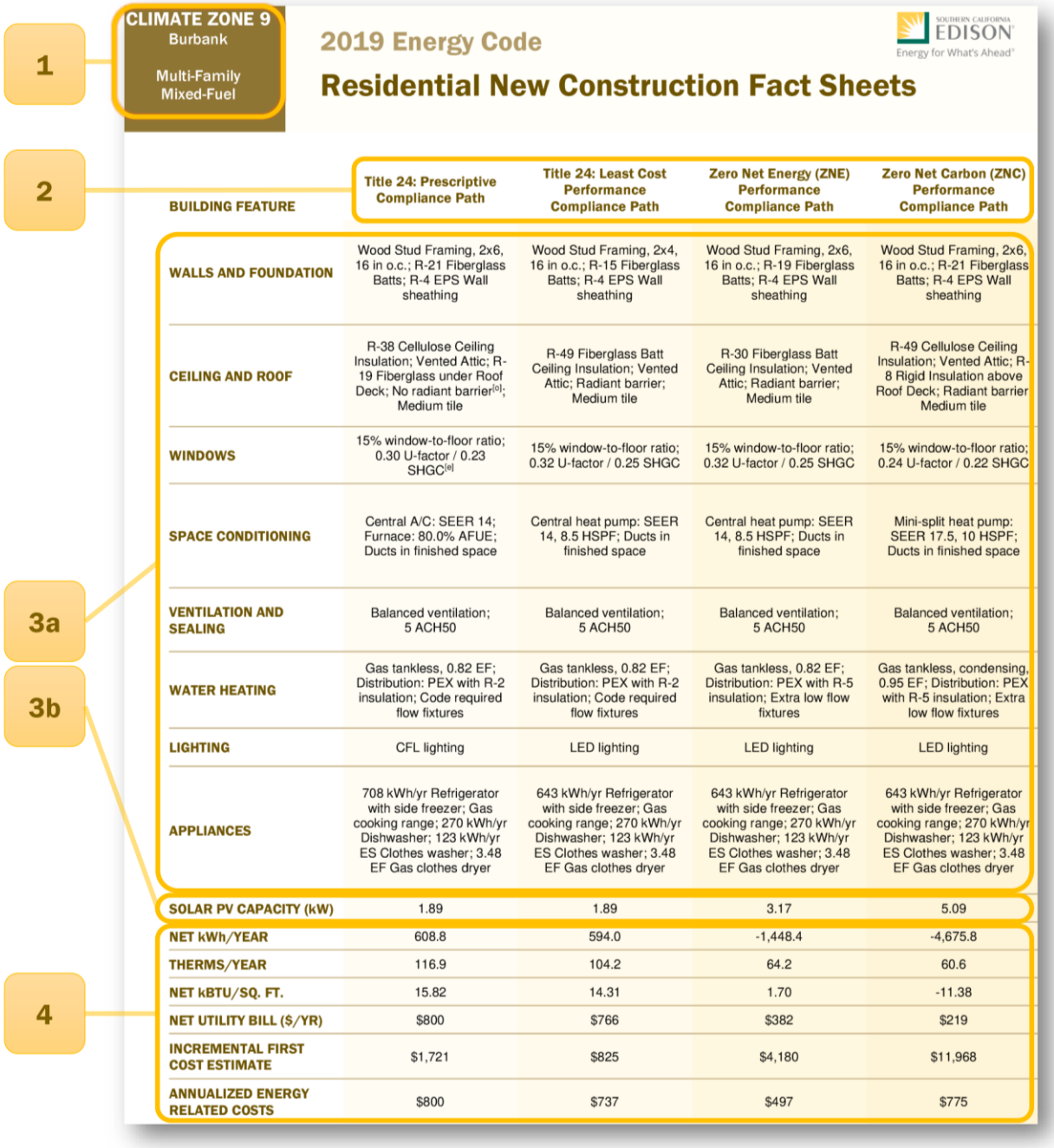
Although battery energy storage systems were not modeled as an option in the feature pool, users are advised to also evaluate the option of installing one. Residential battery systems are available in capacities of 13.5 kWh energy / 5 kW power at a cost of about $10,000 per unit.

For each package, the fact sheet also displays the following outputs from the building energy model.

- Net kWh / year — The annual electric energy consumed after deducting the energy generated by on-site solar PV from the gross annual energy usage (at the meter).
- Therms / year —The annual natural gas usage (at the meter).

- Net kBtu / sq. ft. — The net energy intensity, taken by adding annual energy usage from both gas and electric fuels (at the meter) after simple conversion to the same energy unit, and normalized per square foot of conditioned space.
- Net utility bills ($/year) — The annualized utility bills. The first year bills were determined using a representative time-of-use (TOU) rate with a net energy metering tariff. From the first year utility bills, the annual bills are estimated to increase every year for inflation and fuel escalation. Then, the utility bills are annualized to equal yearly payments over a 30 year analysis period.
- Incremental first cost estimates ($) — Sum of costs for all selected features in the package including solar PV. Feature costs are based on a confidential survey of the builder community regarding installation costs (material and labor). It is encouraged that users verify the cost estimates from their own sources. Incremental first cost estimates are relative to the all-electric or mixed-fuel standard reference package, whichever was identified as having the lower first. The baseline for zero cost varies with building type and climate zone, so incremental costs can only be compared across the two fact sheets for one building type and climate zone combination.
    - For example, suppose a hypothetical all-electric standard reference package costs $100,999 and the mixed-fuel standard reference package costs $100,000. The incremental costs are $999 and $0, respectively.
- Annualized energy related costs, a.k.a. annualized life cycle cost ($/year) — The life cycle cost analysis projects 30 years of payments and the annualizing calculation simplifies payments into one cost number representing an equal yearly payment with the same total net present value. For the life cycle analysis, in each year the cost is a sum of two components:
    - the utility bills (non-incremental); plus
    - the incremental cost (over the base package of the same fuel type) to finance, install, and maintain efficient features and solar PV capacity, less any residual value at the end of 30 years. Replacement costs are scheduled according to lifetime estimates for building features using publicly available tools.

Sample Fact Sheet



BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.89	1.89	3.17	5.09
NET kWh/YEAR	608.8	594.0	-1,448.4	-4,675.8
THERMS/YEAR	116.9	104.2	64.2	60.6
NET kBTU/SQ. FT.	15.82	14.31	1.70	-11.38
NET UTILITY BILL ($/YR)	$800	$766	$382	$219
INCREMENTAL FIRST COST ESTIMATE	$1,721	$825	$4,180	$11,968
ANNUALIZED ENERGY RELATED COSTS	$800	$737	$497	$775

Sample fact sheet (multi-family building type, climate zone 9, mixed-fuel)

The callouts in the sample fact sheet highlight the key layers of the fact sheet.

(1) Fixed variables

Fixed variables describe the building type, region, and utility service configuration.

(2) Design variants

Each column shows a building package and model results. The column headers show first the reference building design (code compliant with prescriptive path) and then the three optimized design variants resulting from the Cookbook process (code compliant with performance path).

(3a) Building feature package: energy efficiency features

These construction features, which are the free variables during optimization, determine the dwelling's gross energy usage (independent of solar and battery storage).

(3b) Building feature package: solar PV capacity

For baseline and least cost models, this is the minimum capacity required by the building energy efficiency standards. For ZNE and ZNC variants, this is the capacity required to meet the ZNE or ZNC goal when combined with the package's energy efficiency features.

(4) Energy usage and cost results

Energy usage and cost results come from the building energy simulation and workbook calculations. The meaning of each variable is as defined in Introduction. Negative values are shown in parentheses. For example, in the sample factsheet, the ZNC package in the far right column shows that both annual electric net energy usage (kWh/year) and net energy use intensity are negative, meaning the building generates more energy than it consumes (gross energy usage) on an annual basis.

User guide for selecting a package

This section demonstrates how a user can use a fact sheet to compare and select design options for a given building type and climate zone.

For example, suppose the user is conceptualizing a new residential building that will be a multi-family style building in CEC climate zone 9. First, the user finds the sheets for this combination (on pages 102-103). There are two options for utility service connection (all-electric and mixed-fuel, found together on adjacent pages) and four design variants for each option, with a total of eight designs displayed in the fact sheets. For this example, Table A shows the incremental first costs (per dwelling unit) for all these packages, and Table B shows the annualized life cycle costs.

Table A. Incremental first costs for design packages (multi-family home located in CEC Climate Zone 9)

Utility service option	All-electric				Mixed-fuel			
Design variant	Base	Least first cost	ZNE	ZNC	Base	Least first cost	ZNE	ZNC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Incremental first cost	$0	$0	$5,237	$15,211	$1,721	$825	$4,180	$11,968

Now suppose the user is a builder and wants to keep the first cost as low as possible. Referring to Table A, note the following cost comparisons.

- Between all-electric and mixed-fuel base packages (columns 1 and 5), the all-electric package had the lower first cost, so it is used as the reference for incremental costs for all the packages. All of the mixed-fuel packages have a greater cost than this all-electric base package, so all the values on the on the mixed-fuel side are greater than $0.
- On the all-electric side, the result of a search for least first cost design is in column (2). The incremental first cost value in this column will always be equal to or less than the value in column (1). In this case, the search found no package that was substantially better than the base package, so the all-electric least first cost package has the same first cost as the base package and may be merely an identical duplicate of base features.
- On the mixed-fuel side, the search revealed that there is a design (column 6) with lower cost than the mixed-fuel base package (column 5).
- Thus, based on the first cost only, in this example a builder wanting to minimize first cost would want to select the all-electric base package (column 1). The other columns show the extra costs the builder would need to invest to upgrade to ZNE or ZNC, or to switch to over to an mixed-fuel package.

Table B. Annualized life cycle costs (multi-family home located in CEC Climate Zone 9)

Utility service option	All-electric				Mixed-fuel			
Design variant	Base	Least first cost	ZNE	ZNC	Base	Least first cost	ZNE	ZNC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Annualized life cycle cost	$793	$793	$414	$1,029	$800	$737	$497	$775

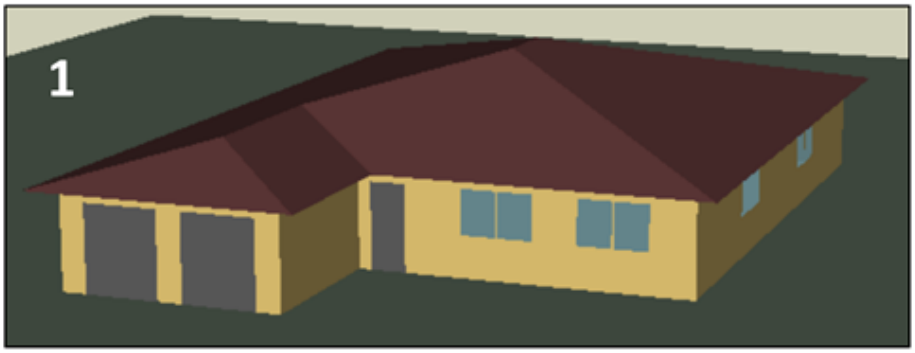
Next, suppose the user is a home buyer and wants to keep the 30-year life cycle costs as low as possible. Referring to Table B, note the following cost comparisons for annualized life cycle costs.

- On the all-electric side, the ZNE package (column 3) has a lower annualized life cycle cost than the base package (column 1) despite the greater first cost (recall from Table A). This is due to the fact that the ZNE package enjoys significantly lower utility bills than the base package, which is reflected in the annualized life cycle cost.
- On the other hand, the ZNC package (column 4) would be an ambitious goal in this case, having a considerably higher cost.
- On the mixed-fuel side, the ZNE package (column 7) also has a lower cost than other mixed-fuel packages, so it would be a good choice if the design will have a natural gas connection. The cost is slightly higher, however, than the ZNE package with electric-only utility service connection.

- Thus, based on annualized life cycle cost alone, the best recipe for the home buyer is the all-electric ZNE package. Selecting this package would not only cut down the life cycle costs for the buyer compared to base package, but also achieve Zero Net Energy.

After selecting a package based on costs or other goals, the user can read off a package recipe consisting of building features (energy efficiency and solar PV).

One Story Single-Family Home Fact Sheets



For this building type, the building energy model has a conditioned floor area of 2100 ft^2.

One Story Single-Family Contents

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CLIMATE ZONE 1
Arcata

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing; R-15 whole slab insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.94	2.94	5.95	7.87
NET kWh/YEAR	7,736.7	7,736.7	-1,050.7	-3,789.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	12.57	12.57	-1.71	-6.16
NET UTILITY BILL ($/YR)	$2,025	$1,788	$272	$311
INCREMENTAL FIRST COST ESTIMATE	$142	-$297	$17,164	$30,759
ANNUALIZED ENERGY RELATED COSTS	$2,025	$1,757	$864	$1,508

CLIMATE ZONE 1
Arcata

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.94	2.94	5.31	14.27
NET kWh/YEAR	1,637.6	1,637.6	-1,799.2	-14,419.4
THERMS/YEAR	544.2	544.2	98.7	228.3
NET kBTU/SQ. FT.	28.58	28.58	1.78	-12.56
NET UTILITY BILL ($/YR)	$2,084	$2,084	$560	$547
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$15,963	$43,009
ANNUALIZED ENERGY RELATED COSTS	$2,084	$2,084	$1,100	$2,129

CLIMATE ZONE 2
Santa Rosa

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.52	2.52	5.08	6.68
NET kWh/YEAR	5,213.3	5,213.3	-843.8	-4,030.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.47	8.47	-1.37	-6.55
NET UTILITY BILL ($/YR)	$1,584	$1,584	$320	$275
INCREMENTAL FIRST COST ESTIMATE	$142	$142	$6,481	$28,099
ANNUALIZED ENERGY RELATED COSTS	$1,584	$1,584	$607	$1,351

CLIMATE ZONE 2
Santa Rosa

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Mini-split heat pump: SEER 17.5, 10 HSPF; No ducts	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.52	2.52	4.44	10.84
NET kWh/YEAR	516.9	516.9	-1,785.4	-12,041.2
THERMS/YEAR	406.8	406.8	99.5	172.9
NET kBTU/SQ. FT.	20.21	20.21	1.84	-11.33
NET UTILITY BILL ($/YR)	$1,639	$1,639	$557	$436
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$6,597	$28,572
ANNUALIZED ENERGY RELATED COSTS	$1,639	$1,639	$1,058	$1,533

CLIMATE ZONE 3
Oakland

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.44	2.44	4.68	6.28
NET kWh/YEAR	4,977.1	4,977.1	-711.3	-3,443.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.09	8.09	-1.16	-5.60
NET UTILITY BILL ($/YR)	$1,564	$1,564	$319	$243
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$6,635	$27,412
ANNUALIZED ENERGY RELATED COSTS	$1,564	$1,564	$572	$1,285

CLIMATE ZONE 3
Oakland

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.44	2.44	4.04	9.48
NET kWh/YEAR	566.3	566.3	-1,848.9	-10,879.6
THERMS/YEAR	390.4	390.4	99.8	152.1
NET kBTU/SQ. FT.	19.51	19.51	1.75	-10.44
NET UTILITY BILL ($/YR)	$1,361	$1,361	$559	$427
INCREMENTAL FIRST COST ESTIMATE	$938	$938	$9,812	$29,557
ANNUALIZED ENERGY RELATED COSTS	$1,361	$1,361	$858	$1,417

CLIMATE ZONE 4
San Jose

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 234 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.44	2.44	4.68	6.92
NET kWh/YEAR	4,621.3	4,562.1	-764.7	-4,299.9
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.51	7.41	-1.24	-6.99
NET UTILITY BILL ($/YR)	$1,424	$1,403	$306	$283
INCREMENTAL FIRST COST ESTIMATE	$142	$739	$3,336	$21,966
ANNUALIZED ENERGY RELATED COSTS	$1,424	$1,061	$173	$715

CLIMATE ZONE 4
San Jose

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.44	2.44	4.68	9.48
NET kWh/YEAR	1,351.8	1,351.8	-2,368.5	-10,304.8
THERMS/YEAR	333.5	333.5	96.9	141.9
NET kBTU/SQ. FT.	18.08	18.08	0.77	-9.99
NET UTILITY BILL ($/YR)	$1,587	$1,587	$658	$394
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,151	$23,478
ANNUALIZED ENERGY RELATED COSTS	$1,587	$1,587	$596	$997

CLIMATE ZONE 5
Santa Maria

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation; R-15 whole slab insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage[k]
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.29	2.29	4.21	5.81
NET kWh/YEAR	4,612.8	4,612.8	-848.2	-3,848.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.50	7.50	-1.38	-6.25
NET UTILITY BILL ($/YR)	$1,456	$1,456	$214	$216
INCREMENTAL FIRST COST ESTIMATE	$142	$142	$10,871	$25,861
ANNUALIZED ENERGY RELATED COSTS	$1,456	$1,456	$512	$1,186

CLIMATE ZONE 5
Santa Maria

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.29	2.29	3.89	8.37
NET kWh/YEAR	510.5	510.5	-2,362.0	-9,616.2
THERMS/YEAR	330.7	330.7	182.3	131.2
NET kBTU/SQ. FT.	16.58	16.58	4.84	-9.38
NET UTILITY BILL ($/YR)	$1,088	$1,088	$576	$293
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$7,698	$28,106
ANNUALIZED ENERGY RELATED COSTS	$1,087	$1,087	$803	$1,226

CLIMATE ZONE 6
Torrance

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier[i]; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-2 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 116 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.48	2.48	4.40	6.00
NET kWh/YEAR	3,533.3	3,533.3	-679.5	-3,604.3
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.74	5.74	-1.10	-5.86
NET UTILITY BILL ($/YR)	$1,091	$1,091	$292	$240
INCREMENTAL FIRST COST ESTIMATE	$3,027	$3,027	$9,098	$26,732
ANNUALIZED ENERGY RELATED COSTS	$1,091	$1,091	$529	$1,225

CLIMATE ZONE 6
Torrance

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; No rigid continuous insulation	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier[i]; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 80.0% AFUE; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-2 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.48	2.48	4.72	9.20
NET kWh/YEAR	1,299.7	1,299.7	-3,019.6	-9,773.7
THERMS/YEAR	233.9	233.9	167.9	137.6
NET kBTU/SQ. FT.	13.25	13.25	3.09	-9.33
NET UTILITY BILL ($/YR)	$1,306	$1,306	$685	$306
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$7,872	$22,375
ANNUALIZED ENERGY RELATED COSTS	$1,306	$1,306	$961	$1,195

CLIMATE ZONE 7
San Diego

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; No rigid continuous insulation	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-5 XPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.35	2.35	3.95	5.55
NET kWh/YEAR	3,217.7	3,099.6	-690.2	-3,542.9
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.23	5.04	-1.12	-5.76
NET UTILITY BILL ($/YR)	$1,636	$1,586	$244	$250
INCREMENTAL FIRST COST ESTIMATE	$142	-$261	$6,860	$25,075
ANNUALIZED ENERGY RELATED COSTS	$1,636	$1,566	$465	$1,226

CLIMATE ZONE 7
San Diego

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; No rigid continuous insulation; R-10 slab edge insulation	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.35	2.35	3.95	7.79
NET kWh/YEAR	478.1	478.1	-2,204.1	-8,327.1
THERMS/YEAR	196.4	196.4	133.8	106.0
NET kBTU/SQ. FT.	10.13	10.13	2.79	-8.49
NET UTILITY BILL ($/YR)	$884	$884	$557	$436
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$4,709	$17,695
ANNUALIZED ENERGY RELATED COSTS	$884	$884	$645	$970

CLIMATE ZONE 8
Fullerton

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-8, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-8, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.60	2.60	5.16	6.12
NET kWh/YEAR	3,226.4	3,226.4	-705.0	-3,201.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.24	5.24	-1.15	-5.20
NET UTILITY BILL ($/YR)	$1,050	$1,050	$321	$123
INCREMENTAL FIRST COST ESTIMATE	$142	$142	$6,758	$3,509
ANNUALIZED ENERGY RELATED COSTS	$1,050	$1,050	$581	$45

CLIMATE ZONE 8
Fullerton

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.60	2.60	4.52	8.68
NET kWh/YEAR	1,251.2	1,251.2	-2,760.5	-9,161.7
THERMS/YEAR	206.1	206.1	163.6	119.7
NET kBTU/SQ. FT.	11.85	11.85	3.31	-9.19
NET UTILITY BILL ($/YR)	$884	$884	$553	$141
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$3,317	$25,019
ANNUALIZED ENERGY RELATED COSTS	$1,029	$1,029	$392	$890

CLIMATE ZONE 9
Burbank

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.65	2.65	5.53	6.17
NET kWh/YEAR	3,434.0	3,434.0	-1,175.3	-3,357.8
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.58	5.58	-1.91	-5.46
NET UTILITY BILL ($/YR)	$1,145	$1,145	$305	$124
INCREMENTAL FIRST COST ESTIMATE	$61	$61	$7,427	$5,035
ANNUALIZED ENERGY RELATED COSTS	$1,145	$1,145	$596	$78

CLIMATE ZONE 9
Burbank

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.65	2.65	4.89	8.73
NET kWh/YEAR	454.8	454.8	-2,671.9	-8,775.1
THERMS/YEAR	217.6	217.6	217.6	128.3
NET kBTU/SQ. FT.	11.10	11.10	6.02	-8.15
NET UTILITY BILL ($/YR)	$1,197	$1,197	$657	$238
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,813	$18,760
ANNUALIZED ENERGY RELATED COSTS	$1,197	$1,197	$882	$737

CLIMATE ZONE 10
Riverside

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.73	2.73	5.29	6.25
NET kWh/YEAR	3,686.1	3,686.1	-1,532.8	-3,457.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.99	5.99	-2.49	-5.62
NET UTILITY BILL ($/YR)	$1,211	$1,211	$224	$188
INCREMENTAL FIRST COST ESTIMATE	$142	$142	$5,651	$16,930
ANNUALIZED ENERGY RELATED COSTS	$1,211	$1,211	$141	$573

CLIMATE ZONE 10
Riverside

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: 2-stage SEER 16; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.73	2.73	4.65	9.45
NET kWh/YEAR	613.9	613.9	-2,290.3	-9,293.5
THERMS/YEAR	228.4	228.4	172.1	137.7
NET kBTU/SQ. FT.	11.87	11.87	4.47	-8.55
NET UTILITY BILL ($/YR)	$1,175	$1,175	$557	$436
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,379	$19,645
ANNUALIZED ENERGY RELATED COSTS	$1,175	$1,175	$453	$778

CLIMATE ZONE 11
Red Bluff

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-5 XPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.20	3.20	5.76	8.00
NET kWh/YEAR	4,931.1	4,931.1	-967.4	-4,308.0
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.01	8.01	-1.57	-7.00
NET UTILITY BILL ($/YR)	$1,615	$1,615	$309	$197
INCREMENTAL FIRST COST ESTIMATE	$142	-$3,088	$7,488	$26,393
ANNUALIZED ENERGY RELATED COSTS	$1,615	$1,239	$321	$836

CLIMATE ZONE 11
Red Bluff

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.20	3.20	5.12	11.84
NET kWh/YEAR	731.2	731.2	-1,754.6	-12,714.0
THERMS/YEAR	356.0	356.0	92.6	188.8
NET kBTU/SQ. FT.	18.14	18.14	1.56	-11.67
NET UTILITY BILL ($/YR)	$1,554	$1,554	$543	$392
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$9,036	$30,671
ANNUALIZED ENERGY RELATED COSTS	$1,554	$1,554	$595	$1,259

CLIMATE ZONE 12
Sacramento

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.69	2.69	5.64	8.52
NET kWh/YEAR	5,111.4	4,227.5	-1,011.7	-4,753.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.31	6.87	-1.64	-7.73
NET UTILITY BILL ($/YR)	$1,622	$1,374	$318	$298
INCREMENTAL FIRST COST ESTIMATE	$142	-$1,693	$7,982	$26,723
ANNUALIZED ENERGY RELATED COSTS	$1,622	$996	$346	$995

