A Modeling Comparison: Recognizing Passive House Performance within California Title 24

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ABSTRACT

This study develops a diagnostic modeling comparison between the Passive House Planning Package (PHPP), WUFI Passive, and California's CBECC compliance software across all 16 California climate zones for illustrative single-family and multi-family prototypes. It encompasses a structured comparison of how the same Passive House-related design strategies are represented across modeling platforms, where assumptions can be aligned, and where differences in software structure, input options, or compliance rules affect modeled outcomes.

The analysis compares Passive House-certified and Passive House-equivalent prototype buildings against prescriptive Title 24 baselines and includes targeted sensitivity testing focused on airtightness, thermal bridging, and heat recovery ventilation performance. Outcomes are evaluated in terms of annual energy use, peak demand, and Title 24 compliance results. The study also documents key modeling challenges across platforms and identifies where current compliance tools recognize, simplify, mute, or omit the effects of enclosure and ventilation strategies central to Passive House practice.

The resulting diagnostic comparison and recommendations are intended to improve consistency between Passive House and Title 24 assessments, reduce project rework associated with dual-modeling workflows, and better recognize high-performance enclosure and ventilation strategies within California's existing compliance pathways, while supporting California's evaluation of Passive House standards and compliance pathways under AB 368.

Introduction

California's building energy code framework is increasingly shaped by objectives that extend beyond annual energy savings alone. Electrification, load flexibility, indoor environmental quality, and climate resilience are now central to how high-performance buildings are defined and evaluated in the state (CEC 2025a; CEC 2025b). Within this context, enclosure-driven design strategies are gaining importance because they can reduce space-conditioning demand, improve indoor thermal stability, maintain more habitable conditions during outages, and limit pollutant intrusion during wildfire smoke events. As these priorities become more prominent in policy and practice, the question is no longer only how much energy a building uses annually, but also how well it performs under increasingly demanding conditions.

Passive House is highly relevant to these priorities. Its design approach emphasizes deep load reduction through airtight construction, high-performance fenestration, minimized thermal bridging, robust insulation, and balanced mechanical ventilation with heat recovery (Mirhosseini et al. 2024; Rojas et al. 2024). In California, these strategies are becoming more important not only for reducing heating and cooling demand, but also for supporting occupant protection during extreme heat, wildfire smoke events, and grid disruptions (Ji et al. 2026; Chen et al. 2026; HCD 2024; Malik et al. 2026; Flores et al. 2025). For this reason, Passive House is increasingly understood not simply as a voluntary certification pathway, but as a framework that may offer useful insight into how California can advance durable, enclosure-based building performance.

This policy relevance was elevated in 2025 with the enactment of AB 368, which directs the California Energy Commission to evaluate the cost-effectiveness of Passive House energy efficiency standards by climate zone, assess the use of the two energy models currently required for Passive House certification, and submit findings and recommendations to the Legislature by July 1, 2028 (California AB 368 2025). By placing Passive House within a formal state policy inquiry, AB 368 underscores the importance of understanding how Passive House performance, modeling tools, and documentation practices compare with California's adopted compliance framework.

Despite this alignment, Passive House remains only partially integrated into California's Title 24 compliance framework. Projects pursuing both Passive House certification and Title 24 compliance often require parallel modeling workflows using different tools, assumptions, and performance metrics, increasing time, cost, and uncertainty for project teams while making it more difficult for code officials and reviewers to consistently interpret the value of key Passive House measures. These challenges are especially significant for strategies such as airtightness, thermal bridge mitigation, and balanced ventilation with heat or energy recovery, whose impacts may not be represented consistently across modeling environments even when the design intent is the same.

This paper examines how key Passive House-related measures are represented when translated into California's compliance environment. Our goal is not to determine whether Passive House should replace or supplement Title 24 compliance modeling, but to identify where current Title 24 workflows recognize Passive House strategies, where important effects may be reduced or omitted, and what these findings imply for compliance practice, market adoption, and future evaluation of Passive House as a potential alternative or complementary compliance pathway.

Background

Passive House and Title 24 share important areas of overlap, but they are designed for different purposes and have evolved to represent building performance in different ways. Passive House is a design and certification framework centered on load reduction through enclosure quality and controlled ventilation. Its core strategies include high levels of insulation, airtight construction, minimized thermal bridging, high-performance fenestration, and balanced ventilation systems with heat or energy recovery. These measures are intended to reduce heating and cooling demand, improve comfort, and support stable indoor conditions through an integrated building-science approach.