CLIMATE ZONE 12
Sacramento

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.69	2.69	4.93	11.97
NET kWh/YEAR	742.2	742.2	-1,725.7	-13,458.8
THERMS/YEAR	377.9	377.9	95.0	199.8
NET kBTU/SQ. FT.	19.20	19.20	1.72	-12.36
NET UTILITY BILL ($/YR)	$1,566	$1,566	$593	$480
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$7,085	$35,956
ANNUALIZED ENERGY RELATED COSTS	$1,566	$1,566	$580	$1,486

CLIMATE ZONE 13
Fresno

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.39	3.39	6.27	7.55
NET kWh/YEAR	4,482.1	3,692.4	-1,726.7	-4,019.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.28	6.00	-2.81	-6.53
NET UTILITY BILL ($/YR)	$1,491	$1,268	$252	$170
INCREMENTAL FIRST COST ESTIMATE	$142	-$1,693	$8,017	$19,990
ANNUALIZED ENERGY RELATED COSTS	$1,491	$890	$277	$561

CLIMATE ZONE 13
Fresno

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.39	3.39	5.63	12.03
NET kWh/YEAR	588.1	588.1	-2,328.6	-12,873.2
THERMS/YEAR	324.0	324.0	91.6	185.5
NET kBTU/SQ. FT.	16.38	16.38	0.58	-12.09
NET UTILITY BILL ($/YR)	$1,419	$1,419	$512	$360
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$8,717	$32,210
ANNUALIZED ENERGY RELATED COSTS	$1,419	$1,419	$561	$1,258

CLIMATE ZONE 14
Palmdale

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.82	2.82	5.06	7.62
NET kWh/YEAR	5,107.7	3,939.2	-852.0	-4,125.8
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.30	6.40	-1.38	-6.71
NET UTILITY BILL ($/YR)	$1,520	$1,265	$305	$100
INCREMENTAL FIRST COST ESTIMATE	$142	-$1,362	$6,386	$25,962
ANNUALIZED ENERGY RELATED COSTS	$1,520	$894	$266	$730

CLIMATE ZONE 14
Palmdale

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.82	2.82	4.74	10.82
NET kWh/YEAR	441.0	441.0	-1,899.5	-13,462.0
THERMS/YEAR	363.8	363.8	93.3	200.2
NET kBTU/SQ. FT.	18.04	18.04	1.35	-12.35
NET UTILITY BILL ($/YR)	$1,275	$1,275	$434	$248
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$6,271	$26,623
ANNUALIZED ENERGY RELATED COSTS	$1,276	$1,276	$382	$1,003

CLIMATE ZONE 15
Palm Springs

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[d]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 3 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	4.75	4.75	6.35	8.91
NET kWh/YEAR	3,391.6	2,423.5	-1,790.5	-5,669.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.51	3.94	-2.91	-9.21
NET UTILITY BILL ($/YR)	$1,462	$1,153	$237	$148
INCREMENTAL FIRST COST ESTIMATE	$142	$57	$5,536	$24,476
ANNUALIZED ENERGY RELATED COSTS	$1,462	$787	$125	$673

CLIMATE ZONE 15
Palm Springs

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[d]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	4.75	4.75	5.71	12.43
NET kWh/YEAR	1,766.1	227.3	-2,185.9	-9,343.5
THERMS/YEAR	119.8	132.1	78.0	83.0
NET kBTU/SQ. FT.	8.57	6.66	0.16	-11.23
NET UTILITY BILL ($/YR)	$1,626	$1,110	$357	$117
INCREMENTAL FIRST COST ESTIMATE	$0	-$2,586	$3,331	$24,142
ANNUALIZED ENERGY RELATED COSTS	$1,626	$695	$371	$705

CLIMATE ZONE 16
Blue Canyon

One Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 3 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 234 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.46	2.46	6.94	7.90
NET kWh/YEAR	8,662.1	6,685.5	-2,026.2	-4,725.5
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	14.08	10.87	-3.29	-7.68
NET UTILITY BILL ($/YR)	$2,260	$1,759	$259	$397
INCREMENTAL FIRST COST ESTIMATE	$142	-$2,332	$8,494	$25,281
ANNUALIZED ENERGY RELATED COSTS	$2,260	$1,392	$395	$1,035

CLIMATE ZONE 16
Blue Canyon

One Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 16; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.46	2.46	5.66	14.94
NET kWh/YEAR	798.6	669.4	-2,402.0	-19,756.7
THERMS/YEAR	543.2	433.5	106.0	330.3
NET kBTU/SQ. FT.	27.17	21.73	1.14	-16.38
NET UTILITY BILL ($/YR)	$1,625	$1,336	$557	$436
INCREMENTAL FIRST COST ESTIMATE	$0	-$698	$9,760	$35,716
ANNUALIZED ENERGY RELATED COSTS	$1,625	$1,022	$599	$1,587

Footnotes

[a] For construction of 2x6 framed walls, in the absence of wall sheathing, the mandatory requirement is minimum R-20 cavity insulation. For technical reasons, cost and energy models assumed walls were insulated with R-19 batts in this package, with negligible impact on costs and energy figures.

[b] In single-family construction of 2x6 framed walls with 16 in. OC spacing, in CZ1-CZ5 and CZ8-CZ15, the prescriptive requirement for insulation is equivalent to R-21 batts with R-5 sheathing. For technical reasons, cost and energy models assumed R-19 batts and R-4 sheathing. (R-4 EPS is the predominant product in use.)

[c] For technical reasons, cost and energy models assumed a radiant barrier was present in this package, with negligible impact on costs and energy figures.

[d] For technical reasons, cost and energy models assumed windows had 0.30 U-factor / 0.50 SHGC in this package, with negligible impact on cost and energy figures.

[e] For technical reasons, cost and energy models assumed windows had 0.32 U-factor / 0.25 SHGC. In this package, with negligible impact on cost and energy figures.

[f] For technical reasons, cost and energy models assumed slab insulation was not present in this package, although it is a prescriptive requirement.

[g] For technical reasons, cost and energy models assumed roof tile with high thermal emittance (TE=0.92) exceeding the prescriptive requirement.

[h] For ducts in vented attic, prescriptive requirement is R-8 duct insulation in this climate zone. For technical reasons, cost and energy models assumed R-6 duct insulation.

[i] With ducts in vented attic, prescriptive standard requires attic radiant barrier in this climate zone. For technical reasons, cost and energy models assumed no radiant barrier.

[j] For typical residential heat pump, Title 20 requires minimum 8.2 HSPF for a split-system and 8.0 HSPF for a packaged system. For technical reasons, cost and energy models assumed 8.5 HSPF.

[k] Standard practice consistent with unvented attics is to furnish ducts in conditioned space (minimally insulated). For technical reasons, cost and energy models assumed R-8 duct insulation.

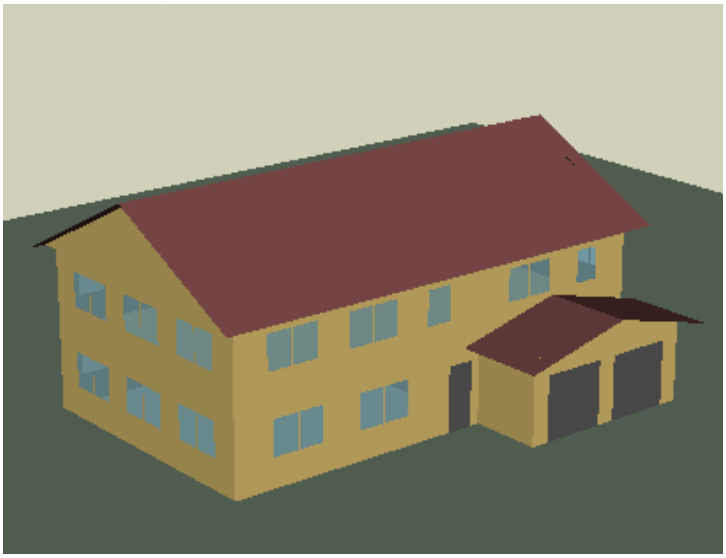
[l] Standard practice consistent with vented attics is to install ducts in attics with code required insulation. For technical reasons, cost and energy models assumed ducts were installed in conditioned space (minimally insulated).

[m] For technical reasons, cost and energy models ("base" package) assumed cool roof tile (SR = 0.20, TE = 0.92), although there is no prescriptive requirement in CZ16.

[n] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-30 ceiling insulation, no insulation below roof deck, and no radiant barrier.

[o] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-38 ceiling insulation, no insulation below roof deck, and no radiant barrier.

Two Story Single-Family Home Fact Sheets



For this building type, the building energy model has a conditioned floor area of 2700 ft^2.

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CLIMATE ZONE 1
Arcata

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.41	3.41	7.57	8.53
NET kWh/YEAR	6,767.6	6,767.6	-1,389.3	-3,749.3
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.55	8.55	-1.76	-4.74
NET UTILITY BILL ($/YR)	$2,101	$2,101	$309	$133
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$12,441	$31,548
ANNUALIZED ENERGY RELATED COSTS	$2,101	$2,101	$854	$1,218

CLIMATE ZONE 1
Arcata

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.41	3.41	6.61	10.77
NET kWh/YEAR	325.6	325.6	-1,786.1	-8,204.6
THERMS/YEAR	543.2	543.2	98.6	98.6
NET kBTU/SQ. FT.	20.53	20.53	1.39	-6.72
NET UTILITY BILL ($/YR)	$2,235	$2,124	$625	$254
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$10,383	$28,178
ANNUALIZED ENERGY RELATED COSTS	$2,235	$2,235	$1,113	$1,316

CLIMATE ZONE 2
Santa Rosa

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.90	2.90	6.42	8.66
NET kWh/YEAR	8,892.9	8,892.9	-3.5	-3,925.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.24	11.24	0.00	-4.96
NET UTILITY BILL ($/YR)	$2,773	$2,773	$121	$125
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$12,644	$34,405
ANNUALIZED ENERGY RELATED COSTS	$2,773	$2,773	$677	$1,327

CLIMATE ZONE 2
Santa Rosa

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-5 XPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.90	2.90	5.78	11.54
NET kWh/YEAR	1,120.0	1,120.0	-1,140.6	-9,756.3
THERMS/YEAR	688.4	688.4	143.4	131.9
NET kBTU/SQ. FT.	26.91	26.91	3.87	-7.45
NET UTILITY BILL ($/YR)	$2,886	$2,886	$831	$271
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$10,444	$33,911
ANNUALIZED ENERGY RELATED COSTS	$2,886	$2,886	$1,290	$1,530

CLIMATE ZONE 3
Oakland

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.80	2.80	5.36	6.32
NET kWh/YEAR	4,694.2	4,694.2	-1,097.9	-3,176.9
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.93	5.93	-1.39	-4.02
NET UTILITY BILL ($/YR)	$1,530	$1,530	$318	$134
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$6,334	$27,907
ANNUALIZED ENERGY RELATED COSTS	$1,530	$1,530	$643	$1,049

CLIMATE ZONE 3
Oakland

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.80	2.80	5.04	9.20
NET kWh/YEAR	404.4	404.4	-2,913.4	-9,261.0
THERMS/YEAR	335.0	335.0	208.4	124.0
NET kBTU/SQ. FT.	12.92	12.92	4.03	-7.11
NET UTILITY BILL ($/YR)	$1,491	$1,491	$888	$255
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$3,918	$20,132
ANNUALIZED ENERGY RELATED COSTS	$1,491	$1,491	$1,128	$1,090

CLIMATE ZONE 4
San Jose

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.79	2.79	5.67	6.63
NET kWh/YEAR	5,165.3	5,165.3	-1,186.6	-3,424.0
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	6.53	6.53	-1.50	-4.33
NET UTILITY BILL ($/YR)	$1,631	$1,631	$301	$100
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,958	$28,502
ANNUALIZED ENERGY RELATED COSTS	$1,631	$1,631	$485	$861

CLIMATE ZONE 4
San Jose

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.79	2.79	5.35	10.15
NET kWh/YEAR	543.7	1,018.5	-3,412.1	-11,109.8
THERMS/YEAR	365.4	346.4	240.6	168.9
NET kBTU/SQ. FT.	14.22	14.12	4.60	-7.79
NET UTILITY BILL ($/YR)	$1,601	$1,660	$932	$370
INCREMENTAL FIRST COST ESTIMATE	$89	-$3,616	$7,419	$27,743
ANNUALIZED ENERGY RELATED COSTS	$1,601	$1,469	$1,145	$1,259

CLIMATE ZONE 5
Santa Maria

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.64	2.64	5.20	5.84
NET kWh/YEAR	4,810.2	4,810.2	-992.2	-3,107.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	6.08	6.08	-1.25	-3.93
NET UTILITY BILL ($/YR)	$1,550	$1,550	$244	$44
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$3,205	$27,171
ANNUALIZED ENERGY RELATED COSTS	$1,550	$1,550	$460	$926

CLIMATE ZONE 5
Santa Maria

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.64	2.64	4.56	5.84
NET kWh/YEAR	347.3	347.3	-2,616.4	-5,299.5
THERMS/YEAR	334.3	334.3	201.8	53.9
NET kBTU/SQ. FT.	12.82	12.82	4.17	-4.70
NET UTILITY BILL ($/YR)	$1,142	$1,142	$662	$458
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$6,616	$17,068
ANNUALIZED ENERGY RELATED COSTS	$1,142	$1,142	$930	$991

CLIMATE ZONE 6
Torrance

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.83	2.83	5.39	6.35
NET kWh/YEAR	4,026.1	3,987.1	-1,403.2	-3,418.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.09	5.04	-1.77	-4.32
NET UTILITY BILL ($/YR)	$1,296	$1,278	$261	$106
INCREMENTAL FIRST COST ESTIMATE	$0	-$3,046	$3,997	$18,452
ANNUALIZED ENERGY RELATED COSTS	$1,296	$1,208	$493	$789

CLIMATE ZONE 6
Torrance

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.83	2.83	4.75	9.23
NET kWh/YEAR	486.5	537.3	-2,831.9	-9,889.1
THERMS/YEAR	260.0	249.2	194.8	149.9
NET kBTU/SQ. FT.	10.24	9.91	3.64	-6.95
NET UTILITY BILL ($/YR)	$1,260	$1,253	$644	$239
INCREMENTAL FIRST COST ESTIMATE	$189	-$2,964	$6,192	$22,142
ANNUALIZED ENERGY RELATED COSTS	$1,260	$1,165	$853	$1,092

CLIMATE ZONE 7
San Diego

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-6, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.69	2.69	4.61	5.57
NET kWh/YEAR	3,639.0	3,639.0	-878.5	-2,977.5
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	4.60	4.60	-1.11	-3.76
NET UTILITY BILL ($/YR)	$1,918	$1,918	$241	$47
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$1,040	$23,446
ANNUALIZED ENERGY RELATED COSTS	$1,915	$1,915	$377	$934

CLIMATE ZONE 7
San Diego

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.69	2.69	4.29	8.13
NET kWh/YEAR	481.1	481.1	-2,425.4	-8,736.2
THERMS/YEAR	218.4	218.4	163.1	124.8
NET kBTU/SQ. FT.	8.70	8.70	2.98	-6.42
NET UTILITY BILL ($/YR)	$1,006	$1,006	$558	$210
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$2,064	$20,135
ANNUALIZED ENERGY RELATED COSTS	$1,006	$1,006	$679	$981

CLIMATE ZONE 8
Fullerton

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-5 XPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.95	2.95	6.15	6.15
NET kWh/YEAR	3,696.3	3,696.3	-1,383.0	-3,036.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	4.67	4.67	-1.75	-3.84
NET UTILITY BILL ($/YR)	$1,305	$1,271	$256	$123
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$7,360	$19,089
ANNUALIZED ENERGY RELATED COSTS	$1,305	$1,305	$858	$874

CLIMATE ZONE 8
Fullerton

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.95	2.95	5.19	9.03
NET kWh/YEAR	564.9	564.9	-2,990.6	-9,431.5
THERMS/YEAR	232.3	232.3	232.3	140.0
NET kBTU/SQ. FT.	9.32	9.32	4.82	-6.74
NET UTILITY BILL ($/YR)	$1,234	$1,234	$725	$258
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$5,241	$20,135
ANNUALIZED ENERGY RELATED COSTS	$1,234	$1,234	$951	$935

CLIMATE ZONE 9
Burbank

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.02	3.02	6.86	6.54
NET kWh/YEAR	4,223.1	4,223.1	-2,049.6	-3,441.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.34	5.34	-2.59	-4.35
NET UTILITY BILL ($/YR)	$1,433	$1,421	$246	$110
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$8,832	$22,346
ANNUALIZED ENERGY RELATED COSTS	$1,433	$1,433	$919	$817

CLIMATE ZONE 9
Burbank

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.02	3.02	5.90	9.42
NET kWh/YEAR	765.1	765.1	-3,939.4	-10,128.0
THERMS/YEAR	250.2	250.2	250.2	149.9
NET kBTU/SQ. FT.	10.23	10.23	4.29	-7.25
NET UTILITY BILL ($/YR)	$1,388	$1,388	$626	$257
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$6,713	$22,519
ANNUALIZED ENERGY RELATED COSTS	$1,388	$1,388	$917	$1,000

CLIMATE ZONE 10
Riverside

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-5 XPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.10	3.10	6.62	6.94
NET kWh/YEAR	4,479.2	4,479.2	-2,504.1	-3,632.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	5.66	5.66	-3.17	-4.59
NET UTILITY BILL ($/YR)	$1,530	$1,530	$181	$94
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$8,096	$18,781
ANNUALIZED ENERGY RELATED COSTS	$1,530	$1,530	$406	$748

CLIMATE ZONE 10
Riverside

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.10	3.10	5.66	9.82
NET kWh/YEAR	919.0	919.0	-3,638.3	-10,572.5
THERMS/YEAR	261.5	261.5	203.7	158.1
NET kBTU/SQ. FT.	10.85	10.85	2.95	-7.51
NET UTILITY BILL ($/YR)	$1,499	$1,499	$616	$233
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$4,971	$23,484
ANNUALIZED ENERGY RELATED COSTS	$1,499	$1,499	$702	$1,013

CLIMATE ZONE 11
Red Bluff

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage[l]	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	CFL lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.70	3.70	6.90	8.82
NET kWh/YEAR	5,762.0	5,374.4	-1,210.1	-4,494.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.28	6.79	-1.53	-5.68
NET UTILITY BILL ($/YR)	$1,980	$1,813	$311	$107
INCREMENTAL FIRST COST ESTIMATE	$0	-$4,545	$8,864	$25,996
ANNUALIZED ENERGY RELATED COSTS	$1,980	$1,609	$580	$976

CLIMATE ZONE 11
Red Bluff

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.70	3.70	6.26	10.74
NET kWh/YEAR	926.3	926.3	-2,289.6	-9,807.4
THERMS/YEAR	408.9	408.9	115.9	115.9
NET kBTU/SQ. FT.	16.32	16.32	1.40	-8.10
NET UTILITY BILL ($/YR)	$2,011	$2,011	$626	$208
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$7,629	$28,812
ANNUALIZED ENERGY RELATED COSTS	$2,011	$2,011	$842	$1,145

CLIMATE ZONE 12
Sacramento

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.06	3.06	6.58	7.86
NET kWh/YEAR	5,972.5	5,972.5	-1,267.8	-4,084.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.55	7.55	-1.60	-5.16
NET UTILITY BILL ($/YR)	$1,966	$1,966	$355	$146
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$7,430	$27,398
ANNUALIZED ENERGY RELATED COSTS	$1,966	$1,966	$604	$938

CLIMATE ZONE 12
Sacramento

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.06	3.06	5.94	10.42
NET kWh/YEAR	977.3	977.3	-2,453.0	-9,783.3
THERMS/YEAR	426.4	426.4	118.5	118.5
NET kBTU/SQ. FT.	17.03	17.03	1.29	-7.98
NET UTILITY BILL ($/YR)	$1,998	$1,998	$647	$249
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$8,525	$29,749
ANNUALIZED ENERGY RELATED COSTS	$1,998	$1,998	$905	$1,232

CLIMATE ZONE 13
Fresno

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.92	3.92	7.44	8.40
NET kWh/YEAR	5,341.8	5,341.8	-2,015.4	-4,165.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	6.75	6.75	-2.55	-5.27
NET UTILITY BILL ($/YR)	$1,865	$1,865	$260	$122
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$9,812	$28,003
ANNUALIZED ENERGY RELATED COSTS	$1,865	$1,865	$556	$995

CLIMATE ZONE 13
Fresno

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts with R-6, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.92	3.92	6.80	9.68
NET kWh/YEAR	867.7	867.7	-2,895.5	-8,584.3
THERMS/YEAR	370.0	370.0	114.7	106.9
NET kBTU/SQ. FT.	14.80	14.80	0.59	-6.89
NET UTILITY BILL ($/YR)	$1,851	$1,851	$592	$626
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$8,365	$26,704
ANNUALIZED ENERGY RELATED COSTS	$1,851	$1,851	$840	$1,418

CLIMATE ZONE 14
Palmdale

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[h][j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-6, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	3.26	3.26	6.46	7.42
NET kWh/YEAR	6,028.6	6,028.6	-1,668.9	-4,412.9
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.62	7.62	-2.11	-5.58
NET UTILITY BILL ($/YR)	$1,868	$1,868	$258	$65
INCREMENTAL FIRST COST ESTIMATE	$2,422	$2,422	$6,605	$30,490
ANNUALIZED ENERGY RELATED COSTS	$1,868	$1,868	$244	$741

CLIMATE ZONE 14
Palmdale

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage[h]	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-6, 5% Leakage	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	3.26	3.26	5.50	11.58
NET kWh/YEAR	942.5	942.5	-3,826.1	-14,670.0
THERMS/YEAR	404.0	404.0	303.8	228.8
NET kBTU/SQ. FT.	16.15	16.15	6.42	-10.07
NET UTILITY BILL ($/YR)	$1,997	$1,997	$866	$253
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$6,688	$32,346
ANNUALIZED ENERGY RELATED COSTS	$1,997	$1,997	$977	$1,300

CLIMATE ZONE 15
Palm Springs

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[j]	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage[l]	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	5.68	5.68	7.60	8.56
NET kWh/YEAR	2,604.7	2,060.8	-2,441.3	-4,621.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	3.29	2.60	-3.09	-5.84
NET UTILITY BILL ($/YR)	$1,392	$1,257	$238	$4
INCREMENTAL FIRST COST ESTIMATE	$0	-$4,392	$5,993	$22,377
ANNUALIZED ENERGY RELATED COSTS	$1,392	$1,169	$493	$765

CLIMATE ZONE 15
Palm Springs

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)[g]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.92)
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	20% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	20% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts with R-8, 5% Leakage	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts in finished space	Central A/C: 2-stage SEER 16; Furnace: 92.5% AFUE; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	5.68	5.68	6.64	9.20
NET kWh/YEAR	375.4	375.4	-3,068.2	-7,019.1
THERMS/YEAR	157.6	157.6	116.5	63.7
NET kBTU/SQ. FT.	6.31	6.31	0.44	-6.51
NET UTILITY BILL ($/YR)	$1,447	$1,447	$408	$132
INCREMENTAL FIRST COST ESTIMATE	$89	$89	$5,562	$21,066
ANNUALIZED ENERGY RELATED COSTS	$1,447	$1,447	$586	$806

CLIMATE ZONE 16
Blue Canyon

Two Story
Single-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts[a]; No rigid continuous insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile[m]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile[m]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts with R-8, 5% Leakage[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts with R-8, 5% Leakage	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts with R-8, 5% Leakage
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.81	2.81	8.89	10.17
NET kWh/YEAR	9,572.4	9,572.4	-3,162.6	-5,738.0
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	12.10	12.10	-4.00	-7.25
NET UTILITY BILL ($/YR)	$2,470	$2,470	$86	-$103
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$11,025	$31,365
ANNUALIZED ENERGY RELATED COSTS	$2,470	$2,470	$681	$969

CLIMATE ZONE 16
Blue Canyon

Two Story
Single-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 Wall sheathing[b]; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-4 EPS Wall sheathing; R-15 whole slab insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile[m]	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile[m]	Unvented Attic; R-38 Fiberglass under Roof Deck; No radiant barrier; Medium tile	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Medium tile
WINDOWS	20% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	20% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space	Central heat pump: SEER 16, 9.5 HSPF; Ducts in finished space
VENTILATION AND SEALING	Exhaust ventilation; 5 ACH50	Exhaust ventilation; 5 ACH50	Supply ventilation; 5 ACH50	Supply ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.81	2.81	6.65	10.81
NET kWh/YEAR	936.2	936.2	-3,114.6	-10,662.0
THERMS/YEAR	567.4	567.4	131.8	131.8
NET kBTU/SQ. FT.	22.20	22.20	0.94	-8.60
NET UTILITY BILL ($/YR)	$2,653	$2,653	$540	$198
INCREMENTAL FIRST COST ESTIMATE	$850	$850	$13,044	$31,477
ANNUALIZED ENERGY RELATED COSTS	$2,253	$2,253	$1,082	$1,345

Footnotes

[a] For construction of 2x6 framed walls, in the absence of wall sheathing, the mandatory requirement is minimum R-20 cavity insulation. For technical reasons, cost and energy models assumed walls were insulated with R-19 batts in this package, with negligible impact on costs and energy figures.