Title 24, by contrast, is a compliance framework developed to support statewide code implementation, enforcement, and comparability across projects. Compliance software tools such as California Building Energy Code Compliance (CBECC) are structured around California-specific ACM rules, standard design assumptions, and rule-based performance outputs (CEC 2025b; CEC 2025c). Passive House tools such as PHPP and WUFI Passive are designed to evaluate enclosure performance, space-conditioning demand, and ventilation effectiveness at greater measure-level detail. Because these tools simplify and organize building physics differently, the same building may produce different modeled outcomes depending on which tool is used and how individual measures are represented. The policy question is not simply whether the models differ, but whether those differences affect compliance outcomes, market signals, or the ability of Passive House strategies to be fully recognized within California's regulatory framework.

These differences matter for any future consideration of Passive House as an alternative or complementary compliance pathway, particularly in light of AB 368's direction to evaluate the cost-effectiveness of Passive House energy efficiency standards by California climate zone. A compliance pathway must not only demonstrate that a building meets a high-performance standard, but also show how that standard compares to California's adopted compliance metrics, climate-zone requirements, documentation expectations, and enforcement procedures. Failing to demonstrate how a Passive House standard compares to California's existing framework would likely necessitate changes to building review and compliance enforcement. Measures that are central to Passive House practice may therefore need to be evaluated both on their own performance value and on how reliably they can be represented, reviewed, and verified within California's compliance context.

The overlap between the two frameworks is substantial, particularly in their shared focus on lower energy demand, improved envelope performance, and better ventilation outcomes. However, the differences become more consequential for measures that are central to Passive House practice and do not always map directly into California compliance software. Airtightness affects both heating and cooling loads, as well as the control of outdoor pollutant intrusion. Thermal bridging is treated explicitly in Passive House workflows but is often represented only indirectly in compliance modeling. Slab and foundation losses may also be evaluated with different levels of detail across tools. Ventilation systems with heat or energy recovery raise additional translation questions, particularly when sensible and latent recovery are treated differently. Together, these areas of overlap and divergence provide the technical basis for the comparative modeling and sensitivity analysis presented in this paper.

Policy and Market Context

California's policy environment is increasingly supportive of building strategies that reduce energy demand, lower peak loads, improve indoor environmental quality, and strengthen resilience (CEC 2025a; CEC 2025b). The 2025 Energy Code reflects this direction through expanded heat pump adoption, greater electric readiness, and stronger ventilation-related provisions. Within this landscape, Passive House has drawn growing attention because many of its core strategies align with the state's long-term interests: durable load reduction through enclosure performance, tighter control of infiltration, improved ventilation, and reduced dependence on oversized mechanical systems. This is especially relevant as California continues to confront extreme heat, wildfire smoke, and grid reliability concerns.

That alignment, however, has not resulted in seamless integration with Title 24. California's Energy Code has historically taken a climate-responsive, performance-based approach that accounts for orientation, shading, thermal mass, and other building characteristics within standardized compliance methods, rather than relying on a single enclosure-focused paradigm (CEC 2019; CEC 2025a). By contrast, Passive House emphasizes superinsulation, airtightness, and controlled ventilation to minimize loads (CPUC 2025). This difference helps explain why Passive House is often seen as consistent with California's long-term efficiency and resilience goals, yet still somewhat outside the mainstream compliance tradition.

Market adoption depends not only on technical merit but also on whether project teams can move efficiently through compliance and approval processes. When Passive House projects require separate modeling workflows with nonaligned assumptions and outputs, transaction costs increase and compliance review can become more burdensome. As a result, the translation gap between Passive House tools and Title 24 compliance software becomes a practical market issue, not just a technical one.

AB 368 makes this question increasingly relevant from a policy perspective. Since the legislation requires evaluation of Passive House cost-effectiveness by climate zone and consideration of Passive House certification modeling tools, it elevates the need for transparent, replicable methods for comparing Passive House performance with Title 24 requirements using California-adopted metrics. That legislation elevates Passive House from a niche market discussion to a formal state policy inquiry and underscores the importance of transparent, replicable methods for comparing Passive House performance with Title 24 requirements using California-adopted metrics.

In this context, evaluating Passive House as a potential alternative compliance pathway requires a clear understanding of both performance outcomes and compliance infrastructure. California would need to understand whether Passive House modeling can demonstrate equivalency with Title 24 requirements, how software versions and model assumptions would be reviewed, and how project documentation could be verified by compliance officials. The analysis in this paper supports that evaluation by identifying where Passive House and Title 24 modeling approaches align, where they diverge, and which differences are most important for future policy, software, and implementation decisions.