[b] In single-family construction of 2x6 framed walls with 16 in. OC spacing, in CZ1-CZ5 and CZ8-CZ15, the prescriptive requirement for insulation is equivalent to R-21 batts with R-5 sheathing. For technical reasons, cost and energy models assumed R-19 batts and R-4 sheathing. (R-4 EPS is the predominant product in use.)

[c] For technical reasons, cost and energy models assumed a radiant barrier was present in this package, with negligible impact on costs and energy figures.

[d] For technical reasons, cost and energy models assumed windows had 0.30 U-factor / 0.50 SHGC in this package, with negligible impact on cost and energy figures.

[e] For technical reasons, cost and energy models assumed windows had 0.32 U-factor / 0.25 SHGC. In this package, with negligible impact on cost and energy figures.

[f] For technical reasons, cost and energy models assumed slab insulation was not present in this package, although it is a prescriptive requirement.

[g] For technical reasons, cost and energy models assumed roof tile with high thermal emittance (TE=0.92) exceeding the prescriptive requirement.

[h] For ducts in vented attic, prescriptive requirement is R-8 duct insulation in this climate zone. For technical reasons, cost and energy models assumed R-6 duct insulation.

[i] With ducts in vented attic, prescriptive standard requires attic radiant barrier in this climate zone. For technical reasons, cost and energy models assumed no radiant barrier.

[j] For typical residential heat pump, Title 20 requires minimum 8.2 HSPF for a split-system and 8.0 HSPF for a packaged system. For technical reasons, cost and energy models assumed 8.5 HSPF.

[k] Standard practice consistent with unvented attics is to furnish ducts in conditioned space (minimally insulated). For technical reasons, cost and energy models assumed R-8 duct insulation.

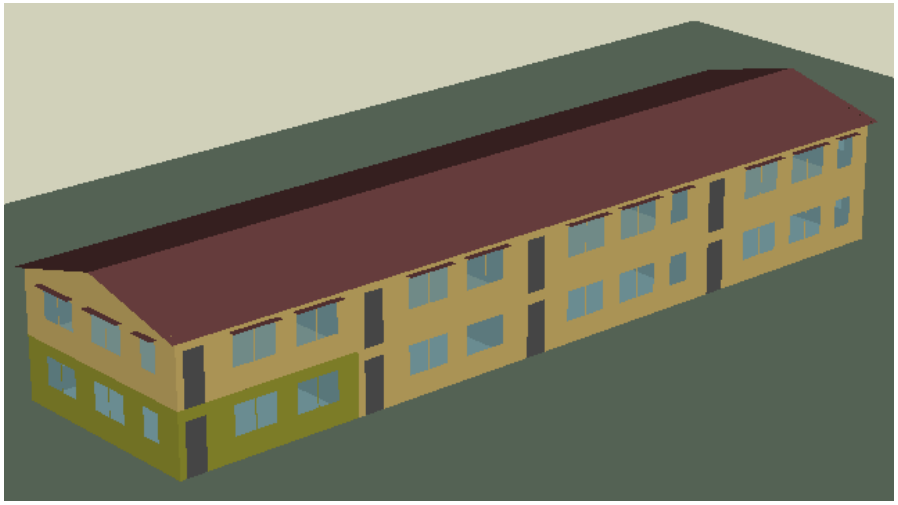
[l] Standard practice consistent with vented attics is to install ducts in attics with code required insulation. For technical reasons, cost and energy models assumed ducts were installed in conditioned space (minimally insulated).

[m] For technical reasons, cost and energy models ("base" package) assumed cool roof tile (SR = 0.20, TE = 0.92), although there is no prescriptive requirement in CZ16.

[n] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-30 ceiling insulation, no insulation below roof deck, and no radiant barrier.

[o] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-38 ceiling insulation, no insulation below roof deck, and no radiant barrier.

Multi-Family Home Fact Sheets



For this building type, the building energy model included eight (8) dwelling units, however note that energy and cost figures were normalized to show results per dwelling unit. The average conditioned area is 870 ft^2.

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CLIMATE ZONE 1
Arcata

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50	Heat recovery ventilation (HRV); 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.96	1.96	4.20	5.16
NET kWh/YEAR	3,487.1	3,487.1	-641.5	-2,247.5
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	13.68	13.68	-2.52	-8.82
NET UTILITY BILL ($/YR)	$1,109	$1,109	$210	$111
INCREMENTAL FIRST COST ESTIMATE	$0	-$686	$7,575	$18,344
ANNUALIZED ENERGY RELATED COSTS	$1,109	$985	$526	$1,053

CLIMATE ZONE 1
Arcata

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	Unvented Attic; R-38 Fiberglass under Roof Deck; R-8 Rigid Insulation above Roof Deck; No radiant barrier[c]; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Extra low flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.96	1.96	3.88	6.76
NET kWh/YEAR	590.8	590.8	-1,054.5	-5,484.6
THERMS/YEAR	204.2	204.2	52.7	69.1
NET kBTU/SQ. FT.	25.78	25.78	1.92	-13.57
NET UTILITY BILL ($/YR)	$956	$956	$401	$221
INCREMENTAL FIRST COST ESTIMATE	$120	-$1,404	$4,979	$17,531
ANNUALIZED ENERGY RELATED COSTS	$956	$836	$616	$1,021

CLIMATE ZONE 2
Santa Rosa

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead®

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Heat recovery ventilation (HRV); 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.76	1.76	3.36	4.32
NET kWh/YEAR	2,970.2	2,869.9	-472.4	-2,113.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.65	11.26	-1.85	-8.29
NET UTILITY BILL ($/YR)	$954	$921	$234	$110
INCREMENTAL FIRST COST ESTIMATE	$0	-$217	$5,195	$17,114
ANNUALIZED ENERGY RELATED COSTS	$954	$927	$446	$1,005

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.76	1.76	3.04	5.28
NET kWh/YEAR	578.2	625.4	-1,264.8	-4,861.8
THERMS/YEAR	137.3	133.3	69.4	65.1
NET kBTU/SQ. FT.	18.05	17.77	3.01	-11.59
NET UTILITY BILL ($/YR)	$750	$743	$452	$293
INCREMENTAL FIRST COST ESTIMATE	$527	$418	$3,356	$14,633
ANNUALIZED ENERGY RELATED COSTS	$750	$729	$582	$955

CLIMATE ZONE 3
Oakland

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.67	1.67	3.27	3.91
NET kWh/YEAR	2,806.3	2,608.3	-631.3	-1,914.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.01	10.23	-2.48	-7.51
NET UTILITY BILL ($/YR)	$896	$845	$211	$119
INCREMENTAL FIRST COST ESTIMATE	$0	-$466	$4,994	$14,777
ANNUALIZED ENERGY RELATED COSTS	$896	$846	$417	$925

CLIMATE ZONE 3
Oakland

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.67	1.67	2.95	5.51
NET kWh/YEAR	584.0	962.0	-1,223.9	-5,158.1
THERMS/YEAR	142.3	110.1	69.5	65.2
NET kBTU/SQ. FT.	18.65	16.43	3.19	-12.74
NET UTILITY BILL ($/YR)	$761	$761	$431	$217
INCREMENTAL FIRST COST ESTIMATE	$249	-$699	$3,481	$15,487
ANNUALIZED ENERGY RELATED COSTS	$761	$741	$579	$915

CLIMATE ZONE 4
San Jose

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead®

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[n]; Medium tile	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.72	1.72	3.32	4.28
NET kWh/YEAR	2,773.9	2,773.9	-576.6	-2,164.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	10.88	10.88	-2.26	-8.49
NET UTILITY BILL ($/YR)	$890	$890	$210	$80
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$4,258	$15,559
ANNUALIZED ENERGY RELATED COSTS	$890	$890	$385	$906

CLIMATE ZONE 4
San Jose

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[n]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.72	1.72	3.00	5.88
NET kWh/YEAR	584.0	930.9	-1,032.0	-5,618.8
THERMS/YEAR	146.4	117.1	67.6	67.6
NET kBTU/SQ. FT.	19.12	17.11	3.72	-14.27
NET UTILITY BILL ($/YR)	$778	$772	$427	$212
INCREMENTAL FIRST COST ESTIMATE	$651	-$813	$3,994	$13,093
ANNUALIZED ENERGY RELATED COSTS	$778	$724	$574	$863

CLIMATE ZONE 5
Santa Maria

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Heat recovery ventilation (HRV); 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Extra low flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.57	1.57	3.17	3.81
NET kWh/YEAR	2,835.7	2,835.7	-788.2	-2,182.3
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.12	11.12	-3.09	-8.56
NET UTILITY BILL ($/YR)	$916	$916	$158	$63
INCREMENTAL FIRST COST ESTIMATE	$0	-$466	$4,790	$15,670
ANNUALIZED ENERGY RELATED COSTS	$916	$862	$362	$886

CLIMATE ZONE 5
Santa Maria

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.57	1.57	2.53	4.77
NET kWh/YEAR	555.5	555.5	-1,146.3	-4,759.2
THERMS/YEAR	124.4	124.4	76.3	66.1
NET kBTU/SQ. FT.	16.48	16.48	4.27	-11.08
NET UTILITY BILL ($/YR)	$609	$609	$386	$219
INCREMENTAL FIRST COST ESTIMATE	$1,092	$1,092	$4,138	$11,804
ANNUALIZED ENERGY RELATED COSTS	$609	$609	$494	$785

CLIMATE ZONE 6
Torrance

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-5 XPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.75	1.75	3.35	3.99
NET kWh/YEAR	2,426.9	2,412.6	-898.3	-2,067.7
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	9.52	9.46	-3.52	-8.11
NET UTILITY BILL ($/YR)	$759	$752	$200	$122
INCREMENTAL FIRST COST ESTIMATE	$0	-$97	$4,844	$13,035
ANNUALIZED ENERGY RELATED COSTS	$759	$748	$407	$899

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.75	1.75	2.71	5.27
NET kWh/YEAR	569.7	680.4	-1,067.0	-4,907.2
THERMS/YEAR	119.6	107.8	75.7	62.0
NET kBTU/SQ. FT.	15.98	15.06	4.51	-12.12
NET UTILITY BILL ($/YR)	$765	$779	$423	$212
INCREMENTAL FIRST COST ESTIMATE	$1,092	$197	$4,409	$11,542
ANNUALIZED ENERGY RELATED COSTS	$765	$754	$540	$794

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-5 XPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.65	1.65	2.93	3.57
NET kWh/YEAR	2,306.3	2,293.7	-588.7	-1,728.0
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	9.05	9.00	-2.31	-6.78
NET UTILITY BILL ($/YR)	$1,167	$1,160	$186	$119
INCREMENTAL FIRST COST ESTIMATE	$0	-$120	$4,039	$12,085
ANNUALIZED ENERGY RELATED COSTS	$1,167	$1,155	$361	$860

CLIMATE ZONE 7
San Diego

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead®

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.65	1.65	2.61	4.85
NET kWh/YEAR	639.3	652.1	-1,042.7	-4,619.3
THERMS/YEAR	106.9	106.5	65.2	61.9
NET kBTU/SQ. FT.	14.79	14.80	3.41	-11.01
NET UTILITY BILL ($/YR)	$705	$707	$361	$211
INCREMENTAL FIRST COST ESTIMATE	$1,109	$214	$3,130	$10,389
ANNUALIZED ENERGY RELATED COSTS	$705	$682	$459	$616

CLIMATE ZONE 8
Fullerton

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.88	1.88	3.16	3.80
NET kWh/YEAR	2,186.6	2,191.6	-604.3	-1,785.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	8.58	8.60	-2.37	-7.00
NET UTILITY BILL ($/YR)	$723	$726	$223	$143
INCREMENTAL FIRST COST ESTIMATE	$0	-$485	$3,542	$11,923
ANNUALIZED ENERGY RELATED COSTS	$723	$704	$375	$868

CLIMATE ZONE 8
Fullerton

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.88	1.88	2.84	3.80
NET kWh/YEAR	468.7	404.5	-1,088.8	-2,650.9
THERMS/YEAR	110.3	104.4	64.3	22.6
NET kBTU/SQ. FT.	14.52	13.58	3.12	-7.80
NET UTILITY BILL ($/YR)	$729	$702	$405	$299
INCREMENTAL FIRST COST ESTIMATE	$1,093	$144	$2,599	$7,222
ANNUALIZED ENERGY RELATED COSTS	$729	$670	$481	$690

CLIMATE ZONE 9
Burbank

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead®

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.89	1.89	3.49	4.13
NET kWh/YEAR	2,392.2	2,392.2	-984.1	-2,284.1
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	9.38	9.38	-3.86	-8.96
NET UTILITY BILL ($/YR)	$793	$793	$196	$205
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,237	$15,211
ANNUALIZED ENERGY RELATED COSTS	$793	$793	$414	$1,029

CLIMATE ZONE 9
Burbank

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.89	1.89	3.17	5.09
NET kWh/YEAR	608.8	594.0	-1,448.4	-4,675.8
THERMS/YEAR	116.9	104.2	64.2	60.6
NET kBTU/SQ. FT.	15.82	14.31	1.70	-11.38
NET UTILITY BILL ($/YR)	$800	$766	$382	$219
INCREMENTAL FIRST COST ESTIMATE	$1,721	$825	$4,180	$11,968
ANNUALIZED ENERGY RELATED COSTS	$800	$737	$497	$775

CLIMATE ZONE 10
Riverside

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.96	1.96	3.56	4.20
NET kWh/YEAR	2,442.5	2,442.5	-926.2	-2,257.1
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	9.58	9.58	-3.63	-8.85
NET UTILITY BILL ($/YR)	$822	$822	$196	$108
INCREMENTAL FIRST COST ESTIMATE	$0	-$460	$4,725	$14,607
ANNUALIZED ENERGY RELATED COSTS	$822	$806	$391	$907

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-30 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.96	1.96	3.24	5.16
NET kWh/YEAR	675.8	675.8	-1,457.6	-4,656.3
THERMS/YEAR	108.4	108.4	63.9	60.4
NET kBTU/SQ. FT.	15.11	15.11	1.63	-11.33
NET UTILITY BILL ($/YR)	$811	$811	$364	$218
INCREMENTAL FIRST COST ESTIMATE	$1,075	$1,075	$3,638	$11,365
ANNUALIZED ENERGY RELATED COSTS	$811	$811	$482	$751

CLIMATE ZONE 11
Red Bluff

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.17	2.17	4.09	4.73
NET kWh/YEAR	2,926.4	2,926.4	-956.6	-2,347.5
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.48	11.48	-3.75	-9.21
NET UTILITY BILL ($/YR)	$981	$981	$192	$105
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,961	$15,369
ANNUALIZED ENERGY RELATED COSTS	$981	$981	$436	$937

CLIMATE ZONE 11
Red Bluff

Multi-Family
Mixed-Fuel

2019 Energy Code

Residential New Construction Fact Sheets

SOUTHERN CALIFORNIA EDISON
Energy for What's Ahead®

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.17	2.17	3.45	6.01
NET kWh/YEAR	721.1	721.1	-1,212.8	-5,333.5
THERMS/YEAR	133.9	133.9	64.5	60.9
NET kBTU/SQ. FT.	18.22	18.22	2.66	-13.92
NET UTILITY BILL ($/YR)	$795	$795	$401	$221
INCREMENTAL FIRST COST ESTIMATE	$1,092	$1,092	$4,179	$13,986
ANNUALIZED ENERGY RELATED COSTS	$795	$795	$535	$868

CLIMATE ZONE 12
Sacramento

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.94	1.94	3.86	4.50
NET kWh/YEAR	2,890.9	2,696.2	-982.5	-2,293.2
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.34	10.58	-3.85	-9.00
NET UTILITY BILL ($/YR)	$945	$884	$205	$118
INCREMENTAL FIRST COST ESTIMATE	$0	-$286	$5,961	$15,369
ANNUALIZED ENERGY RELATED COSTS	$945	$878	$449	$950

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x4, 16 in o.c.; R-15 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.93	1.93	3.21	5.77
NET kWh/YEAR	663.4	1,015.7	-1,009.0	-5,131.3
THERMS/YEAR	162.2	114.0	66.2	62.4
NET kBTU/SQ. FT.	21.24	17.09	3.65	-12.96
NET UTILITY BILL ($/YR)	$854	$798	$440	$221
INCREMENTAL FIRST COST ESTIMATE	$1,092	-$129	$4,125	$13,286
ANNUALIZED ENERGY RELATED COSTS	$854	$761	$571	$854

CLIMATE ZONE 13
Fresno

Multi-Family
All-Electric

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.29	2.29	4.21	4.85
NET kWh/YEAR	2,716.4	2,716.4	-1,101.3	-2,458.9
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	10.66	10.66	-4.32	-9.65
NET UTILITY BILL ($/YR)	$920	$920	$186	$104
INCREMENTAL FIRST COST ESTIMATE	$0	-$79	$5,961	$15,369
ANNUALIZED ENERGY RELATED COSTS	$920	$838	$430	$935

2019 Energy Code

Residential New Construction Fact Sheets

BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.29	2.29	3.57	5.81
NET kWh/YEAR	653.9	653.9	-1,304.9	-4,891.3
THERMS/YEAR	123.7	123.7	63.9	60.3
NET kBTU/SQ. FT.	16.79	16.79	2.22	-12.25
NET UTILITY BILL ($/YR)	$750	$750	$405	$217
INCREMENTAL FIRST COST ESTIMATE	$1,092	$1,092	$4,125	$12,550
ANNUALIZED ENERGY RELATED COSTS	$750	$750	$536	$816

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.91	1.91	3.51	4.15
NET kWh/YEAR	3,008.8	3,008.8	-730.0	-2,266.6
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	11.80	11.80	-2.86	-8.89
NET UTILITY BILL ($/YR)	$957	$957	$230	$119
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,150	$14,558
ANNUALIZED ENERGY RELATED COSTS	$957	$957	$440	$917

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-19 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: code-minimum insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.91	1.91	3.19	5.43
NET kWh/YEAR	990.5	990.5	-1,205.4	-5,282.6
THERMS/YEAR	132.7	132.7	64.9	61.3
NET kBTU/SQ. FT.	19.14	19.14	2.73	-13.68
NET UTILITY BILL ($/YR)	$883	$883	$406	$218
INCREMENTAL FIRST COST ESTIMATE	$1,109	$159	$4,195	$13,125
ANNUALIZED ENERGY RELATED COSTS	$905	$806	$540	$828

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Fiberglass Batt Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: code-minimum insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	LED lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	2.83	2.83	4.43	4.75
NET kWh/YEAR	1,871.3	1,846.8	-1,438.6	-2,440.1
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	7.34	7.24	-5.64	-9.57
NET UTILITY BILL ($/YR)	$794	$794	$144	$91
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$5,174	$13,794
ANNUALIZED ENERGY RELATED COSTS	$794	$794	$355	$855

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier[o]; Cool Roof Tile (SR=0.20 / TE=0.75)	R-38 Cellulose Ceiling Insulation; Vented Attic; R-19 Fiberglass under Roof Deck; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.23 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 16; Furnace: 92.5% AFUE; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	2.83	2.83	3.79	5.71
NET kWh/YEAR	480.8	480.8	-1,603.7	-4,835.4
THERMS/YEAR	84.2	84.2	55.3	55.2
NET kBTU/SQ. FT.	11.56	11.56	0.07	-12.63
NET UTILITY BILL ($/YR)	$847	$847	$340	$210
INCREMENTAL FIRST COST ESTIMATE	$2,162	$2,162	$4,954	$10,699
ANNUALIZED ENERGY RELATED COSTS	$847	$847	$464	$698

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathingSlab perimeter insulation, 1.5ft R-10 XPS[f]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-23 Blown-in Fiberglass; R-6 Polyiso Wall sheathing; R-15 whole slab insulation
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; R-8 Rigid Insulation above Roof Deck; Radiant barrier; Medium tile
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[d]	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central heat pump: SEER 14, 8.2 HSPF; Ducts in finished space[j]	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Central heat pump: SEER 14, 8.5 HSPF; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-2 insulation; Code required flow fixtures	Heat pump, 2.4 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Heat pump, 3.2 COP; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	708 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.45 EF Electric clothes dryer	643 kWh/yr Refrigerator with side freezer; Electric cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer	643 kWh/yr Refrigerator with side freezer; Induction cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 5.85 CEF ES Ventless heat pump clothes dryer
SOLAR PV CAPACITY (kW)	1.73	1.73	3.97	4.29
NET kWh/YEAR	3,590.6	3,590.6	-1,389.9	-2,168.4
THERMS/YEAR	0	0	0	0
NET kBTU/SQ. FT.	14.09	14.09	-5.45	-8.51
NET UTILITY BILL ($/YR)	$1,151	$1,071	$158	$101
INCREMENTAL FIRST COST ESTIMATE	$0	$0	$8,167	$9,437
ANNUALIZED ENERGY RELATED COSTS	$1,151	$1,151	$457	$945

CLIMATE ZONE 16
Blue Canyon

Multi-Family
Mixed-Fuel

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BUILDING FEATURE	Title 24: Prescriptive Compliance Path	Title 24: Least Cost Performance Compliance Path	Zero Net Energy (ZNE) Performance Compliance Path	Zero Net Carbon (ZNC) Performance Compliance Path
WALLS AND FOUNDATION	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathingSlab perimeter insulation, 1.5ft R-10 XPS[f]	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-4 EPS Wall sheathing; R-10 slab edge insulation	Wood Stud Framing, 2x6, 16 in o.c.; R-21 Fiberglass Batts; R-6 Polyiso Wall sheathing; R-10 slab edge insulation
CEILING AND ROOF	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier[o]; Medium tile	R-38 Cellulose Ceiling Insulation; Vented Attic; R-13 Fiberglass under Roof Deck; No radiant barrier; Medium tile	R-49 Cellulose Ceiling Insulation; Vented Attic; No radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)	R-49 Cellulose Ceiling Insulation; Vented Attic; Radiant barrier; Cool Roof Tile (SR=0.20 / TE=0.75)
WINDOWS	15% window-to-floor ratio; 0.30 U-factor / 0.35 SHGC[e]	15% window-to-floor ratio; 0.32 U-factor / 0.25 SHGC	15% window-to-floor ratio; 0.24 U-factor / 0.22 SHGC	15% window-to-floor ratio; 0.30 U-factor / 0.50 SHGC
SPACE CONDITIONING	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 80.0% AFUE; Ducts in finished space	Central A/C: SEER 14; Furnace: 92.5% AFUE; Ducts in finished space	Mini-split heat pump: SEER 17.5, 10 HSPF; Ducts in finished space
VENTILATION AND SEALING	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 5 ACH50	Balanced ventilation; 3 ACH50
WATER HEATING	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-2 insulation; Code required flow fixtures	Gas tankless, 0.82 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures	Gas tankless, condensing, 0.95 EF; Distribution: PEX with R-5 insulation; Extra low flow fixtures
LIGHTING	CFL lighting	CFL lighting	LED lighting	LED lighting
APPLIANCES	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	708 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer	643 kWh/yr Refrigerator with side freezer; Gas cooking range; 270 kWh/yr Dishwasher; 123 kWh/yr ES Clothes washer; 3.48 EF Gas clothes dryer
SOLAR PV CAPACITY (kW)	1.73	1.73	3.65	5.89
NET kWh/YEAR	801.1	801.1	-776.3	-4,197.8
THERMS/YEAR	189.1	189.1	171.8	68.8
NET kBTU/SQ. FT.	24.88	24.88	16.70	-8.56
NET UTILITY BILL ($/YR)	$824	$824	$431	$249
INCREMENTAL FIRST COST ESTIMATE	$827	$827	$7,068	$14,888
ANNUALIZED ENERGY RELATED COSTS	$1,067	$1,067	$657	$936

Footnotes

[a] For construction of 2x6 framed walls, in the absence of wall sheathing, the mandatory requirement is minimum R-20 cavity insulation. For technical reasons, cost and energy models assumed walls were insulated with R-19 batts in this package, with negligible impact on costs and energy figures.

[b] In single-family construction of 2x6 framed walls with 16 in. OC spacing, in CZ1-CZ5 and CZ8-CZ15, the prescriptive requirement for insulation is equivalent to R-21 batts with R-5 sheathing. For technical reasons, cost and energy models assumed R-19 batts and R-4 sheathing. (R-4 EPS is the predominant product in use.)

[c] For technical reasons, cost and energy models assumed a radiant barrier was present in this package, with negligible impact on costs and energy figures.

[d] For technical reasons, cost and energy models assumed windows had 0.30 U-factor / 0.50 SHGC in this package, with negligible impact on cost and energy figures.

[e] For technical reasons, cost and energy models assumed windows had 0.32 U-factor / 0.25 SHGC. In this package, with negligible impact on cost and energy figures.

[f] For technical reasons, cost and energy models assumed slab insulation was not present in this package, although it is a prescriptive requirement.

[g] For technical reasons, cost and energy models assumed roof tile with high thermal emittance (TE=0.92) exceeding the prescriptive requirement.

[h] For ducts in vented attic, prescriptive requirement is R-8 duct insulation in this climate zone. For technical reasons, cost and energy models assumed R-6 duct insulation.

[i] With ducts in vented attic, prescriptive standard requires attic radiant barrier in this climate zone. For technical reasons, cost and energy models assumed no radiant barrier.

[j] For typical residential heat pump, Title 20 requires minimum 8.2 HSPF for a split-system and 8.0 HSPF for a packaged system. For technical reasons, cost and energy models assumed 8.5 HSPF.

[k] Standard practice consistent with unvented attics is to furnish ducts in conditioned space (minimally insulated). For technical reasons, cost and energy models assumed R-8 duct insulation.

[l] Standard practice consistent with vented attics is to install ducts in attics with code required insulation. For technical reasons, cost and energy models assumed ducts were installed in conditioned space (minimally insulated).

[m] For technical reasons, cost and energy models ("base" package) assumed cool roof tile (SR = 0.20, TE = 0.92), although there is no prescriptive requirement in CZ16.

[n] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-30 ceiling insulation, no insulation below roof deck, and no radiant barrier.

[o] For technical reasons, cost and energy models ("base" package) differed from prescriptive requirements, assuming R-38 ceiling insulation, no insulation below roof deck, and no radiant barrier.

Technical Report and Appendices

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Nomenclature

- All-electric or electric only = a residential dwelling receiving electric service but not natural gas
- BattSim = A simple residential battery simulation tool in workbook format
- BEM = building energy model
- BEopt™ = Simulation-based residential design optimizer for building energy (software), developed by NREL
- CBECC-Res = California Building Energy Code Compliance - Residential (software)
- CEC = California Energy Commission
- CO_2 = carbon dioxide
- CPUC = California Public Utilities Commission
- CZ = CEC Climate Zone
- EDR = Energy design rating
- EE = energy efficiency, i.e. design feature
- EnergyPlus™ = Building energy simulation software used by BEopt
- EnergyPro™ = Commercial software for building energy simulation
- GHG = greenhouse gas
- HERS = Home energy rating system
- HVAC = Heating, ventilation, and air conditioning
- MEL = Miscellaneous electric loads (other than lighting, water heating, space cooling, or heating)
- Mixed-fuel or dual fuel = a residential dwelling receiving both electric and natural gas service
- NREL = National Renewable Energy Laboratory
- PG&E™ = Pacific Gas & Electric
- RNC, NC = (residential) new construction
- SCE™ = Southern California Edison
- SDG&E™ = San Diego Gas & Electric
- Solar PV = rooftop solar photovoltaic (panel, array, or system)
- TDV = Time-dependent values of site energy, pre-computed tables per CEC
- Title 24 = California building energy code (latest version is 2019 Title 24)
- TOU = time-of-use, i.e. electric rate tariff
- ZNE, ZNC = zero net energy, zero net carbon

Design feature terminology

- ACH50 = Air changes per hour, at 50 Pascal pressure
- AFUE = Annual fuel utilization efficiency
- ASHRAE 62.2 = Industry standard for ventilation
- CFL = compact fluorescent lighting
- COP = coefficient of performance, for heat pumps
- EER/SEER = (seasonal) energy efficiency ratio, i.e. for air conditioner or heat pump cooling mode
- EF = water heater energy factor

- EPS = expanded polystyrene insulation
- HSPF = Heating seasonal performance factor
- HRV = Heat recovery ventilator
- ISO = polyisocyanurate insulation
- LED = light emitting diode
- PEX = Cross-linked polyethylene pipe
- PUR = polyeurethane insulation
- PV = solar photovoltaic
- R-value = thermal resistance per unit area for insulation or assembly
- SHGC = Solar heat gain coefficient for window
- SPF = spray polyeurethane foam insulation
- U-factor = Overall heat transfer coefficient
- XPS = extruded polystyrene insulation

Energy units

- kW = kilowatt, SI unit for power (instantaneous energy transfer rate)
- 1 kWh = the energy used over the course of one hour by a 1 kW power load
- 1 kBtu = approximately 0.2931 kWh (US customary unit of energy)
- 1 therm = 100 kBtu
- 1 MBtu = approximately 293.1 kWh

Glossary of key terms

- Annualized energy related cost – BEopt terminology for *annualized life cycle cost*, which is the sum of the incremental cost (over the base package) to finance, install, and maintain efficient features and solar PV capacity; plus utility bills; all annualized to equal yearly payments over a 30 year analysis period. Replacement costs are scheduled according to lifetime estimates for building features using publicly available tools.
- First cost – Initial cost incurred by the builder.
- Regulated loads – Parts of buildings regulated by Title 24 which include building envelope, space-conditioning systems, water-heating systems, pool and spas, solar ready buildings, indoor lighting systems of buildings, outdoor lighting systems, electrical power distribution systems, and signs located either indoors or outdoors, in buildings
- Unregulated loads – Typically plug loads which is the load consumed by any appliances or electronic device that is plugged into a receptacle or receptacle outlet. Plug loads are not related to general lighting, heating, ventilation, cooling, and water heating, domestic and service water system, renewable power, information technology equipment, computer room electronic equipment, and electric vehicle charging.

Introduction to the ZNE Cookbook Concept

Southern California Edison (SCE) conceptualized a means to deliver high performance home designs to the residential builder community in the form of a cookbook full of recipes (easy-to-adopt building features packages[1]). Each recipe meets a specific cost or performance goal (such as ZNE) and is backed by a virtual test kitchen to narrow down the best recipe from among many options.

Specifically, the virtual test kitchen picks the high performance feature sets by an objective design strategy that minimizes an appropriate cost function while enforcing building energy code compliance. Ideation and evaluation of prospective designs is a data-driven process of detailed modeling and life cycle cost analysis, supported by an industry survey cost database and using Building Energy Simulations (BES) to precisely model performance with sub-hourly resolution. The process is scalable and replicable, but the products of this Cookbook are specific to California residential new construction (RNC), incorporating compliance checks based on California's 2019 Building Energy Efficiency Standards – Title 24 (CEC 2018a), and using the definition of ZNE that applies to California residential buildings.

The ZNE Cookbook presents four design variants, which are typically compliant with 2019 Residential Building Energy Efficiency Standards.

1. Prescriptive standard – the reference baseline design that meets the prescriptive code requirements but is not optimized. This variant is also referred to as "Base" package of energy efficiency features, with minimum code-required solar PV capacity.
2. Least Cost – a basic, code-compliant design with the least possible first cost (the required investment to build), which models the most realistic baseline for comparison of higher performing models. This variant complies under the performance path. Also referred to as "Min Cost" package of building features, coupled with minimum code-required solar PV capacity.
3. Zero Net Energy (ZNE) – design that provides least annualized life cycle cost to the resident. This variant complies under the performance path. For convenience the design is referred to as a bundle of "Site" energy efficiency with additional solar PV capacity as needed to meet ZNE.
4. Zero Net Carbon (ZNC) – design that achieves the greatest possible carbon savings through energy efficient features. For discussion, this design is referred to as a "CO_2" energy efficiency package with additional solar PV capacity as needed to meet ZNC.

These design variants are presented in a set of factsheets, showing the results of applying the Cookbook process. Each factsheet presents these variants specifically for

[1] Building features are the energy related building features such as building envelope (walls, ceiling & roof, windows & doors), space conditioning equipment, ventilation systems, lighting and appliances, and on-site energy generation.

one combination of residential building type, region (CEC climate zones), and utility service connection configuration (electric-only or electric plus natural gas). For each variant, the factsheet presents the design in terms of the set of features, initial cost, annualized life cycle cost, and other key metrics.

The Cookbook is intended to create accessible knowledge about ZNE design and provide a path to keeping costs low. The factsheets and documented process can simplify energy efficiency design decision-making for the RNC market and for multiple stakeholders including regulators, utilities, and the builder community alike. When considering a new start on a residential build, a builder or homebuyer can consult the corresponding factsheet and quickly anticipate the incremental cost to upgrade from a baseline design to reach the ZNE or ZNC level of performance, as well as a sample set of high performance features to build.

The simplicity of decision-making that comes from following the Cookbook stems from the fact that the BEM-based optimization process is based on an objective function, which helps avoid the need for subjective decisions or arbitrary rules in the process of upgrading a design to meet high performance goals. Furthermore, the annualized cost metric reflects costs from all aspects of design that are essential for achieving ZNE or ZNC level of performance, building design, solar PV generation, and potentially energy storage. This means that the design process does not make decisions about a given technology or upgradable feature nor attempt to evaluate individual features for cost-effectiveness. Instead, it treats the whole building design as a holistic, integrated process.

For each design variant, following the workflow yields a unique feature set, which is optimal in the strict sense of the mathematical optimization problem it solves. However, there are many possible paths to a given high performance level. There may be design variations that reach a performance goal with only slightly higher costs. Also, as with any mathematical optimization problem, changes to the assumptions (design template, feature pool, and economics) can yield changes to the solution. This work compiles reasonable assumptions for an overview of possible design scenarios for RNC across California. However, builders may wish to take the results from the Cookbook as a starting point to customize their analysis and apply any subjective preferences.

Project Management

This work was commissioned by Southern California Edison (SCE). SCE also provided expert guidance as well as its BattSim calculation tool. BIRAenergy was the primary contractor and developed the methodology, feature pool, feature cost surveys, building energy models, and calculation workbooks; performed optimization runs; and finalized building design packages and performance metrics. Substantial computational resources were dedicated by BIRAenergy to the optimization effort, estimated at around 3,136 hours of run time on its bank of state-of-the-art PCs. Build Smart Group provided quality assurance, expert guidance, and building design compliance checks. Solaris

Technical, LLC, contributed to quality assurance, reporting, and fact sheets. Scope of quality assurance included, for example, checks on all key numerical inputs to the models including economics and feature costs as well as baseline feature sets. Because of the large number of individual building instances and the risk for data entry faults when working with the BEopt user interface, the team developed an internal review process and scripting tools to

Selection of features for the feature pool took place via discussion with industry, and cost surveys were performed, during 2019. Regarding the overall project goals, methods, and anticipated outcomes, virtual stakeholder meetings were held in late 2019 and early 2020. Stakeholder feedback was received and incorporated into the project.

Background on ZNE in California and existing work

In its *Energy Action Plan: 2008 Update* and *2015 New Residential Zero Net Energy Action Plan*, the California Public Utilities Commission (CPUC) discussed ZNE construction as a favorable goal (CPUC 2008, CPUC 2015). The California Energy Commission (CEC) has further developed definitions for ZNE in the context of residential buildings that is aligned with regulatory concepts from its Residential Building Energy Efficiency Standards – Title 24. The *2019 Title 24 Alternative Compliance Manual – Residential* specifies the energy design ratio (EDR) as a metric for energy performance, with 100 representing a baseline compliance level, and a lower score representing lower net energy usage and better performance (CEC 2018b, ECA 2020). The energy usage terms in the EDR calculation are measured by time-dependent values (TDV) of energy usage, which differ from a simple sum of usage from meter readings (as discussed elsewhere in this report). Hence, in the context of California RNC, the definition of a ZNE home is a home with an EDR score of 0. By contrast, a definition of ZNE based on source energy instead of TDV is typically used in contexts outside California RNC (LAO 2015). According to CEC, “zero-net-energy homes or buildings may not interact with the grid in the most beneficial ways if the accounting ignores when energy is generated and consumed on site” (CEC 2019).

Some prior projects have developed the art of applying optimization techniques to ZNE design. In particular, the US Department of Energy and NREL developed the Building America Protocols and a software package called BEopt™ to support a nationwide energy efficiency upgrade program for residential retrofit projects (Wilson 2014). NREL has published several research articles based on the experience from this program, eg. (Wilson 2015). In California, a recent reach code cost-effectiveness study documented a process for evaluating ZNE design and offered findings regarding cost-effectiveness (PG&E 2019). A number of local governments use that and similar analyses to evaluate “reach codes” that exceed the statewide codes and standards (confer CPUC Docket 19-BSTD-06). However, as of 2019, the statewide codes and standards did not require ZNE in residential construction (CEC 2019).

Background on BEopt

At the heart of the Cookbook process is the use of a tool that connects BES and automatic optimization. BEopt (as in building energy optimization) is an existing tool that was developed specifically for this purpose and is free to download and use. Since its inception for residential retrofit analysis, BEopt has evolved to support also residential new construction analysis. A brief overview of BEopt is presented here as it relates to the adopted methodology. For further reading, see publications from NREL (Wilson 2015) and the built-in help viewer available after installing BEopt locally.

The basic function of BEopt is to transform a design blueprint by swapping out features from a user-specified list of options, generate one building model input file for this design, run the model through a BES engine (EnergyPlus™ in this case), collect key output data from the simulation, and perform economic analysis based on the output for this design. See Appendix 5 for a list of feature categories recognized by BEopt, which include design features and behaviors that affect energy and water usage (such as HVAC, construction choices, and even appliances and water fixtures) as well as solar PV features. On top of this basic function for analyzing one design at a time, BEopt can manage a batch of simulations, where each simulation represents a possible combination of available feature options. Using this batch simulation function, BEopt can perform an optimization run during which it searches for the design combination that optimizes a selected objective function or until a user-specified stop condition is reached, either by brute force search through all possible design combinations or by using proprietary techniques to reduce the number of required simulations to find the optimum. Only predefined objective functions are allowed; for example, the Cookbook process utilized annualized life cycle costs. The optional stop condition, such as 100% site energy savings, allows BEopt to conclude the search when a design criterion has been met, avoiding excessive simulation time spent on combinations that exceed the designer's goals.

Technical Background

This section describes technical terms and concepts frequently discussed in this report.

The other, less familiar terms describing grid impacts are used in the context of managing energy consumption and its associated impacts at larger scales, including through regulations (codes and standards) and utility efficiency programs. Here, energy delivered to the residence is further labeled as *site energy* for clarity. The utility provides net site energy at the meter by generating electricity (or natural gas) elsewhere from a variety of sources and delivering it through the grid (or pipeline). The raw sources used to deliver electricity (or gas) to the meter are represented by the source energy metric. Because the generation mix changes over time due to many influences such as weather, demand, and grid operations (such as bringing on gas peaking plants), there is a need to compare the relative value of one unit of site energy over time, which is represented by time-dependent values or TDV (ECA 2020). California regulatory frameworks such as building energy codes use pre-computed TDV tables provided by

the CEC, updated most recently in 2017 for the 2019 code cycle (CEC 2017). Greenhouse gas emissions due to energy consumption of carbon-based fuels are typically referred to in this report as simply carbon emissions (or CO_2 emissions for short), although they include trace amounts of other greenhouse gases released along the path from generation and delivery to the end user. For the Cookbook, the analysis adopts GHG emissions factors per unit natural gas usage and per net electric energy usage at the site that area averaged across years in the duration of the analysis period, but vary depending on climate zone and hour of the year. The GHG emissions for electricity imported from the grid are evaluated using the long run marginal emissions factors developed by Energy and Environmental Economics, Inc., and selected in coordination with SCE (E3 2020a). The emissions factors are provided with hourly resolution, in the form of a ratio of CO2e emissions to site energy, indexed by climate zone. The long run factors account for renewable portfolio standards, SB100, and other forecasted policy impacts (E3 2020b).

Following the usage of the term by CEC, a zero net energy (ZNE) home refers to a home that can achieve 100% reduction of annual TDV usage according to a building energy simulation of the design, relative to an equivalent baseline home, where the reduction is achieved by energy efficient building features, renewable energy generation, and energy storage systems (LAO 2015). Similarly, zero net carbon (ZNC) refers to 100% reduction of carbon emissions.

The Cookbook also models utility tariffs to estimate energy cost on optimized energy efficiency-measure alternatives. See Appendix 2 for economic assumptions and the TOU rate assigned as a function of climate zone and utility service connection configuration.

Benefits of high-performance designs include a combination of grid impacts known as time-dependent values (TDV) of net energy usage and carbon emissions associated with net energy use. To provide accurate results, costs and grid impacts are evaluated at an hourly resolution, and simulations run at sub-hourly resolution (typically 10 minute intervals or lower were required for convergence).

The Cookbook workflow can also accommodate analysis of a distributed energy resource, focused on an electric battery system behind the meter. Although other forms of energy storage may be available, this option is relatively simple to install as well as to analyze. Because any battery is less than 100% efficient, use of a battery storage system increases annual net energy usage of a home. However, energy storage shifts the hours when the home is importing electricity from the grid or exporting it back, which can have beneficial impact on other metrics such as TDV energy, CO2 emissions, and energy bills.

Overview of the Cookbook Workflow and Work Products

Table 3 presents the nominal goals for the "four variants" of design packages in terms of formal mathematical optimization problems consisting of objective and constraints.

Table 3. Nominal goals for "four variants" of design packages.

Variant	Objective	Resource constraint	Code compliance constraint	Starting from
1. Base package	N/A	N/A	Prescriptive path	CEC building prototype
2. Least first cost	Minimize first cost	N/A	Performance path (positive annual TDV energy savings)	Base package
3. Zero net energy	Minimize annualized life cycle cost	At least 100% annual TDV energy savings from EE+PV	Performance path	Base package
4. Zero net carbon	Maximize annual carbon savings from EE features	At least 100% annual carbon savings from EE+PV	Performance path	Base package

In addition to the building packages and analysis that are the main products, an intermediate product of the Cookbook workflow is a set of time series for each simulated whole building and end-use load (and generation from solar PV and battery systems). These time series, each covering a one-year simulated interval and resolved at hourly resolution, have been recorded and could be useful for future analysis based on the building models. In the Cookbook workflow, these hourly time series are considered intermediate data in the process for connecting BEM and post-simulation analyses. For example, BEopt (used for BEM) cannot accommodate battery energy storage features. The hourly data is used as part of the post-simulation phase of building evaluation, including, for example, sizing of solar PV and battery systems, and analysis of grid impacts such as energy usage, demand, and CO_2 emissions. The hourly data may also be useful to researchers who wish to extend the analysis but is not presented in the fact sheets.

This process employs the publicly available building energy modeling software BEopt, a user interface for EnergyPlus. BEopt was developed by the National Renewable Energy Lab (NREL) to determined optimum features sets based on different performance objectives, including first cost, efficiency, and utility bills. BEopt also simplifies and minimizes the permutations necessary to find these optimum feature sets.

The Cookbook process requires a pool of EE features with their associated costs obtained by directly surveying the market in 2019. The final energy efficiency features pool consisted of a number of different possible upgrades (see Appendix 5).

The Cookbook also uses up-to-date, region-matched utility tariffs for accurate estimates of operation costs when evaluating cost-optimized energy efficiency packages (see Appendix 2). This approach will provide above-code and just-meets-code energy packages to California builders in 2020, as well as their associated carbon emissions.

See Appendix 1 for a formal mathematical description of the optimization problem being solved by the Cookbook workflow.

Figure 1 shows sample images from the BEopt on the residential prototypes. These are the same building geometries used by CA in the triennial updates of the California building energy-efficiency standards and they can be found as pre-loaded models in CBECC-Res 2019, the California building code compliance software program. Building 1 is the “1-Story Medium” building prototype, with a single story and 2,100 sqft of conditioned floor area. Building 2 is the “2-Story Medium” building prototype, with two (2) stories and 2,700 square-feet of conditioned floor area. Building 3 is an 8-plex multi-family building with two (2)-stories, four (4) dwellings with 960 square-feet of conditioned floor area, and four (4) dwellings with 780 square-feet of conditioned floor area.

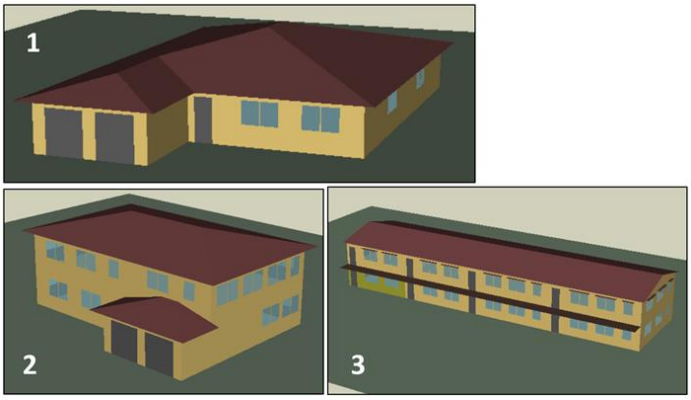

Figure 1. Screenshots of the three residential building templates used in this study.

All feature sets included a rooftop photovoltaic (PV) system, sized per *2019 Residential Building Energy Efficiency Standards* minimum requirements or sized sufficiently to achieve ZNE or ZNC. In addition to evaluating the effects of PV, the project intended to use BEopt hourly energy consumption outputs and the SCE-developed battery simulator (BattSim) to predict the effects on each package of addition of a battery energy storage system. To be consistent with the overall method for evaluating packages, this would require analysis of energy-related impacts (TDV energy and GHG emissions) as well as cost impacts (utility bill impacts, feature maintenance costs, and financing and annualizing calculation). For the energy calculations, BattSim was used with control strategy in line with *2019 Residential Building Energy Efficiency Standards*' basic controls option (see Appendix 3). A proof-of-concept for the energy calculation workflow is shown in Appendix 4, along with specifications used to model the battery system. However, the project did not include a standalone utility bill calculator, as needed to calculate annualized lifecycle costs for feature packages having a battery. So the battery option is still being evaluated and does not appear in the Fact Sheets.

In all, the fact sheets show results for all combinations of the three (3) building templates, 16 California climate zones, two (2) utility service connection configurations, and four (4) design variants, totaling 96 fact sheets and 384 building designs.

Approach and Methodology

The Cookbook workflow was developed to be replicable using the built-in user interface to BEopt and some light spreadsheet calculations (although advanced users may be able to automate some steps by scripting to reduce user interactions). The next sections explain these steps.