Comparative Modeling Study

The following section describes the framework used in this comparative modeling study, focusing on comparing Passive House certified homes to 2025 Title 24 compliant homes. The study does not propose an automated model-conversion tool, compliance shortcut, or prescriptive set of conversion factors between Passive House software and CBECC. Rather, it establishes a structured method for comparing how the same building and the same high-performance measures are represented across tools. This approach allows the analysis to identify where inputs can be aligned, where modeled effects diverge, and where current compliance software or documentation practices may need refinement before a more formal translation pathway could be developed.

The goal of the study is to translate Passive House designs into California Title 24 framework and identify how Passive House and Title 24 simulation tools value efficiency building strategies differently. In particular, the analysis evaluates where performance credit is preserved, where it is reduced, and which modeling assumptions or software limitations help explain those differences. The overall approach is intended to be transparent, reproducible, and useful for policy and implementation discussions.

A 2025 Title 24 baseline model was developed in the California Building Energy Code Compliance (CBECC) tool using a prescriptive all-electric design with required photovoltaic measures as the reference case in each California climate zone. High-performance design cases were then developed in Passive House tools to meet climate-specific targets for space conditioning, primary or source energy, airtightness, and comfort. Those Passive House designs were subsequently recreated in CBECC as closely as possible using aligned assumptions for insulation levels, window performance, mechanical efficiency, infiltration, and ventilation airflow. The intent is not to force exact agreement between tools with different calculation methods, defaults, and compliance rules, but to establish a consistent basis for identifying where modeled outcomes diverge.

Using this framework, the analysis separates differences attributable to building design from those attributable to tool structure, compliance assumptions, and software limitations. The comparison focuses on enclosure and ventilation measures that are central to Passive House practice and that commonly raise translation questions in California compliance workflows, including airtightness, thermal bridge mitigation, high-performance fenestration, slab and foundation heat loss, and recovery ventilation performance. By examining how these measures carry over into CBECC, the study identifies where Passive House performance is recognized within Title 24 and where important effects may be simplified, muted, or omitted in current compliance modeling.

Framework

To compare different Passive House workflows without positioning one software pathway as the reference case, the results are presented as PH Design 1 and PH Design 2 rather than by program name. This allows the study to compare outcomes from two modeling approaches in a neutral way. PH Design 1 and PH Design 2 refer to the models generated from the Passive House tools. The terms CBECC-PH Design 1 and CBECC-PH Design 2 equivalent models represent the Passive House designs that are translated into CBECC.

For the Passive House Institute (PHI) pathway, the analysis uses the Passive House Planning Package (PHPP), an Excel-based tool commonly used for Passive House design and certification. For the Phius pathway, the analysis uses WUFI Passive, which includes the energy modeling capabilities of WUFI Plus along with features specific to Passive House design. The software versions used in this study are PHPP v10.6, WUFI Passive v3.5.0.1, and CBECC 2025.2.0.

Two standard residential prototypes are used in the analysis. The first is a single-family prototype: a 2,100 ft², one-story, slab-on-grade home with a realistic layout and all-electric systems. The second is a multifamily prototype: a three-story loaded-corridor building with central circulation, a representative unit mix, and flat-roof/parapet construction.

Both prototypes are modeled in all 16 California climate zones. For the PH Design 1 models, designs begin with envelope values informed by Title 24 prescriptive requirements for wall and roof insulation, which are then refined until Passive House criteria are met. As a result, PH Design 1 is somewhat closer to Title 24 baselines at the outset while still satisfying full Passive House performance requirements. The PH Design 2 models were developed without reference to Title 24 prescriptive requirements and instead were based on typical construction practices and climate-zone-specific Passive House criteria. Both PH designs took the general approach of creating a Passive House design that is minimally compliant with respective PH requirements. This was done to help inform any instances where a model may meet PH criteria but would fail to meet Title 24 compliance requirements when translated into CBECC.

Overall, this framework provides a consistent method for comparing Passive House and Title 24 model outputs and for identifying where Passive House measures are or are not fully recognized in California compliance modeling.

Results Summary

This section presents observations from the single-family and multifamily modeling comparison, focusing on site energy, peak demand, and Title 24 compliance outcomes for the PH Design 1 and PH Design 2 models, the CBECC-PH equivalent models, and 2025 Title 24 prescriptive models.