Step 1: Create Feature Pool

Specific to each building type, a feature pool was created. The feature pool was meant to include all the features typically used in code and above-code (high performance) homes. The criteria for inclusion was that a feature should be readily available, perceived as not excessively expensive, and represent a type of measure homeowners and homebuilders would expect to find in energy-efficient buildings. This allows for inclusion of possibly overlooked and underutilized features. In other words, these are features that were not emerging technologies and could be installed in California without specialized contractors. See Appendix 5 for a list of these features.

Step 2: Create Feature Cost Database

To evaluate the first costs later in the process, the next step was to gather costs information for each option in the feature pool. Although costs were available from commercial cost-estimators and cost-database firms, such as RSMeans, it was determined that current costs from high volume builders would be more beneficial as it may better represent the majority of future builds specific to California. Via custom cost surveys delivered to a coterie of industry contacts, cost documentation on selected energy efficiency feature pool was collected and organized into a cost database. Due to the sensitive nature of cost data in this industry, builders participated in these surveys on condition that individual feature costs be withheld from publication.

Step 3: BEopt Setup

In this step, the analyst set up a BEopt model for a given combination of building type (small single-family, two-story single-family, and multi-family), climate zone (1-16), and fuel configuration (all-electric and mixed-fuel). First, the geometry of the CEC prototype for the building type were reproduced using the BEopt user interface (since no import functions exist). For every BEopt optimization run there are factors that affect the results and that need to be appropriately set. In the language of optimization, these are fixed variables, and they include for example geographic location captured by CZ2010 weather files (one for each of 16 CEC climate zones), utility tariffs, and mortgage rates. Other than location and utility tariffs, these figures were the same for all models in the project. See Appendix 2 for details.

Then, the analyst set the feature options to match the CEC prototype as closely as possible. The starting point, or Base package, for the mixed-fuel models (those with both electrical energy use and natural gas use) was the prescriptive standard specified by *2019 Residential Building Energy Efficiency Standards*, which varies as a function of climate zone and building type (see for example single-family standards in Table 150.1-A, and low-rise multi-family in Table 150.1-B of *2019 Residential Building Energy Efficiency Standards*). Models that were all-electric used the minimum performance features set by Title 24 for electrical appliances. Minimum PV sizes were also based on the building code, found in Table 150.1-C of Title 24.

Note that some deviations from the prescriptive standard were assumed for Base packages, based on engineering judgment. For example, consider the case of a 2-story mixed fuel building in Climate Zone 1. For exterior wall assembly, the analysts used R-19 cavity plus R-4 continuous insulation as Base case rather than the R-21+R-5 prescriptive standard because it had nearly the same energy performance but had significantly lower cost. This choice made the Base Case match the industry predominant design. This was also true for the Base Case windows at 0.32 / 0.25 (U-factor / SHGC), just slightly lower performing than 2019 prescriptive 0.30 / 0.23 (U-factor / SHGC), but lower cost and industry predominant at the time of the study.

Next, the analyst updated the BEopt feature library to add all the options from the feature pool and enter costs from the survey data. The choices of which of these costed features to build were the free variables for BEopt optimization in the next step.

Step 4: BEopt Optimization

At this point BEopt started its optimization run, by incrementally adding user-selected features to the user-defined starting point. The rest follows standard operational procedures of a BEopt optimization scheme. When optimization is completed, BEopt produces a scatter plot in terms of calculated annual energy costs ($/yr; ordinate) vs annual site energy savings (%/yr; abscissa) for all the permutations calculated. Overlayed on the scatter plots, BEopt draws the Pareto optimal curve, appearing as a semi-parabolic curve that shows the boundaries of feasible cost and energy savings results. From these curves the optimized packages were selected as discussed in the next step.

Note that although BEopt has the ability to run permutations on solar PV capacity and optimize that aspect of design, this capability was not used in the Cookbook process. Instead solar PV size was held fixed to the code minimum during this optimization step, and sizing and self-generation (required for ZNE and ZNC goals) was deferred to a later step. The feature upgrades allowed in this optimization run included all the EE features in the pool but did not include options to add panels to the PV array. This was a decision meant to reduce the number of permutations required in simulation and also

meant to prevent the optimization scheme from violating the California Loading Order[2], a guiding principal regarding energy procurement in California. The loading order directs that the foundational and first resource to tap is energy efficiency. Energy features are to be added to a package upgrade before renewables, reducing gross energy use and reducing the need for self-generation capacity (Bender 2005). BEopt, although computationally powerful, did not have all the functionality required, for example, to directly compute hourly TDV calculations and GHG emissions calculations and to simulate battery energy storage, so these aspects of analysis were also deferred to a post-processing step later in the workflow.

Step 5: Selection Of Energy Efficiency Packages From The Optimization Curve

BEopt's optimization engine displays progress by plotting intermediate packages on a resource savings vs cost plot, and by drawing a *Pareto optimal curve* showing the most cost-effective package after each iteration stepping toward greater resource savings. The Pareto optimal curve is the bold line highlighted in plots from BEopt. Following the standard BEopt workflow after an optimization run, BEopt expects the analyst to interact with the user interface to click on individual points in the graph of Cost vs Savings in order to bring up the details of the corresponding design package and simulation outputs. The analyst repeats this process to select each candidate package of interest and then exports all such candidates to a clean analysis case for further inspection. In this graph each permutation of features is represented by a dot, and the feature set represented on the graph can be viewed by hovering over the dot. This section discusses the selection criteria for the Min Cost, Site, and CO_2 packages, and why multiple candidates were selected for further inspection.

Figure 2 illustrates a generic BEopt optimization curve including points of interest for this analysis. In this figure, the regions of interest are circled and labeled 1-4. The “Base” package is the reference package defined in the previous step (blue #1). The “Min Cost” package leverages the performance compliance path option of trading among Title 24 prescriptive compliance path requirements but complying with the code at the whole building level. The Min Cost package was typically found in a region near the Base package (red #2). The “Site” package was selected to minimize the annualized life cycle cost (blue #3), as a first step toward the ZNE goal. At the far right of the graph is a point representing the greatest resource savings per the visible x-axis variable (blue #4). Switching to display of emissions rather than energy savings along the x-axis, “CO_2” packages have the most CO_2 emissions savings possible, and were selected using that procedure (as a first step toward the ZNC goal).

[2] CPUC, CEC and California Consumer and Conservation Power Authority (CPA)-Energy Action Plan-defined the Loading Order with 1) energy efficiency and demand response as the preferred means of meeting energy growth followed by 2) renewable sources of power and distributed generation, and 3) clean and efficient fossil generation.

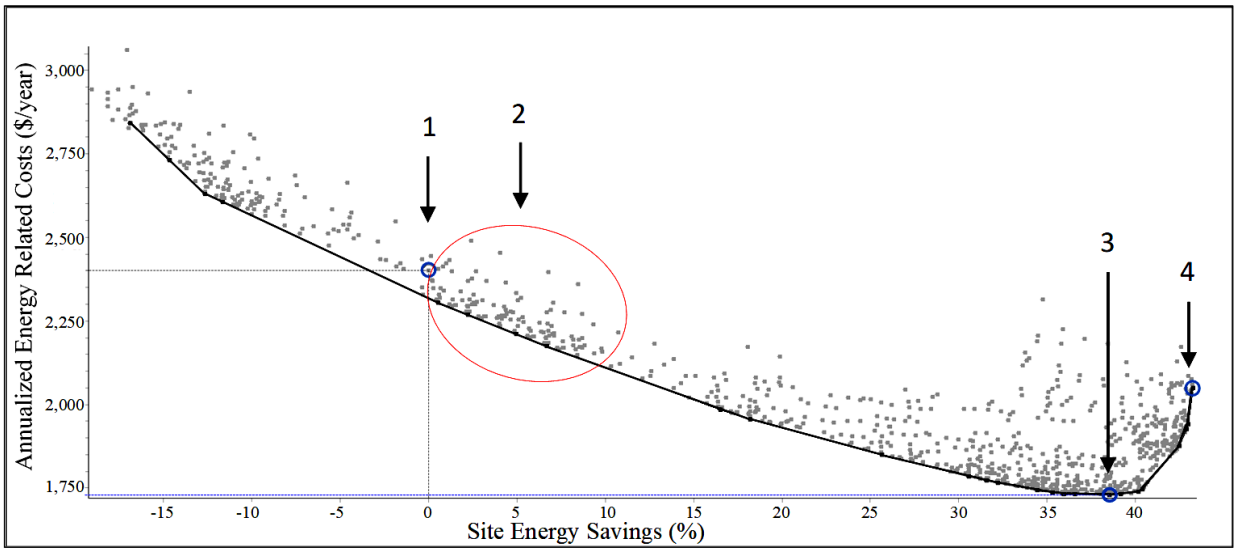

Figure 2. A BEopt batch run plot for the 2-Story prototype, All-Electric model in California Climate Zone 1 (Arcata, CA).

Each data point representing an optimum case is chosen individually. As can be seen in Figure 2, the density of dots on the BEopt curves can make package selection, using the user interface only, somewhat difficult. To deal with this problem, BEopt has the facility to magnify chosen areas of the output curves, allowing accurate choices of desired data points. For example, referring to Figure 3, which shows the same data as Figure 2 but with magnification, the Site package can be found at the bottom of the energy well, with the Site package having an ordinate axis with the dimension “Site Energy Savings (%).” For Site and CO_2 packages, BEopt calls out a candidate for each extreme value to aid the process.

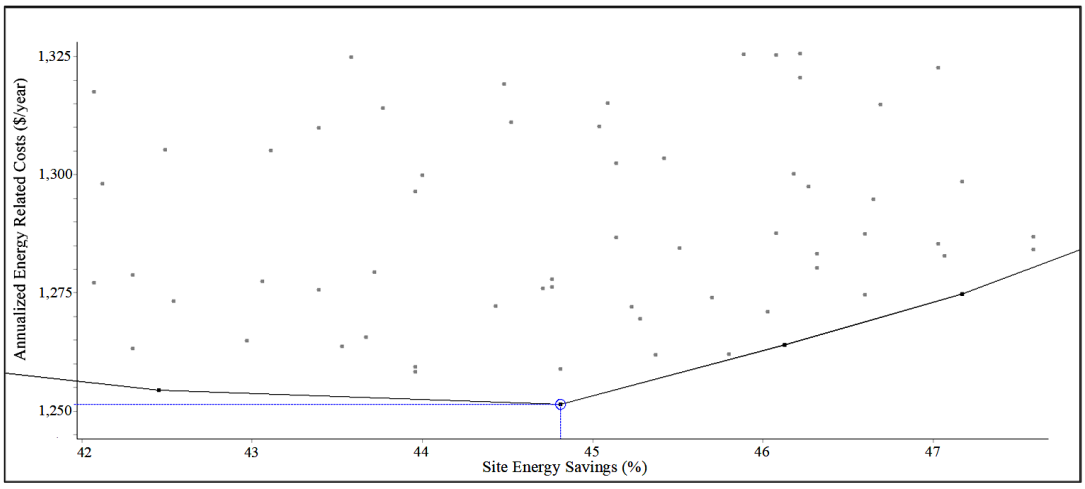

Figure 3. BEopt output data magnified for selection of minimum value along y-axis.

Because BEopt plots do not offer initial build cost (a.k.a. first cost) as a display variable, the method utilized for finding a Min Cost package is distinct from the method for a Site or CO_2 package, so is summarized below:

1. Export data for the packages between 0% and 10% site energy savings into a spreadsheet, including the incremental First Cost of each package, compared to the Base Case package cost.
2. Reject the packages which have a positive incremental First Cost.
3. Filter out and reject all packages that utilize upgrades that only affect loads that are unregulated by Title 24.
4. Of the remaining packages, select the lowest cost option.
5. If no options remain, the default selection is the Base Case package.

Figure 4 shows an example of the region in which the analysts found the Min Cost packages.

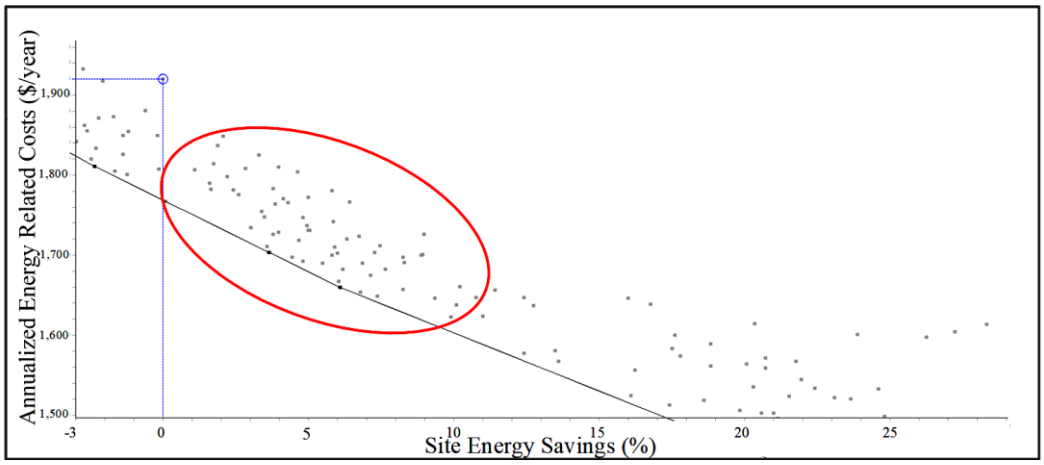

Figure 4. A close-up of the BEopt optimization curve for an all-electric Site package in a new 2-Story home in CEC climate zone 1.

The Max CO_2 package can be found by going to the furthest right bottom point of the energy curve, while it has an ordinate axis with the dimension "% CO_2 Emissions Reduction, per year," as shown in Figure 5:

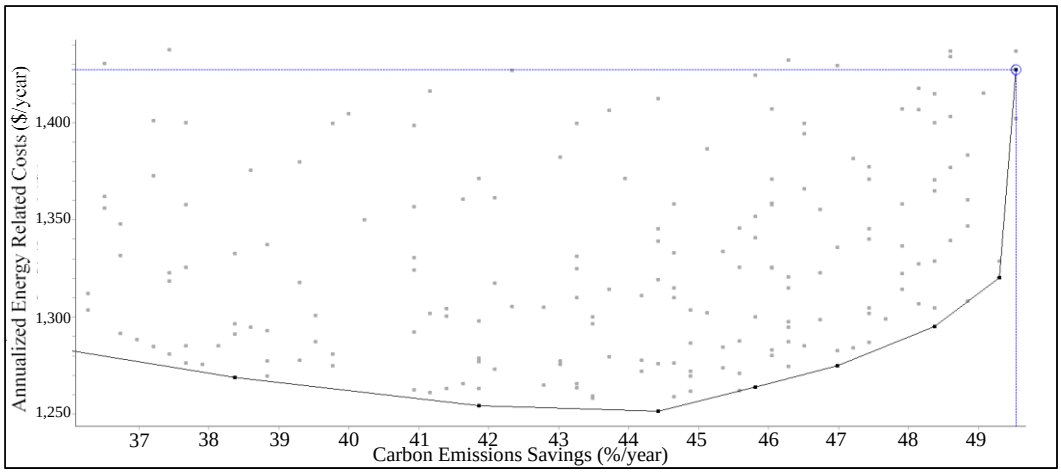

Figure 5. BEopt output plot magnified for Max CO_2 package selection from optimization run for 2-story home, CZ1, all-electric configuration.

These packages were located in consistent positions in the cost-savings plots.

Further inspection of candidates

When BEopt generates permutations for a single optimization run, it refuses to generate permutations that require switching between feature types that are mutually exclusive, such as switching out between different HVAC types (central AC with gas furnace vs. central air-source heat pump vs. mini-split heat pump). Additionally, there were a few more features for which, due to bugs or limitations in the software, BEopt fails to calculate first costs and/or replacement costs. For these reasons, multiple points were selected from the plots near the optimal point, and were then considered candidates until the analyst could vet them to ensure that costing is calculated correctly and that feature types excluded in the initial optimization run have been considered as competing options. To accomplish these checks, the Cookbook team developed additional procedures and workarounds, about which Appendix 6 offers basic details.

To recap, for each design variant (Min Cost, Site, and CO_2), a few packages are selected as candidates. These were vetted in the next step for code compliance, and then one candidate will be selected as a final design.

Step 6: Package Vetting and Verification of Title 24 Code Compliance

This step requires to take each Min Cost and Site package from step 6 and model it in CBECC-Res 2019 (the approved reference software for the *2019 Residential Building Energy Efficiency Standards – Title 24*) to determine whether the package meets Title 24 requirements. Please note that compliance requirements limit trading regulated loads for unregulated loads. BEopt is not an approved compliance tool, and thus it may generate design permutations that reduce annualized life cycle costs by trading out efficient features on regulated loads (reverting those to low efficiency) in favor of efficient features on unregulated loads. Hence, the Min Cost and Site packages from BEopt were run through the approved compliance tool. Any Min Cost package that did

not meet the minimum code Energy Design Rating and mandatory measures was rejected, and if no package passed compliance, then Min Cost was by default select to be equivalent to the Base Case package. Any Site package that did not meet minimum code compliance was adjusted, reverting as few features as possible to the option used by the Base package until the revised package was code compliant. The packages selected in Step Six are considered the "Final Packages."

Step 7: Solar PV Sizing and Other Post-processing for ZNE and ZNC

Once the packages are selected, the hourly performance data which includes electrical energy use with and without solar photovoltaics (PV) and natural gas usage were exported from BEopt (via CSV file) for each package into a post-processing spreadsheet. For each package, the PV required to convert the Site package into a true ZNE package, and to convert the CO_2 package into a true ZNC package, were calculated. Please note the PV sizing beyond the minimum size required by 2019 Title 24 was not performed within BEopt for reasons previously explained. Hence, PV sizing to achieve ZNE and ZNC are calculated using these equations.

$$\text{Additional capacity to reach ZNE} = \frac{(\text{Net TDV energy usage of Site Package})}{(\text{TDV energy exported per unit solar PV capacity})}$$

$$\text{Additional capacity to reach ZNC} = \frac{(\text{Net carbon emissions of } CO_2 \text{ Package})}{(\text{Carbon emissions reduced per unit solar PV capacity})}$$

Net TDV energy use and carbon emissions were calculated hourly by multiplying net site energy use with TDV and emissions factors in the spreadsheet. Considering that PV panels are available in discrete capacities, the sizing calculation assumes nominal capacity of 0.325 kW per panel and rounds up to the nearest number of panels. The updated PV sizing were input back into BEopt to calculate the utility bills/year and annualized life cycle costs for the full ZNE and ZNC packages.

Using SCE's BattSim tool and applying basic control strategy, the energy usage with and without battery were calculated for each design variant. Because of the losses associated with charging and discharging the battery, the energy (kWh) usage with battery is always higher. However, battery should provide other benefits such as reduce energy bills and CO_2 emissions because of the flexibility battery provides by limiting the power import from the grid during times of higher electric rates and less clean power. A simplified analysis using an average electric rate ($/kWh) was used to estimate the utility bill impact from battery. This report and fact sheets do not show the battery option in any packages because the costing methodology was inconsistent with the realistic TOU rate calculations used to evaluate all other features. In the future phases of this project it is recommended to use the TOU electric rate structure to realistically model utility bills for homes with a battery as well as to perform the analysis with other commonly used battery control strategies offered under Title 24. Refer to Appendix 3 for a discussion of BattSim and its implementation of these battery control strategies and refer to Appendix 4 for a sample battery analysis and result using the tool.

Results and Observations on Key Financial Metrics

As a visual overview of the cost information in the fact sheets, Figure 6 through Figure 15 plot the key financial metrics (net utility bills, incremental first cost estimate, and annualized energy related cost) for the all the packages.

Overall trends for annualized costs

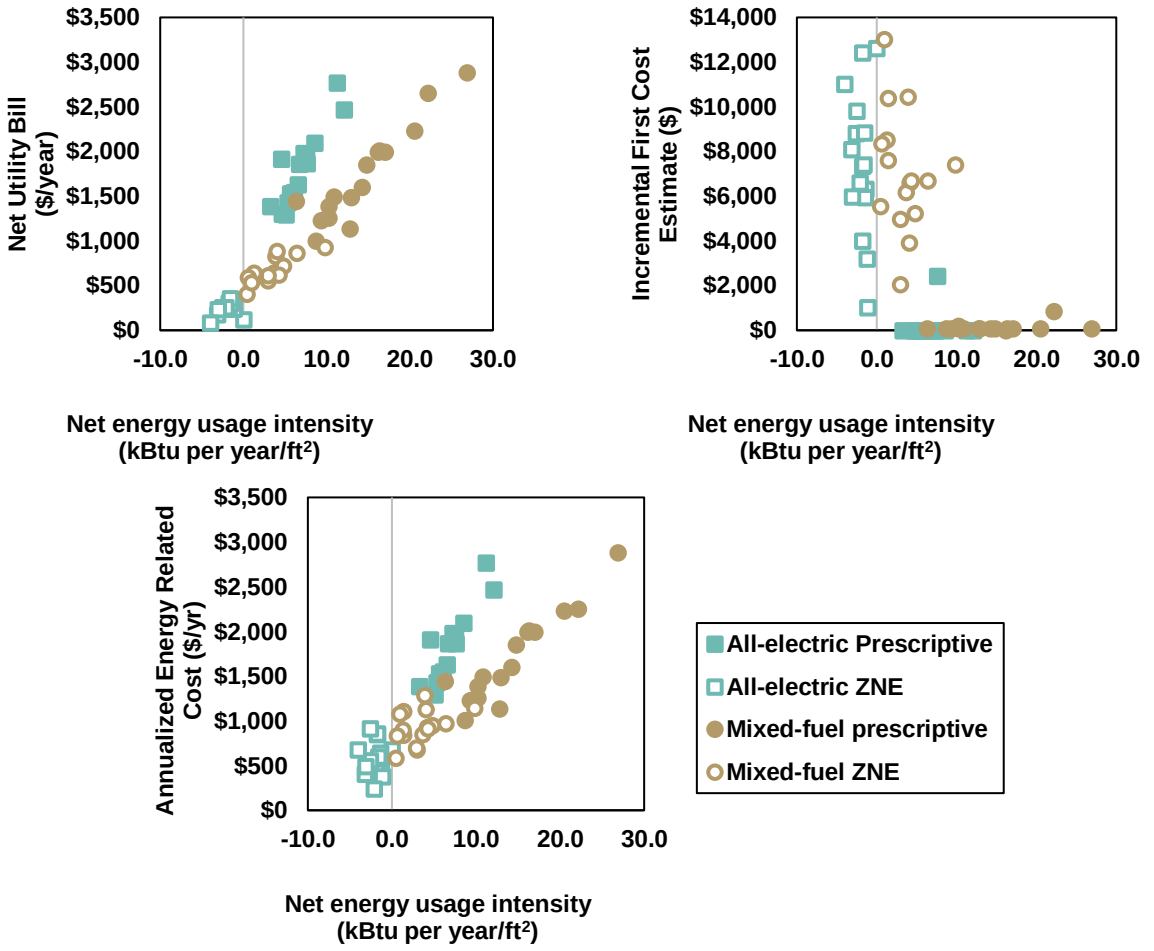

Figure 6. Overall trends for two-story, single-family home packages: all climate zones, prescriptive and ZNE packages only. *(Upper left)* Net utility bill, already annualized. *(Upper right)* Incremental first cost. Other cost components are not shown, e.g. financing, rebates, maintenance, etc. *(Bottom)* Annualized energy related cost.

Figure 6 makes it easy to compare the trends for net utility bill and annualized energy related cost, with net energy usage intensity along the x-axis. In this example, costs are shown only for prescriptive and ZNE packages, for the two-story, single-family home. Note that in both the plots for net utility bill (upper left plot) and for annualized energy related cost (bottom plot), the ZNE packages cluster toward the low end of the cost axis. Since the two plots are so similar, it appears that net utility bill is a much more significant contribution to the overall trend of annualized energy related cost than any other cost component. The difference between the two annualized cost metrics (net

utility bill, upper left; and annualized energy related cost, bottom) is due to first costs, financing, rebates, maintenance, etc. Even though incremental first costs for the ZNE package are as much as $13,000 (upper right plot), this turns out to be less significant over the 30 year analysis period than the utility bills. Note that net energy usage intensity for ZNE packages is not exactly zero, because a TDV-based definition was used for ZNE. Also note that the net energy usage intensity metric shown here is based on site (metered) net energy, which excludes losses from generation, transmission, and distribution. If source energy were plotted, all-electric packages would shift to the right, closer to mixed-fuel packages. And if annual total TDV energy were plotted, then each ZNE package would be at or below zero energy.