For the single-family prototype, the PH Design 1 and PH Design 2 models showed the most consistent alignment between Passive House and Title 24 modeling outcomes. Across all climate zones, the CBECC-PH Design 1 equivalent models reduced annual site energy relative to the CBECC prescriptive baseline. The PH Design 1 models themselves generally predicted lower site energy than the CBECC-PH Design 1 equivalents, reflecting differences in how airtightness, thermal bridges, and ventilation are represented in the PH software versus in CBECC. Peak demand generally decreased for the CBECC-PH Design 1 equivalents compared with prescriptive baselines, with only a few climate zones showing modest increases. Compliance margins for all single-family CBECC-PH Design 1 equivalent models were positive, indicating strong compliance under the 2025 Title 24 performance path.

The single-family PH Design 2 models showed a more mixed pattern. In many climate zones, the CBECC-PH Design 2 equivalent models reduced site energy relative to the prescriptive baseline, but several milder climate zones showed slight increases instead. Comparisons between the original PH Design 2 models and their CBECC equivalents were also mixed, with lower energy use predicted by one tool or the other depending on climate zone. Peak demand increased in some milder and cooling-dominated climates, consistent with PH Design 2 design choices that rely more heavily on passive solar gains and higher solar heat gain coefficients to control heating demand. Compliance outcomes were also mixed: while many climate zones retained positive Long-term System Cost (LSC) efficiency margins, Climate Zones 8–10 showed negative margins, indicating potential noncompliance in CBECC even where the design met Passive House criteria.

The multifamily prototype results differed in important ways, particularly for PH Design 1-based models. For CBECC-PH Design 1 equivalent multifamily models, site energy was higher than the CBECC prescriptive baseline across all climate zones, even though the underlying PH Design 1 models indicated substantially lower energy use than prescriptive baselines. When these designs were translated into CBECC, the envelope and ventilation strategies did not appear as savings relative to prescriptive. Peak demand for the PH Design 1 equivalent increased in all climate zones except Climate Zone 3, which showed a slight decrease. Compliance margins nevertheless remained positive for all multifamily CBECC-PH Design 1 equivalents, indicating that PV and other factors were sufficient to maintain performance-path compliance.

For the multifamily PH Design 2 models, the results were more aligned. The CBECC-PH Design 2 equivalents showed modest site energy differences relative to prescriptive baselines, with some climate zones seeing increases and others small decreases. Comparisons between the PH Design 2 models and the translated CBECC equivalents also produced mixed outcomes. Peak demand results also varied by climate zone, with some slight increases and some decreases. Importantly, all multifamily CBECC-PH Design 2 equivalent models maintained positive compliance margins, indicating no noncompliance flags in the modeled Title 24 results even where site energy or peak demand increased slightly.

The results suggest that Passive House-equivalent designs do not translate uniformly into California compliance software. The single-family PH Design 1 model showed the clearest and most consistent recognition of Passive House-related performance in CBECC, while the multifamily PH Design 1 model showed the largest divergence between Passive House and Title 24 results. Across both prototypes, compliance outcomes were shaped not only by enclosure and ventilation performance, but also by how Title 24 evaluates the building, including load shifting, standard design assumptions, and photovoltaic credits. These findings show the importance of distinguishing actual building performance from how that performance is captured in the modeling tools.

Sensitivity Study

Building on the models created in the comparative modeling study, a sensitivity study was completed to further examine how key Passive House-related measures are represented in Passive House tools and CBECC. The analysis focused primarily on isolating infiltration, HRV/ERV performance, and thermal bridging with specific comparisons in this section made between CBECC and PHPP. The purpose of the sensitivity study was to isolate individual variables and better understand how each modeling tool responds when a single building characteristic changes. The impact on annual site energy (kWh) as well as annual heating energy (kWh) are the main building impacts that were looked at. This investigation aims to explore where differences in total energy use between Passive House tools and CBECC may result from differences in tool logic rather than differences in the building design itself.

Infiltration

The infiltration analysis begins with the Passive House-equivalent CBECC models created in the comparative modeling study. All building characteristics remained constant except for the air infiltration rate, which was varied. In the comparative study, both the PHPP and CBECC-equivalent models used an airtightness level of 0.6 ACH50, consistent with Passive House practice, and this value serves as the baseline here. For the single-family analysis, additional models were run at 3 and 5 ACH50 in both CBECC and PHPP. Changes in annual site energy and annual heating energy were then evaluated, with heating energy examined closely because infiltration has its greatest effect during periods of larger indoor-outdoor temperature differences.

The first comparison evaluates how changes in ACH50 affect annual site energy in both CBECC and PHPP. As expected, higher infiltration rates increased annual site energy in both tools. To illustrate the magnitude of this effect, annual site energy at 3 ACH50 and 5 ACH50 was compared with the Passive House baseline of 0.6 ACH50 across all climate zones. Figure 1 presents the percentage increase in electric usage for both CBECC and PHPP.