For each building type, the next subsections provide some additional observations based on detailed figures that plot the cost metrics labeled individually by package and by climate zone.

(See next page)

One story, single-family package costs summary

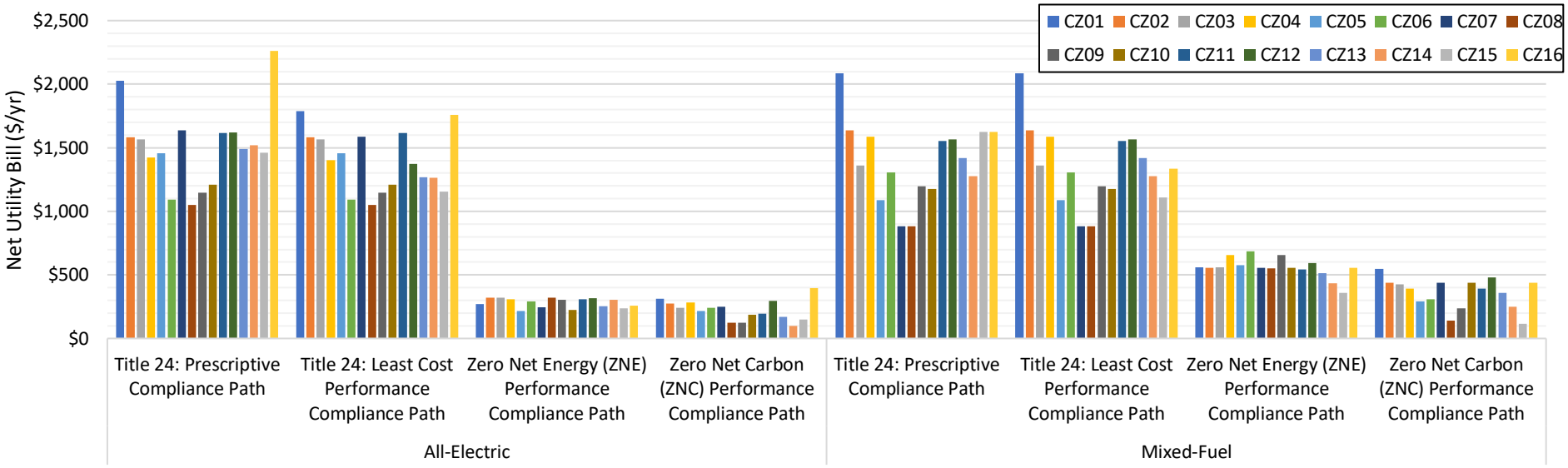

Figure 7. Net utility bill trends for one-story, single-family packages

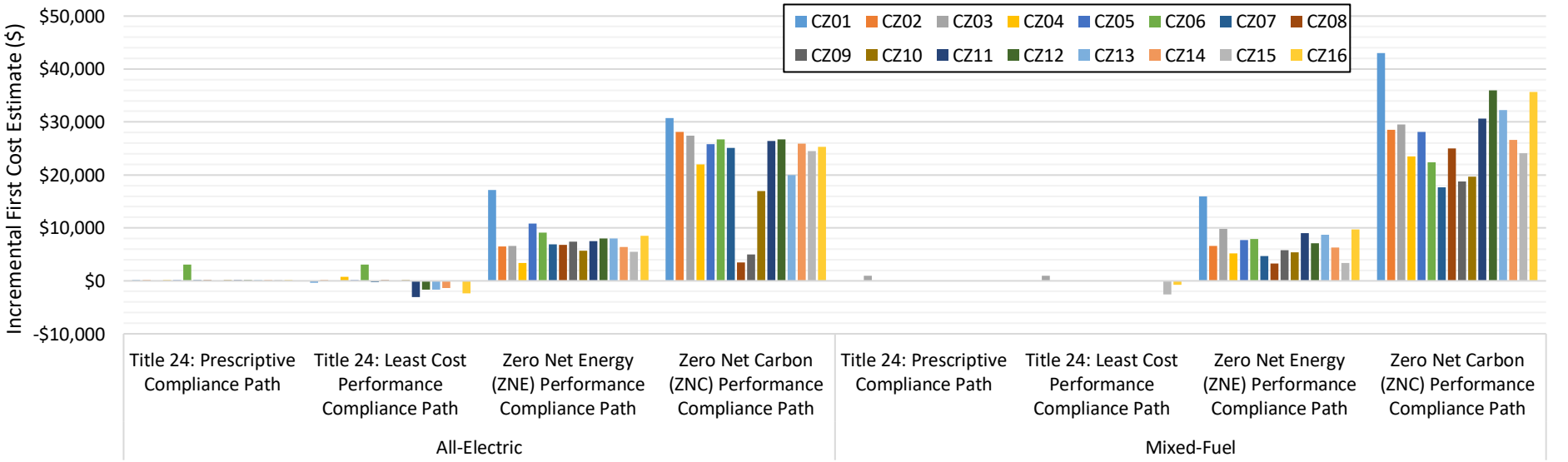

Figure 8. Incremental first cost estimate trends for one-story, single-family packages.

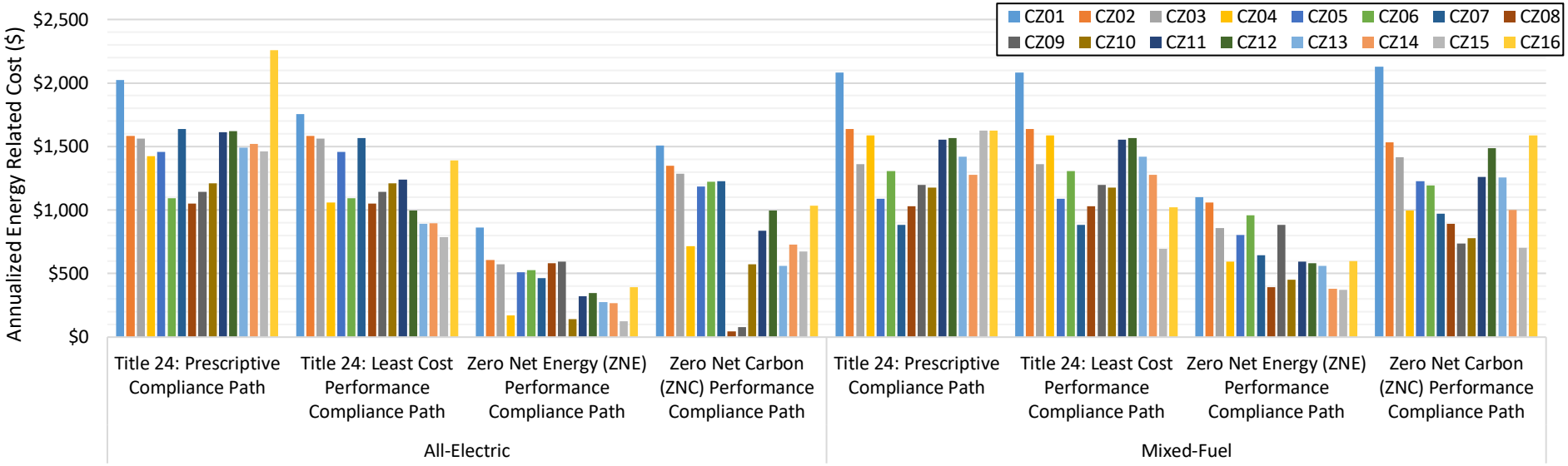

Figure 9. Annualized energy related cost trends for one-story, single-family packages

Observations comparing all-electric to mixed-fuel options

For one-story, single-family home packages, net utility bills (Figure 7) show a clear trend: each all-electric ZNE and ZNC package has lower utility bills compared to the same package with mixed-fuel. There is only a small difference between estimated incremental first costs across all-electric and mixed-fuel packages (Figure 8). This holds true for all package goals except ZNC. Similarly to net utility bills, annualized energy related cost show a clear trend: typically, each all-electric ZNE and ZNC package comes with a lower cost than the same package with mixed-fuel options (Figure 9). From these three observations, if a ZNE package is desired, it appears that the all-electric option has better financial metrics compared to mixed-fuel.

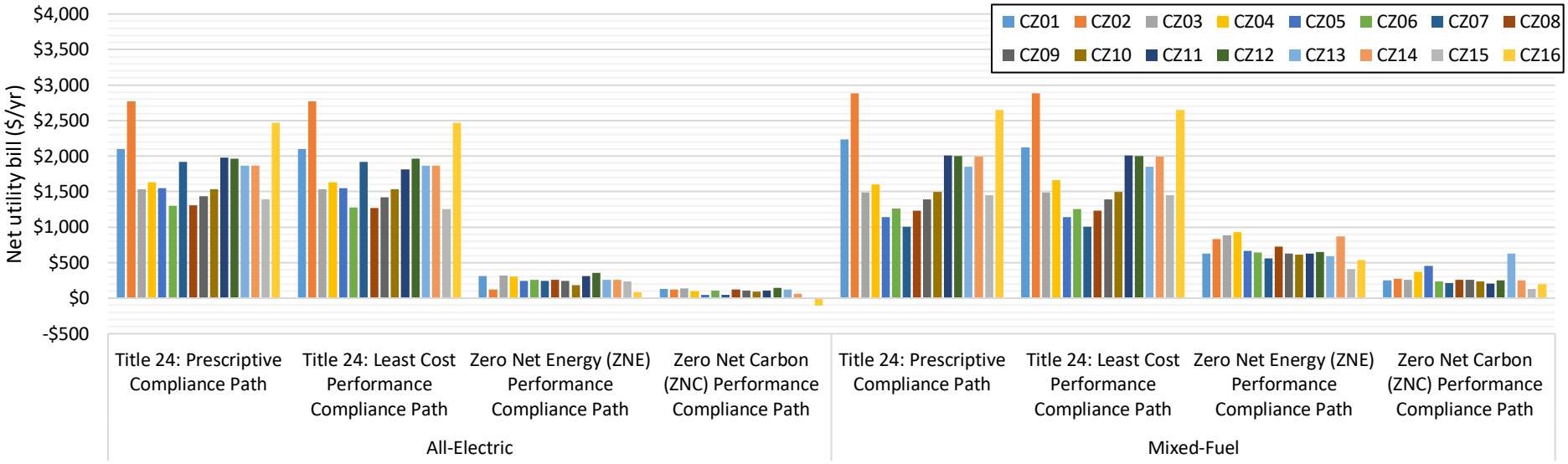

Figure 10. Net utility bill trends for two-story, single-family packages

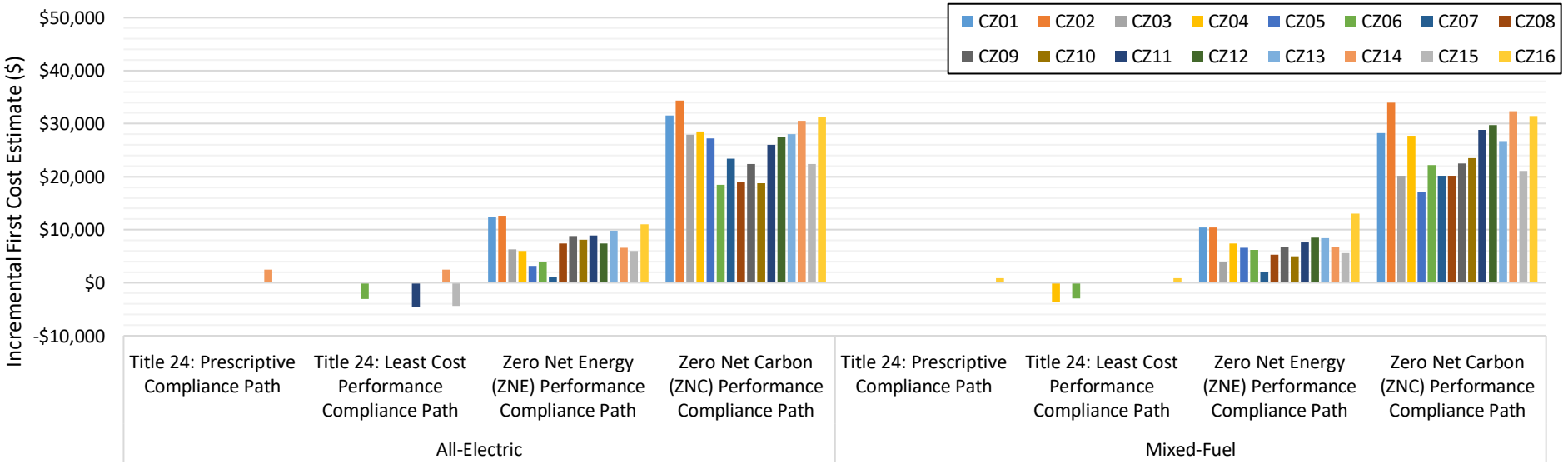

Figure 11. Incremental first cost estimate trends for two-story, single-family packages

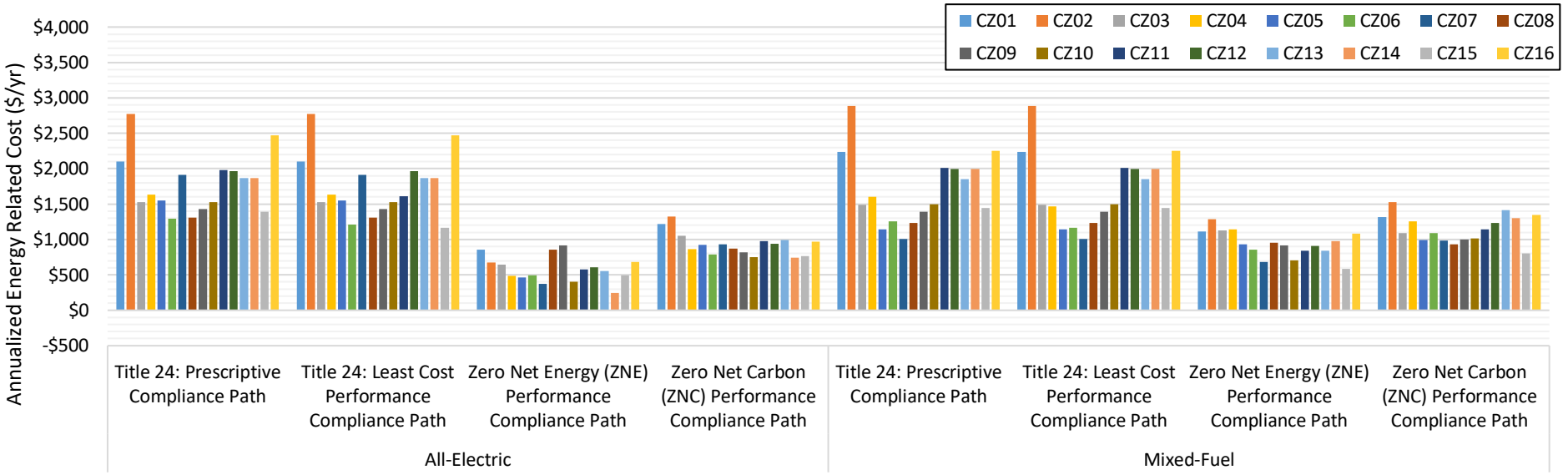

Figure 12. Annualized energy related cost trends for two-story, single-family packages

Observations comparing all-electric to mixed-fuel options

For two-story, single-family home packages, net utility bills (Figure 10) show a clear trend: each all-electric ZNE and ZNC package has lower utility bills compared to the same package with mixed-fuel. There is only a small difference between estimated incremental first costs across all-electric and mixed-fuel packages (Figure 11). This holds true for all package goals except ZNC. Similarly to net utility bills, annualized energy related cost show a clear trend: typically, each all-electric ZNE and ZNC package comes with a lower cost than the same package with mixed-fuel options (Figure 12). From these three observations, if a ZNE package is desired, it appears that the all-electric option has better financial metrics compared to mixed-fuel.

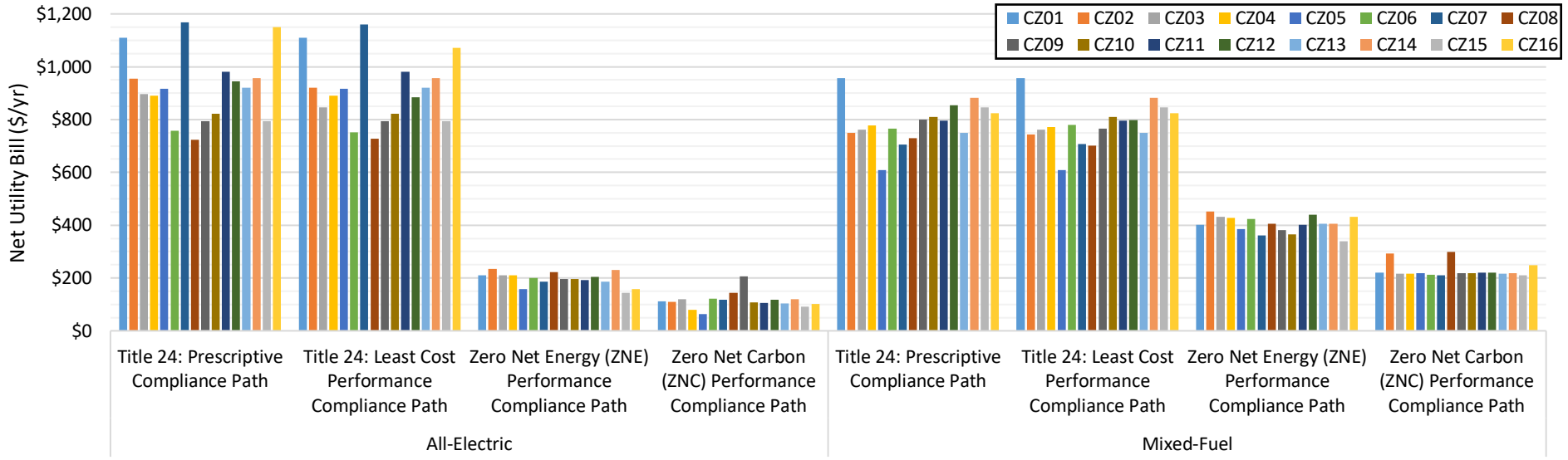

Figure 13. Net utility bill trends for multi-family packages

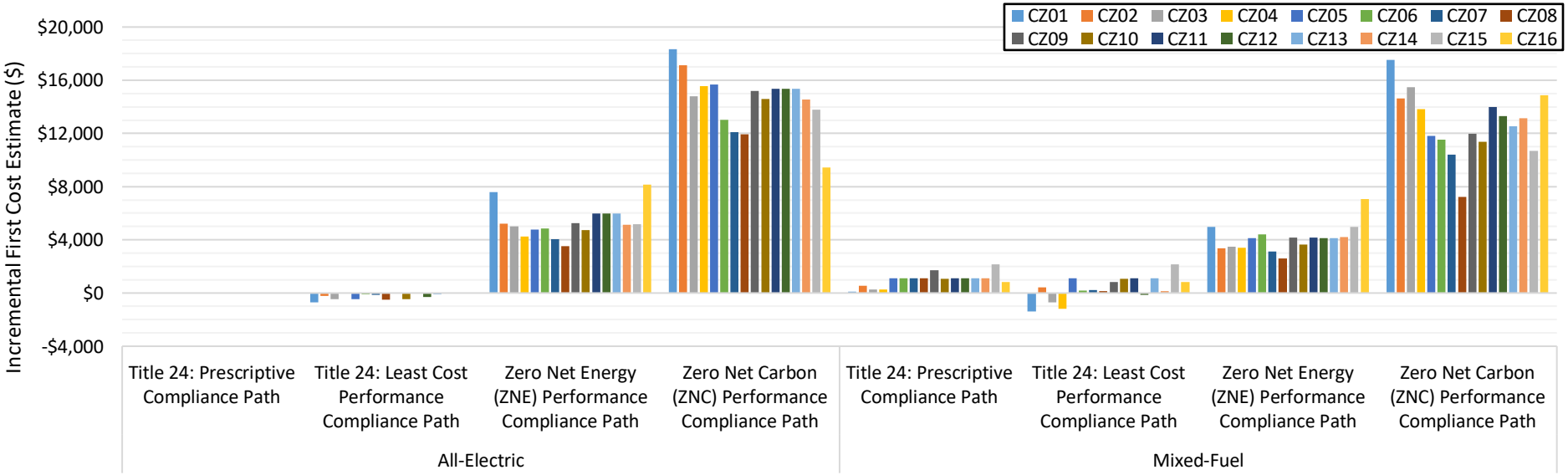

Figure 14. Incremental first cost estimate trends for multi-family packages

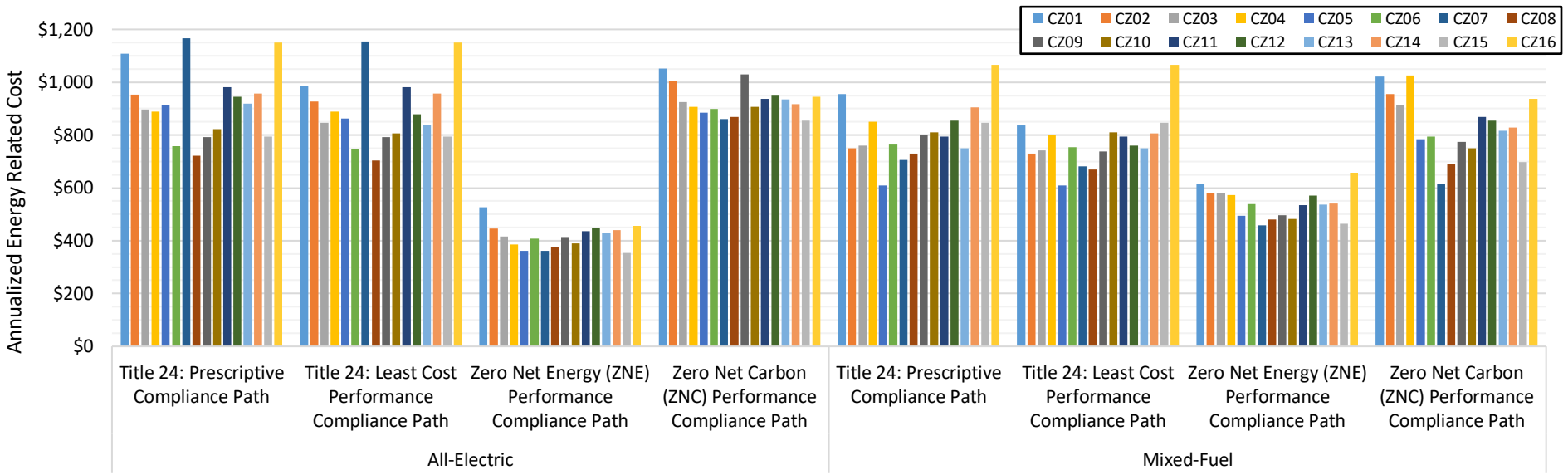

Figure 15. Annualized energy related cost trends for multi-family packages

Observations comparing all-electric to mixed-fuel options

For multi-family home packages, net utility bills (Figure 13) show a clear trend: each all-electric ZNE and ZNC package has lower utility bills compared to the same package with mixed-fuel. There is only a small difference between estimated incremental first costs across all-electric and mixed-fuel packages (Figure 14), for Title 24: Prescriptive Compliance Path and Title 24: Least Cost Performance Compliance Path. Similarly to net utility bills, annualized energy related cost show a clear trend: typically, each all-electric ZNE package comes with a lower cost than the same package with mixed-fuel options (Figure 15).

Observations on Selected Features

When the least first costs packages were run through CBECC-Res to verify compliance with the code, 42% of the least first costs packages had to be reverted to base packages because there we no packages less expensive than the first costs of the base case packages. This was equally true for mixed fuel and all-electric designs. This supports the fact that Title 24 prescriptive and minimum performance compliance paths should be providing packages that closely resemble each other with minimum scope for arbitrage. There were very few Site packages (least annualized life cycle cost) that had to revert back to base design indicating that with higher first cost investments, the owner could choose efficient regulated loads which would lower the life cycle costs.

Some patterns emerge from features in the 96 fact sheets.

- Analysis found that wall insulation and window U-Factor / SHGC were most often reduced, and attic insulation was most often increased.
- Unvented attics are widely cost-effective for above-code projects and even for code-minimum projects.
- Analysis found numerous unregulated loads (lighting and appliances) to be very appealing targets for energy efficiency upgrades.
- Heat pumps appear to be cost-effective across the majority of the state relative to gas furnace split systems in multi-family buildings and in beyond-code single family buildings.
- Slab insulation appeared in the optimizations quite often, suggesting that this feature deserves more study
- Upgraded hot water insulation appears to be widely cost-effective
- High-performance “skinny triple” windows and high-gain windows are highly cost-effective and sensitive to climate zone and Carbon reduction goals

This rest of this section discusses trends for individual feature categories.

Walls

Walls were the feature most frequently downgraded during the course of optimization work, indicating that they are not as compelling as other features modeled in this project. The prescriptive package has continuous insulation in all 16 CZs, but the code minimum optimizations removed the continuous insulation in 22% of the single-family home models. Cavity insulation levels were downgraded in an additional 23% of cases, such as substituting R-19 batts for R-21. In the remaining 55% of cases, the prescriptive high-performance wall was retained by the optimizations. Multi-family optimizations retained the continuous insulation but downgraded from 2x6 R-21 to 2x4 R-15 in 34% of cases.

Even the site energy optimizations downgraded wall insulation and reallocated some cost to other more impactful features. A full 42% of single-family site packages removed continuous insulation from the walls.

When CO_2 is the optimization goal and cost is less of a constraint, the optimizations upgraded the wall insulation and retained the continuous insulation. R-23 in the cavity was most common in the Max CO_2 packages, and R-4 was the most common continuous insulation in most climate zones. In more extreme climate zones and in all-electric optimizations, the continuous insulation was typically upgraded to R-6 polyisocyanurate.

Attics

Attics were the most often upgraded features in the entire simulation process. The optimal designs seem sensitive to many other factors, including HVAC system, optimization target, and CZ. The code minimum packages generally retained the prescriptive standard high-performance attic (R-38+R-19 in most CZs), but 1-story homes upgraded to unvented R-38 attics in 22 % of cases and 2-story homes did not. This probably reflects the greater ratio of surface area of the attic in 1-story homes than in 2-story homes.

Site packages upgraded to unvented R-38 attics in 83% of single-family models. This is an overwhelming sign that unvented attics have a key role to play in energy savings in California homes.

CO_2 optimizations also chose R-38 unvented attics most commonly and added R-8 continuous insulation above the roof deck in addition in most cases. R-49 ceiling insulation plus continuous insulation above the roof deck was a popular choice in more temperate climate zones.

Multi-family buildings were a different case than single-family, as their HVAC systems are located in conditioned space. This yields smaller energy savings from upgrading attic insulation. Still, 25% of multi-family buildings upgraded to R-49 attic insulation for the code minimum package and 47% upgraded to R-49 for the site optimal package. The Max CO_2 packages chose a variety of upgrades, including R-49+R-8 above roof deck, R-49, and R-38 unvented, in declining order of frequency.

These findings suggest that energy modeling should consider multiple attic designs once the other home energy features have been optimized as a final check, since these are so commonly changed in the optimizations. Unvented attics deserve special consideration.

Roof

All options for roof construction in the feature pool assume concrete tile with an air gap, as this was seen as the predominant choice in the state. Two upgrades were available to all models: cool roof tile and radiant barrier, which can reduce space conditioning energy. Code minimum models selected radiant barrier roughly half of the time, and Max CO_2 models chose radiant barriers 61% of the time. Cool Roof tile, which is prescriptively required in CZ10-15, was chosen in those climate zones for the code minimum package, but typically not in Max CO_2 packages. Cool roofs were also

chosen occasionally in CZ 1-9, especially in multi-family building site and Max CO_2 packages with less attic insulation. The calculations on cool roof represent a trade-off between reduced summer cooling energy and increased winter heating energy, making this a highly variable feature with interactions with numerous other features of the house.

Slab Insulation

This little-used technique was selected in 22% of site 1-story models and 59% of Max CO_2 models, suggesting that it is worth further study. Surprisingly, the Max CO_2 models were more likely to use under-slab insulation than slab-edge insulation, despite the significantly higher cost. Under-slab insulation is not currently supported by the California residential compliance software. Slab-edge insulation is enabled in the performance modeling software, and is only prescriptively required in CZ16 in the 2019 energy code in slabs without radiant heating. In the 2-story and multi-family above-code models, some option of slab insulation was selected only 16% of the time, likely because the ratio of slab surface area to conditioned floor area is half what it is in 1-story homes. Climate zones most likely to select slab insulation were 1,2,3, and 4.

Windows & Doors

Windows were a common downgrade in code minimum models and a common upgrade in site and Max CO_2 packages. With the choice between 2016 prescriptive standard glazing (U-Factor = 0.32 / SHGC = 0.25), 2019 standard (0.30 / 0.23), high gain (0.30 / 0.50), and high performance (0.24 / 0.22), the optimizations made heavy use of window options. In half of code minimum models and site models, 0.32 / 0.25 fenestrations were used, as they have a slightly lower cost and similar performance. In climate zones 1,3,5, and 16, where there is no prescriptive maximum SHGC for windows in recognition of the fact that high-gain windows save energy there, high-gain windows were overwhelmingly chosen in all packages. High-gain windows were often selected in CZ 2 and 4, as well. Max CO_2 packages selected high performance (0.24 / 0.22) windows in most climate zones that are not heating dominated and chose high-gain (0.30 / 0.50) windows elsewhere. Site packages chose high-performance windows occasionally in single family models and in CZ 11-15 multi-family models. These results indicate that high performance “skinny triples” have a role to play in CO_2 reduction, and high-gain windows are an important tool for compliance in CZ 1-5 and 16.

Heating & Cooling

Mixed fuel Least Cost packages chose code minimum 14 SEER / 80 AFUE split systems in 65% of CZs, heat pumps in 16% of cases (all multi-family), upgraded the heater to 93% AFUE in 15% of CZs, and upgraded cooling to 16 SEER in just 6%. For ZNE packages, Table 4 shows the result for space conditioning system selection in mixed-fuel homes (for all-electric homes, heat pump is the only available system type). For comparison, the second column shows the heating degree days (base 65 °F) as tabulated for CEC Climate Zones as per the Database of Energy Efficiency Resources

2014 update (DEER 2014). Typically, in climate zones with larger number of heating degree days per year, the selection was a heat pump. In other words, the recommended measure in those cases is to convert the mixed-fuel space conditioning system to an all-electric system. But this is not always the case, and there is variation across the building types.

Table 4. Selected space conditioning system for ZNE packages

Climate zone	Heating degree days	1-Story Single Family, ZNE	2-Story Single Family, ZNE	Multi-family, ZNE
CZ01	5,094	Heat pump	Heat pump	Heat pump
CZ02	3,835	Heat pump	Heat pump	Heat pump
CZ03	3,257	Heat pump	Gas furnace & AC	Heat pump
CZ04	3,050	Heat pump	Gas furnace & AC	Heat pump
CZ05	3,715	Gas furnace & AC	Gas furnace & AC	Gas furnace & AC
CZ06	2,013	Gas furnace & AC	Gas furnace & AC	Gas furnace & AC
CZ07	1,478	Gas furnace & AC	Gas furnace & AC	Heat pump
CZ08	1,702	Gas furnace & AC	Gas furnace & AC	Heat pump
CZ09	2,000	Gas furnace & AC	Gas furnace & AC	Heat pump
CZ10	2,240	Gas furnace & AC	Gas furnace & AC	Heat pump
CZ11	3,027	Heat pump	Heat pump	Heat pump
CZ12	3,122	Heat pump	Heat pump	Heat pump
CZ13	2,794	Heat pump	Gas furnace & AC	Heat pump
CZ14	3,322	Heat pump	Gas furnace & AC	Heat pump
CZ15	1,102	Heat pump	Gas furnace & AC	Gas furnace & AC
CZ16	5,578	Heat pump	Heat pump	Gas furnace & AC

This suggests that heat pumps have an important role to play in energy efficiency independent of their necessary inclusion in all-electric homes. Upgraded split systems were chosen by the optimizations with Site and CO_2 targets in most non-heat pump cases – either 16 SEER, 93% AFUE, or both.

In all-electric optimizations, the economy heat pump was chosen almost all CZs for code minimum packages, but the upgraded heat pumps were chosen in all Max CO_2 packages and 56% of Site packages. Ductless minisplits were selected in almost every case in Multi-family Max CO_2 mixed fuel and electric models and in CZ2 and 15 1-story Max CO_2 mixed fuel packages.

Ventilation

Given the opportunity to select exhaust ventilation, supply ventilation, or enhanced ventilation with an HRV, the code-minimum packages used exhaust ventilation in almost every case. Site and Max CO_2 packages chose supply ventilation in all but the mildest CZs. Balanced ventilation was used in all multi-family models to comply with the 2019 energy code requirements. Heat recovery ventilators were available to be chosen by

the optimizations but were very rarely chosen, indicating that the energy savings are small relative to the incremental cost.

Water Heating

A standard tankless gas water heater was used in almost every code-minimum mixed fuel package. Upgraded 0.95 EF tankless gas water heaters were chosen in 19 % of Site packages and all Max CO_2 packages. R-5 water line insulation proved more cost-effective than upgrading the water heater and was also chosen in the majority of above-code cases, although this upgrade is not currently supported by the California compliance modeling software.

The all-electric packages used the 50 gallon 2.4 COP heat pump base model in every case, except the Max CO_2 packages, which upgraded to 3.2 COP models in the 1-story home in CZ 1,2,3,5,6, and 7, 2-story 7 and 8, and MF all CZs. The upgrades were likely due to the higher efficiency rating more than the larger storage capacity.

Lighting

LED lighting upgrades were selected in most Site and Max CO_2 packages, but CFL lighting was selected in virtually all code minimum mixed fuel packages and electric packages. This finding suggests that upgrading lighting may be a more cost-effective option than many other options available within the set of energy loads regulated by the California energy code. Residential lighting is not currently supported by the California compliance modeling software.

Appliances

Upgraded refrigerators and dishwashers were often chosen in all packages as more cost-effective than regulated load options that reduce space conditioning and water heating energy use.

Electric appliances were very rarely selected for Mixed Fuel packages, as their cost benefit calculation was not helpful to the optimization. Site and Max CO_2 all-electric packages selected upgraded electric induction cooktops and heat pump clothes dryers in approximately half of the CZs. Appliances are not currently regulated loads and are not supported in the California compliance software.

Air Sealing

This analysis included an option to upgrade building envelope air-tightness from 5 ACH50 to 3 ACH50. This was chosen in the multi-family CO_2 optimizations 66% of the time in all but the most temperate climate zones. This option was rarely chosen otherwise. This feature is supported by the current California compliance modeling software and suggests that it is far more beneficial in the multi-family case than single-family.

Conclusion

The primary objective of the ZNE Cookbook project was to provide easy to use building feature packages that could meet high-performance goals such as ZNE and ZNC. This project fulfilled the objective by developing easy-to-use fact sheets where the users can pick the packages based on the three key financial metrics: annual energy bills, first cost and annualized life cycle cost. Additionally, the process followed in developing these fact sheets is scalable to retrofits, other building types and other high-performance goals. The building features presented in this effort do not include energy storage and demand response measures. These measures should be considered in future efforts.

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Appendix 1. Clarification of optimization

Four basic package goals

The basic package goals can be summarized by this table.

Variant	Objective	Resource constraint	Code compliance constraint	Starting from
1. Base package	N/A	N/A	Prescriptive path	CEC building prototype
2. Least first cost	Minimize first cost	N/A	Performance path (positive annual TDV energy savings)	Base package
3. Zero net energy	Minimize annualized life cycle cost	At least 100% annual TDV energy savings from EE+PV	Performance path	Base package
4. Zero net carbon	Maximize annual carbon savings from EE features	At least 100% annual carbon savings from EE+PV	Performance path	Base package

Packages 1 and 2 are provided as references for possible baseline features and costs, representing default assumptions in code compliance software, and most likely builder defaults. Package 2 is optimized by selecting the energy efficiency features that yield the lowest installation or first costs, while still satisfying code compliance requirements.

From the perspective of the performance approach, code compliance is equivalent to positive (at least zero) annual energy savings relative to the base package, when energy savings are evaluated by the compliance software. In this project, the simulation engine (BEopt) differs from the compliance software (CBECC-Res) in some subtle ways that allow it to generate buildings with positive annual energy savings that are nevertheless not code compliant. (The purpose of the simulation engine in this project must be to give the most realistic energy usage and utility costs, looking beyond the focused regulatory requirements of compliance software, so it is not possible to use the compliance software for optimization here.) Reflecting this subtle distinction, this project treats code compliance as a two-step process. First, the Package 2 search looks first for positive energy savings. And second, the authors take any final package developed as a result of an optimization run, then perform a manual check using the compliance software, and resolve compliance issues on a case-by-case basis.

For packages 3 and 4, the basic definition of an optimal building is:

> Given a building template in a given climate zone, select the energy efficiency feature package, the sizing of the rooftop solar PV system, and a battery/no-battery option that minimizes the cost of ownership annualized over a 30-year period, and that satisfies code compliance and a resource savings goal (zero net energy or zero net carbon).

In mathematical terms, annualized cost is the objective to be minimized, and the resource savings goal is a constraint. The details are consistent with the Building America Protocols and life cycle cost analysis implementation in BEopt. The cost of ownership includes the incremental cost (over the base package) to install and maintain efficient features, as well as utility costs. First year utility cost is evaluated using a realistic time-of-use rate structure. Life cycle cost is evaluated with a cash flow analysis by assuming a 30-year mortgage at present interest rates to cover 100% of installation costs, applying inflation to replacement and maintenance costs, scaling first year utility bills by compounding an annual fuel escalate rate, and converting the cash flows to present value at the current discount rate. Individual product lifetimes use the BEopt defaults (which in some cases may differ from CPUC DEER values). Through the rest of this section, "cost" will refer to annualized cost of ownership.

BEopt's optimization engine displays progress by plotting intermediate packages on a resource savings vs cost plot, and by drawing a *Pareto optimal curve* showing the most cost-effective package after each iteration stepping toward greater resource savings. The Pareto optimal curve is the bold line highlighted in plots from BEopt.

Modified sequential design strategy

The basic definition for building optimization is consistent with previous publications on the topic of zero net energy design. However, this project introduces a key modification in the optimization methodology by splitting the design process into sequential steps for energy efficiency feature package, followed by solar PV sizing and battery selection. The project team justifies this modification on the basis that it will save CPU time and comply with loading order.

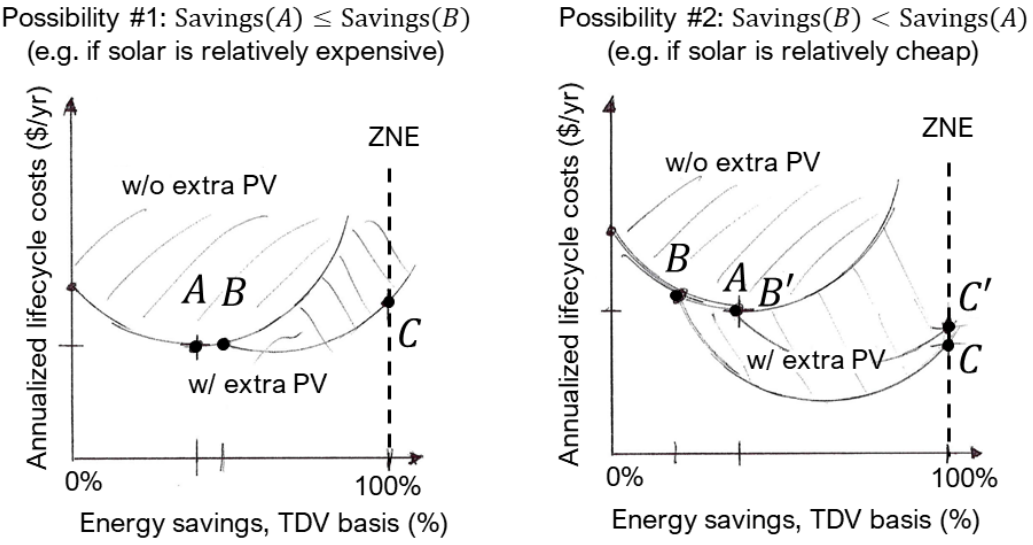
For background, note that the basic definition above treats selection of energy efficiency measures and solar PV sizing with equal priority. BEopt implements solar PV options similar to other features, by allowing only a predefined list of options for array size to be passed into optimization. This means that a BEopt optimization run typically progresses by first generating packages that increase the investment in energy efficiency one measure at a time until adding solar PV becomes more cost-effective than any design measure. Then, from this *solar PV takeoff point*, the optimization engine will end up adding more solar PV (to predefined nominal power levels) at each iteration to close the gap from efficiency upgrades to 100% resource savings. One result of this process (as implemented by BEopt) is that a given package of energy efficiency measures can run through simulation several times, with varying solar PV array sizes. This leads to a computational burden for re-running the building model, which could potentially be avoided.

Additionally, if solar PV is cheap enough, the optimization engine may trade out otherwise cost-effective energy efficient features to get 100% energy savings *at least cost*. To put this in context, consider the subset of possible designs having only the minimum amount of solar PV power as required by code compliance. This set of "min solar" designs could be summarized with its own Pareto optimal curve on the cost vs. resource savings plot. Along the min solar optimal curve, consider these two points: The design point (A) with minimum annualized cost represents the most cost-effective EE

feature package given the fixed solar design. The solar PV take-off point (B) is where the min solar optimal curve diverges from the overall optimal curve (allowing greater PV). Now, by definition Cost(A) ≤ Cost(B). Then there are two possibilities:

- Possibility #1. Savings(A) ≤ Savings(B). This could occur if increasing solar power is relatively expensive compared to other design options that increase resource savings near points A and B. As a result, the cost-optimized design (C) for 100% resource savings (including additional solar PV beyond the minimum) can attribute at least as much resource savings to energy efficiency measures as point A.
- Possibility #2. Savings(B) < Savings(A). This could occur if increasing solar power is relatively cheap compared to other design options near points A and B. As a result, the cost-optimized design (C) for 100% resource savings likely does not achieve as much savings through energy efficiency alone as point A.

The second outcome yields a design that is considered undesirable because the investment in energy efficiency is less than the level that would be most cost-effective if solar PV array size were fixed. In keeping with a popular principle for ZNE design referred to as *loading order*, the final package should provide at least as much resource savings through energy efficiency alone as the minimum cost point with min solar, in order to guarantee that the design does not reduce efficiency in favor of increasing solar PV. This is a requirement beyond what can be expressed concisely in the basic optimization definition.



So instead of optimizing feature package and solar PV simultaneously, this project adopts a sequential design process. During the optimization run, the analyst fixes the solar PV sizing to the minimum code requirement (varying by climate zone and building size) and develops the Pareto optimal curve for the min PV design subset. The initial design step now requires the analyst to select a design point (B') as the "best" energy efficient feature package from among the packages generated by the optimization cycle with min solar. In a post-optimization step, the analyst then simply calculates the

additional solar PV sizing needed to satisfy the resource savings goal (ZNE or ZNC). In this project, the analyst rounds up the total solar array size to an integer number of panels (230 W nominal power each). The analyst then runs the full-size solar PV design (C') through BEopt to confirm 100% resource savings, and to evaluate utility bills and economics. This modified process both reduces computation and allows the analyst to guarantee that loading order is satisfied.

The "best" energy efficient feature package (hereafter just the EE feature package) described so far is not uniquely defined. It should be one that approximates the *optimal solar PV takeoff point* (B) that would be identified by a full optimization process, or the least-cost design with code min PV (A) if Savings(B) < Savings(A). By choice, the project team has chosen to pick the EE feature package to be the same as the one with the lowest annualized cost of ownership, assuming min solar PV (B' = A). This is a conservative choice that does not depend on changes in solar PV unit prices or relative cost of energy from utilities. To eke out the bleeding edge design (for ZNE or ZNC), builders may want to extend the process and consider a few of the optimal min solar designs with greater resource savings (Savings(B'') > Savings(A)), to determine whether a small increased investment in efficiency and reduction of solar array size could be cost-effective for the customer.

Simulation practices and package goal interpretations

For packages #3 and #4, the discussion above on the modified optimization definition is independent of the resource being targeted for 100% savings. As a result of the simplification for sequential design, despite the appearance of resource savings in the graphs in BEopt, the optimization should be viewed as strictly a cost optimization, and so optimization method for this project picks identical EE feature packages for goals #3 and #4. Based on the same EE feature package, what differs is that to design a zero net carbon home typically requires a larger solar PV array than the design for zero net energy.

Package goal #5 is presented to provide more information to help builders considering ZNC design options. Rather than making the same conservative choice for the EE feature package based on cost optimization, this package is based on the EE features that maximize annual carbon savings with min solar as the initial design step, then with additional solar PV to reach 100% carbon savings. The initial feature package can also be selected by the analyst from the data generated by the optimization run for packages #3 and #4, without additional computational burden for optimization.

Revisiting package goal #2, the cheapest compliant build, note that BEopt does not offer a quick option to optimize first cost of installation. It could be forced to optimize first costs by setting all energy prices to zero and all feature lifetimes to 30 years, but this would be impractical due to the amount of time for setup and CPU time required. Instead, the project team uses data on first costs from the set of designs generated during the optimization run for package goals #3 and #4. Unfortunately, BEopt does not allow the analyst to view first costs of installation directly on the plots, so the team has developed work-around methods to perform the selection for package #2.

Appendix 2. Economics parameters

Life cycle cost analysis of each building design was performed automatically by BEopt. SCE determined the following parameters to be reasonable estimates for residential new construction and buyers in California, based on information available in 2019.

Category	Parameter	Value
Life cycle cost analysis options	Analysis period	30 years
	Annual inflation rate	2.4%
	Real discount rate (annual)	3.0%
	Fuel escalation rate, electric (annual)	2.0% above inflation
	Fuel excalation rate, natural gas	4.0% above inflation
Financing options	Down payment	0%
	Fraction of initial costs covered by financing	100%
	Mortgage period	30 years
	Nominal loan interest rate (annual)	5.0%
	Federal marginal tax rate	28%
	Mortgage interest payments claimed as tax deduction	Yes
Tax credits	PV tax credit	30% of system capital cost

The details of how BEopt performs life cycle cost analysis is documented in the help file installed with the program. A few key points are restated here for clarity:

- Life cycle costing begins by creating a table of payment streams for years 1 through 30. Then, each nominal payment stream is discounted to net present value based on nominal discount rate (which is calculated from real discount rate, compounded with inflation). The net present values are totaled across all years, and then multiplied by the uniform cost recovery factor to determine the annualized cost. The annualized cost is a single value representing the equal annual payment that would be made each year (1 to 30) such that the net present value of these equal payments is equal to the net present value of simulated payment stream (which varies from year to year).
- BEopt simulates these payment streams: loan principal, loan interest, replacement cost, utility bill, loan tax deduction, residual value, incentives, tax credits, and cash payments.
- The size of the loan is equal to the capital costs, determined from all the features selected in the design and uninflated.
- Each individual feature has a product lifetime. When the feature reaches end of life, a replacement cost is incurred, which is the modeled as the initial cost with inflation. Some permanent design features have a lifetime greater than the analysis period.
- For the Cookbook, the default feature lifetimes from BEopt were typically adopted without changes. These are based on research by NREL and DOE for its Building America program, and are not linked to California regulatory frameworks.

- At the end of the analysis period, features with remaining life are credited with a residual value, which is prorated from the inflated cost at the end of the analysis period.
- Utility bills in a given year, i, are based on the building energy simulation and rate plans, adjusted by compounding inflation and fuel escalation over i periods.
- For a given building, BEopt defines annualized energy-related cost as the sum of annualized costs, using full cost of utility bills and incremental costs for all other payment streams relative to a reference building design. Therfore, this metric is specific to the building instance because the reference building costs depend on building template variant, climate zone, and fuel option.

Rate structures

Simplified versions of TOU rate structures from the predominant IOU in each climate zone were used. Generation from solar PV was net metered, with exported energy credits rolled over monthly to the end of the simulated year, and annual sellback at $0.03/kWh.

Climate zone	Electric fuel rate	Mixed fuel rate
CZ01	PG&E E-TOU-B	PG&E E-TOU-B
CZ02	PG&E E-TOU-B	PG&E E-TOU-B
CZ03	PG&E E-TOU-B	PG&E E-TOU-B
CZ04	PG&E E-TOU-B	PG&E E-TOU-B
CZ05	PG&E E-TOU-B	PG&E E-TOU-B
CZ06	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ07	SDG&E TOU-DR1 (2)	SDG&E TOU-DR1 (2)
CZ08	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ09	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ10	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ11	PG&E E-TOU-B	PG&E E-TOU-B
CZ12	PG&E E-TOU-B	PG&E E-TOU-B
CZ13	PG&E E-TOU-B	PG&E E-TOU-B
CZ14	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ15	SCE PRIME (HPWH or battery)	SCE TOU-D 4-9
CZ16	PG&E E-TOU-B	PGE E-TOU-B

Appendix 3. BattSim overview and battery model assumptions

For the Cookbook, battery charging and discharging was simulated using BattSim v1.0, by Ryan McFadyen (SCE), a workbook-based calculator.

Limitations

The BattSim calculator is intended to be used for simple analysis only. As such, it allows a user to input characteristics of battery capacity and charge/discharge power, charging efficiency, discharging efficiency, time step, and an option for battery control strategy. Then, the user inputs three columns of time series data: timestamp, load, and PV production. In typical usage, this time series data is taken from hourly output files generated by a building energy simulation that does not include a battery simulation. The time series typically covers a period of one year.

The BattSim tool does not simulate capacity degradation or power degradation over time based on number of cycles, nor does it attempt to calculate an end-of-life for the battery based on the usage pattern it creates. The output of the tool is simply the time series for the net load of the building with the added battery (including usage, PV production, and battery).

BattSim algorithms

Title 24 allows a battery storage system to be claimed as a compliance credit and as an exception to PV requirements (Residential Compliance Manual, Section 7.5). Among the requirements that the code places on a battery storage system is one that its control strategy falls into one of three predefined categories, or is a custom strategy approved by the CEC.

The battery simulation workbook, BattSim, offers five battery control strategies. The first three strategies correspond to the predefined Title 24 controls strategies, and the others are intended to create grid impacts tailored to address grid operation challenges (peak load, and grid net demand peak).

- Basic Control: aims to use the battery to increase self-utilization of PV generation. At any given time, discharges to meet building loads that exceed PV generation, but never exports from battery to grid.
- Time-of-Use (TOU) Control: aims to use the battery to .
- Advanced DR: Accepts a control signal from utility or third party aggregator, and allows discharge to the grid triggered by a demand response signal. For this control strategy, the user must input a region from the list of CEC climate zones.
- Peak Shave: not covered here.
- Lean Duck: not covered here.

For the Cookbook analysis, only basic control was applied.

BattSim implementation details

Hourly update equation

The general update equation is of the form:

$$C_{h+1} = C_h + \left(\eta^{in} P_{h+1}^{in} - P_{h+1}^{out}/\eta^{out}\right) \cdot \Delta t$$

where

- instantaneous values are indicated by a timestamp subscript, h, representing the number of hours since the start of the year;
- values averaged or integrated over an interval between two timestamps (h and $h+1$) are indicated by subscript $h+1$;
- C_h = Charge level at timestamp h (kWh), with initial value C_0 = 0 kWh;
- P_{h+1}^{in} = Power draw during charging, average from h to $h+1$;
- P_{h+1}^{out} = Power delivered to loads during discharging, average from h to $h+1$;
- η^{in} = charging efficiency;
- η^{out} = discharging efficiency;
- and Δt = timestep.

During any given time step, the battery is assumed to be either in charging or in discharging mode. The power flow (kW) into the battery circuit (as measured at the panel) is described by a variable, F, which is a signed variable with sign indicating direction of power flow (positive for charging mode, negative for discharging). Thus,

$$P^{in} = \max(0, F)$$
$$-P^{out} = \min(F, 0)$$

Each battery charge control algorithm supplies a signal, R, a signed variable representing a charge power request (kW), which is unconstrained. The inverter is assumed to set F equal R except when doing so would violate the battery's physical constraints. In other words,

$$F = \begin{cases} \max(R, -P^{out,max}, -D/\Delta t), & R \leq 0 \\ \min\left(R, P^{in,max}, E/\Delta t\right), & R > 0 \end{cases}$$

where $P^{in,max}$ is the maximum charging power (kW), $P^{out,max}$ is the maximum discharging power (kW), D is the maximum available discharge capacity (kWh), and E is the maximum available charge capacity (kWh) given the current charge level. That is,

$$D = \eta^{out} C$$
$$E = (C^{max} - C)/\eta^{in}$$

where C^{max} is the storage capacity or maximum charge level of the battery (kWh). Note that by default, BattSim calculates values for maximum charge and discharge power based on a time to fully charge or discharge the user-input storage capacity, hard-coded to be approximately 2.4 hours based on the BattSim author's experience with typical products. The user can override these charge and discharge power limits.

Each charge control algorithm is a function of:

- L, building load (kW) as a positive number indicating usage;
- V, PV production (kW) as a negative number indicating production;
- And N, net load, $N = L + V$.

Basic control

The charge requested by the basic control algorithm is:

$$R = -N$$

TOU Control

For this control strategy, the user must input a single range of months and a single range of daily hours that represent the peak period of the TOU rate.

The charge requested by the time-of-use control algorithm in BattSim is:

$$R = \begin{cases} -1000\ \text{kW}, & \text{during months and hours peak period} \\ \max(0, -N), & \text{during months when peak period is active, but outside peak hours,} \\ -N, & \text{outside months when peak period is active.} \end{cases}$$

This implementation differs slightly from the Title 24 description of TOU Control. It does not enforce the no-export rule. It defines only one season, to be used for summer peak rate. And rather than *beginning to discharge* at the onset of peak hours, it simply enforces charge-only mode outside of peak hours.

Advanced DR Control

The charge requested by the Advanced DR control algorithm in BattSim is:

$$R = \begin{cases} -N, & \text{TDV mode} = 0 \\ -1000\ \text{kW}, & \text{TDV mode} = 1 \\ -1000\ \text{kW}, & \text{TDV mode} = 2 \\ -V, & \text{TDV mode} = 3 \end{cases}$$

where TDV mode is an integer code at each hour taken from a lookup table (described below), based on historical data in the form of TDV factors. Thus, for this control algorithm, BattSim uses TDV factors as a stand-in to simulate demand response signals. In modes 1 and 2, the battery is allowed to discharge at full power, meeting building loads and exporting any excess power onto the grid. In mode 3, the system takes in all the solar generation and charges the battery, making the solar PV and battery combination otherwise invisible to the grid. And in mode 0, the controls fall back to the basic control algorithm.

TDV Logic Trigger

BattSim includes a lookup table ("TDV Logic Trigger") that provides an integer code for each region (climate zone) and each hour of a reference calendar year (2009). The integer codes are from 0 to 3, and most likely indicate a that TDV factor for that hour exceeds a given threshold. The thresholds and TDV factors are not included in the BattSim tool itself, but are precomputed by the author.

BattSim1 Instructions

Follow these instructions when using the tool:

- Input the battery max capacity (D4) and override the max charge power and max discharge power with actual battery specifications (O5:O6)
- Leave all other simulation controls at the default values (A1:X12)
- Paste the hourly building load without PV (column C)
- Paste the hourly PV production – these values should be negative (column D)
- Net load with PV and battery is given in column U.

Appendix 4. Battery and Peak Draw Analyses Using BEopt Hourly Data

The battery parameters used in BattSim matched those of the Tesla PowerWall, and had the performance characteristics shown in Figure 16, below:

Max Capacity	15	kWh
Max Charge Power	6.3	kW
Max Discharge Power	-6.3	kW
Charge Eff.	95%	
Discharge Eff.	95%	
Initial Charge	0	kWh
Timestep	60	Minutes
Battery Control Strategy	Basic	

Figure 16. A snapshot of the input used in BattSim, which modeled a Tesla PowerWall.

An example of how the battery affects a building's net energy use profile can be found below, in Figure 17. The peak has shifted from 7 PM to 8 PM, and been reduced from 2.75 kW to 2.3 kW and there is flatline energy use from about 8 AM to 7 PM. This analysis of the peak shift due to the battery was done in a post-processing workbook with BattSim.

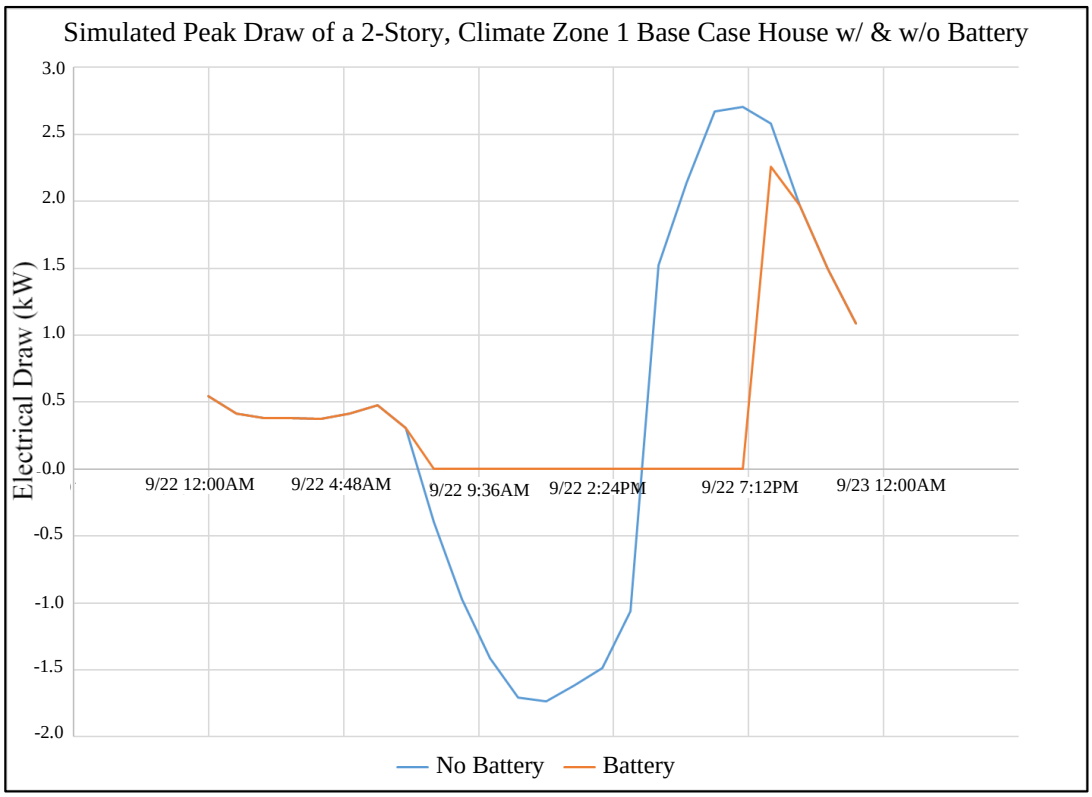


Figure 17. Above are the simulated load profiles for a Base Case, 2-Story, all-electric packages in California Climate Zone 1 (Arcata, CA) with and without a 15 kWh Tesla PowerWall battery.

Appendix 5. Feature categories and options considered for optimization

This section presents the pool of options considered during optimization and the feature categories with which these options were modeled in BEopt.

BEopt offers 92 building feature categories, organized into related groups. Note that some pairs of categories are meant to be mutually exclusive. For example, a central air conditioner and a split system heat pump should not be modeled in the same simulation run. To address this issue, in some categories, BEopt offers an option labeled None. In the fact sheets accompanying this report, such mutually exclusive categories have been condensed to show the unique features that are present.

Note also that provided a building design template, if the template does not include any space type that triggers the need for a certain feature category, then the category will not be applicable to the model. For example, if the template lacks a basement, then no basement options need to be modeled. Also, the template may assign an attic space as unfinished or finished attic, which predetermines whether BEopt allows the user to select options from the unfinished attic category or from the finished attic category. Hence, some feature categories are never used in the Cookbook.

Category Name	**Feature pool options**
Building Group	
Orientation	*Fixed during optimization*
Neighbors	*Fixed during optimization*
Walls Group	
Wood Stud (permanent)	This category represents exterior wall framing and insulation assemblies. • 2x4, 16" on-center (o.c.), R-15 fiberglass batts • 2x6, 16" o.c., R-19 fiberglass batts • 2x6, 16" o.c., R-21 open cell spray foam • 2x6, 16" o.c., R-23 blow-in fiberglass with netting
Wall Sheathing (permanent)	• R-4 expanded polystyrene foam (EPS) • R-5 extruded polystyrene foam (XPS) • R-6 polyiso foam board
Exterior Finish	*Fixed during optimization*
Interzonal Walls	*Fixed during optimization*
Unused categories	Double wood stud, steel stud, concrete masonry unit, structural insulated panel (SIP), insulating concrete form (ICF), other walls
Ceilings/Roofs Group	

Category Name	Feature pool options
Unfinished Attic (permanent)	This category represents attic assemblies including ceiling framing and insulation, roof framing and insulation, and ventilation. • R-30 ceiling fiberglass batt, vented attic • R-38 ceiling fiberglass batt, vented attic • R-38 ceiling blow-in cellulose + R-13 fiberglass batts under roof deck, unvented attic • R-38 ceiling blow-in cellulose + R-19 fiberglass batts under roof deck, unvented attic • R-38 under roof deck open cell spray foam, unvented attic • R-38 under roof deck closed cell spray foam, unvented attic • R-38 under roof deck fiberglass batts, unvented attic • R-49 ceiling blown-in cellulose, vented attic • R-38 under roof deck fiberglass batts + R-8 rigid insulation above roof deck, unvented attic • R-49 ceiling insulation (fiberglass batts or blow-in cellulose) + R-8 rigid insulation above roof deck, vented attic
Roof Material (permanent)	• Tile, medium color, solar reflectance (SR) = 0.15 (modeled via absorptance = 0.85), thermal emittance (TE) = 0.75 or 0.93. • Cool roof tile, white color, solar reflectance (SR) = 0.20 (modeled via absorptance = 0.80), thermal emittance (TE) = 0.75 or 0.92. Please note that home energy performance differs negligibly between roofs with thermal emittance 0.75 and 0.92. Any thermal emittance value shown in the fact sheets is provided merely to clarify the selection used for the energy model.
Radiant Barrier (lifetime 25 years)	• None • Double-sided, foil
Unused categories	Finished roof
Foundations/Floors Group	
Slab (permanent)	• No insulation upgrade • Edge insulation, 18 inches down, R-10 XPS • Whole building slab insulation, R-15 XPS
Carpet	*Fixed during optimization*
Unused categories	Finished / Unfinished Basement, Crawlspace, Pier & Beam, Interzonal floor
Thermal Mass Group	
Floor Mass	*Fixed during optimization*
Exterior Wall Mass	*Fixed during optimization*
Partition Wall Mass	*Fixed during optimization*

Category Name	Feature pool options
Ceiling Mass	*Fixed during optimization*
Windows & Doors Group	
Window Areas	*Fixed during optimization (per CBECC-Res reference models)*
Windows (lifetime 30 years)	All window options have 2 panes and non-metal frames. • U-value 0.32, SHGC 0.25 • U-value 0.30, SHGC 0.50 • U-value 0.30, SHGC 0.23 • U-value 0.24, SHGC 0.22
Interior Shading	*Fixed during optimization*
Door Area	*Fixed during optimization*
Doors	*Fixed during optimization*
Eaves	*Fixed during optimization*
Overhangs	*Fixed during optimization*
Airflow Group	
Air Leakage	• 5 ACH50 (air changes per hour at 50 Pascal) • 3 ACH50
Mechanical Ventilation	All ventilation options use the flow rates from 2013 ASHRAE 62.2, with infiltration credit. • Standard bathroom exhaust fans only • Supply fans only • Heat recovery ventilator, 80 CFM, 65 W, 72% recovery • Heat recovery ventilator, 160 CFM, 140 W, 72% recovery • Balanced ventilation, 27 W
Natural Ventilation	This category is mutually exclusive with mechanical ventilation, so all packages specify natural ventilation as "None."
Space Conditioning Group In this group, BEopt offers feature categories that each define a specific piece of HVAC equipment. BEopt enforces mutual exclusion rules, so the HVAC system consists of one of these combinations of features: • If Central AC and Furnace are specified, then Central Air Source Heat Pump and Mini-split Heat Pump are shown in the package as "None." • If Central Air Source Heat Pump is specified, then other systems are "None." • If Mini-Split Heat Pump is specified, then other systems are "None" and Ducts are "None."	
Central Air Conditioner	• 14 SEER / 12.2 EER • 16 SEER / 14 EER • 16 SEER / 14 EER, 2-stage
Furnace	• Gas, 80% AFUE

Category Name	Feature pool options
	• Gas, 92.5% AFUE
Central Air Source Heat Pump	• 14 SEER / 8.5 HSPF • 16 SEER / 9.5 HSPF
Mini-Split Heat Pump	• 17.5 SEER ductless, 10 HSPF
Ducts	• Ducts installed in conditioned space only, w/o insulation • Ducts in unfinished attic having 5% leakage and R-6 insulation • Ducts in unfinished attic having 5% leakage and R-8 insulation
Ceiling Fan	*Fixed during optimization*
Dehumidifier	*Fixed during optimization*
Unused categories	*Boiler, electric baseboard, ground source heat pump*
Space Conditioning Schedules	
Cooling Set Point	*Fixed during optimization*
Heating Set Point	*Fixed during optimization*
Humidity Set Point	*Fixed during optimization*
Water Heating	
Water Heater	• Gas Tankless, 0.82 energy factor (EF) • Condensing gas tankless, 0.95 EF • Electric heat pump water heater, 2.4 COP, located in garage (50 gallon typical) • Electric heat pump water heater, 3.2 COP, located in garage (80 gallon typical)
Distribution	• PEX trunk & branch, code-minimum insulated hot water lines • PEX trunk & branch, R-2 insulation on hot water lines • PEX trunk & branch, R-5 insulation on hot water lines
Solar Water Heating	*Fixed during optimization (None)*
Solar Water Heating Azimuth	*Fixed during optimization (N/A)*
Solar Water Heating Tilt	*Fixed during optimization (N/A)*
Lighting Group	
Lighting	• 100% compact fluorescent (CFL), 14.1 year lifetime • 100% light emitting diode (LED), 66.5 year lifetime

Category Name	Feature pool options
Appliances & Fixtures Group	
Refrigerator (17.4 year lifetime)	• Side freezer style, standard efficiency, 708 kWh/yr • Side freezer style, Energy Star, 645 kWh/yr
Cooking Range (13 year lifetime)	• Natural gas, standard • Electric, standard resistive coil • Electric, induction
Dishwasher (11 year lifetime)	• Energy Star, efficient, 270 kWh/yr • Energy Star, more efficient, 234 kWh/yr
Clothes Washer (14 year lifetime)	• Energy Star, efficient, 123 kWh/yr • Energy Star, more efficient, 116kWh/yr
Clothes Dryer (13 year lifetime)	• Gas, standard, 3.48 energy factor (EF) • Electric, Energy Star, 3.45 EF • Electric heat pump, 5.85 CEF
Hot Water Fixtures (99 year lifetime)	• 100% flow relative to Building America benchmark (national average) • Extra-low flow faucets: 50% relative sink flow, 50% shower flow, 100% bath flow
Appliances & Fixtures Schedules Group	
Refrigerator Schedule	*Fixed during optimization*
Cooking Range Schedule	*Fixed during optimization*
Clothes Dryer Schedule	*Fixed during optimization*
Miscellaneous Group	
Plug Loads	*Fixed during optimization*
Extra Refrigerator	*Fixed during optimization*
Freezer	*Fixed during optimization*
Pool Heater	*Fixed during optimization*
Pool Pump	*Fixed during optimization*
Hot Tub/Spa Heater	*Fixed during optimization*
Hot Tub/Spa Pump	*Fixed during optimization*
Well Pump	*Fixed during optimization*
Gas Fireplace	*Fixed during optimization*

Category Name	**Feature pool options**
Gas Grill	*Fixed during optimization*
Gas Lighting	*Fixed during optimization*
Miscellaneous Schedules Group	
Plug Loads Schedule	*Fixed during optimization*
Extra Refrigerator Schedule	*Fixed during optimization*
Freezer Schedule	*Fixed during optimization*
Pool Heater Schedule	*Fixed during optimization*
Pool Pump Schedule	*Fixed during optimization*
Hot Tub/Spa Heater Schedule	*Fixed during optimization*
Hot Tub/Spa Pump Schedule	*Fixed during optimization*
Well Pump Schedule	*Fixed during optimization*
Gas Fireplace Schedule	*Fixed during optimization*
Gas Grill Schedule	*Fixed during optimization*
Gas Lighting Schedule	*Fixed during optimization*
Power Generation Group	
PV System	*Fixed during optimization*
PV Azimuth	*Fixed during optimization*
PV Tilt	*Fixed during optimization*

Appendix 6. Cost workaround procedures

For optimization run: (skip this step to reproduce from existing optimization run)

- Define a reference design similar to the CBECC-Res reference model (used as reference energy consumption for percent energy savings -- need not be reachable by optimization options) as "RefPoint."
- Select optimization options from feature set workbook.
    - For Ducts, allow only "In Finished Space."
    - For AC, allow Central AC + Furnace combinations.
    - For Orientation, do not select any extra-cost workarounds.
- Define a design compatible with optimization options as "Start."

Post-process steps

- Note regarding selection of candidate packages: include optimal points from each of several option-differentiated optimal curves (using "option sensitivity" to highlight those curves). Specifically, include at least one of each (reflecting multiple paths to Title 24 compliance):
    - Vented - prescriptive Option B ceiling plus roof insulation
    - vented - prescriptive Option C just ceiling insulation
    - and unvented attic option (performance approach).
- Select RefPoint and candidate packages; export to new case
- "Fix" packages for code-compliant attic/duct combination: change Ducts from "In Finished Space/Living" to "5% Leakage, R-6 (eq to DiCs cost)/Unfinished Attic" for vented attic options. For candidate packages with unvented attic options, keep the duct option at "In Finished Space/Living".
- "Fix" packages for cost workarounds: for some options, BEopt is unable to calculate the cost. Specifically, for unfinished attic options that are of type **Ceiling Continuous + Roof Cavity**, change the Orientation option to add a cost workaround.
    - Unvented attic (UVA) R38/R19: add $4,739
    - Unvented attic (UVA) R38/R13: add $3,838
- Create alternatives: change-out HVAC systems on RefPoint and candidate packages for other options not included in optimization (HP, mini-split).
    - In mixed-fuel analysis model, create three cases to organize candidate comparisons:
        - First case: with gas heat,
        - Second case: with electric heat,
        - Third case: to overlay the optimal designs from each case (gas heat and electric heat)
    - For HP variation, set options in central AC and furnace categories to None.
    - For Mini-split variation, set options in central AC and furnace categories to None; set Ducts to None. (BEopt 2.8 can do ducted mini-split, but that is not being considered here.)