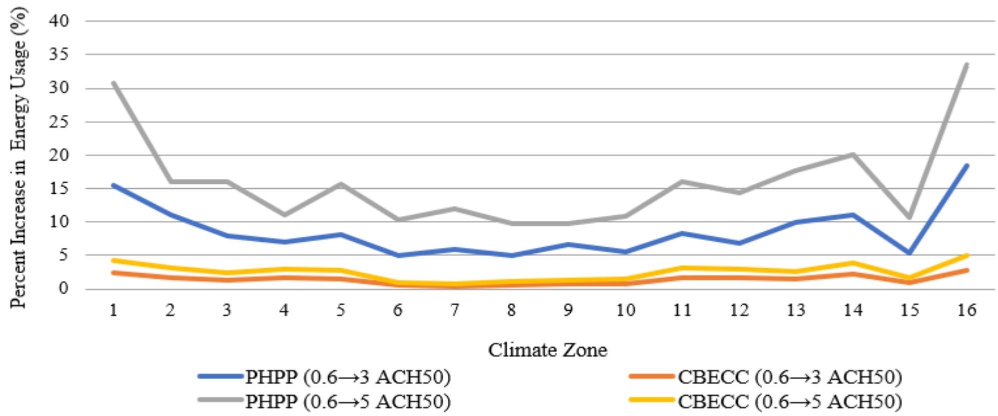

Figure 1. Percent increase in total site energy usage resulting from increased infiltration levels (0.6 ACH50 to 3 ACH50 and 5 ACH50) for PHPP and CBECC simulations across California climate zones for single family homes. *Source*: Frontier Energy 2026.

A clear difference can be seen in how PHPP and CBECC respond to increasing infiltration for the same high-performance building design. In the CBECC models, increasing infiltration to 3 ACH50 and 5 ACH50 resulted in less than a 5 percent increase in annual site energy across all climate zones, with limited variation by climate. PHPP showed a stronger response, with larger percentage increases in annual site energy, greater variation across climate zones, and more pronounced impacts in heating-dominated climates. To examine the difference in response more closely, Climate Zone 12 was selected for comparison of annual heating energy. As shown in Figure 2, both tools exhibit a near-linear increase in heating energy as ACH50 value increases.

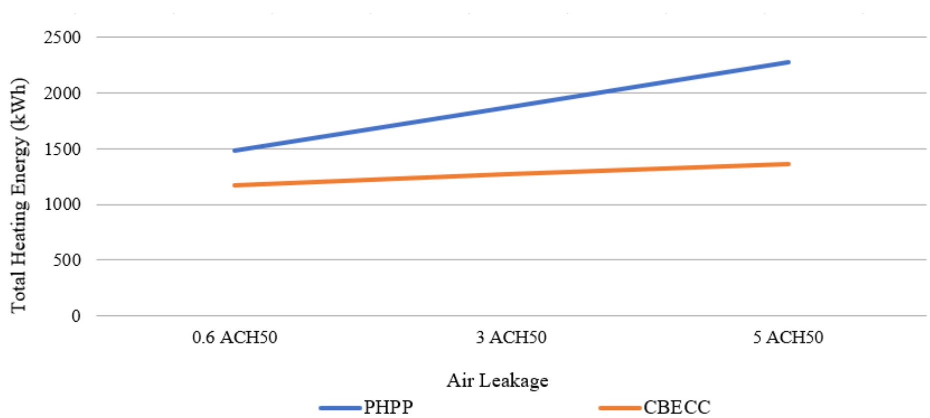

Figure 2. Heat energy vs. ACH50 for PHPP and CBECC in Climate Zone 12 for single family homes. Source: Frontier Energy 2026.

This difference is due in part to the slope of the lines: heating energy in PHPP changes more rapidly than in CBECC as infiltration increases. The comparison is not intended to show that one tool is more correct than the other, but rather to highlight differences in how the two tools represent infiltration. These relationships help explain the difficulty of translating Passive House performance into CBECC, especially at the very low leakage levels associated with Passive House design.

A similar sensitivity analysis was performed for the multifamily prototype. Both PHPP and the corresponding CBECC-equivalent models were evaluated at 0.6 ACH50, 3 ACH50, and 7 ACH50. Percentage increases in annual site energy were calculated relative to the 0.6 ACH50 baseline. Figure 3 shows the percent increase in annual site energy for CBECC and PHPP at 3 ACH50 and 7 ACH50 relative to the Passive House baseline of 0.6 ACH50. The multifamily results follow patterns similar to the single-family results.

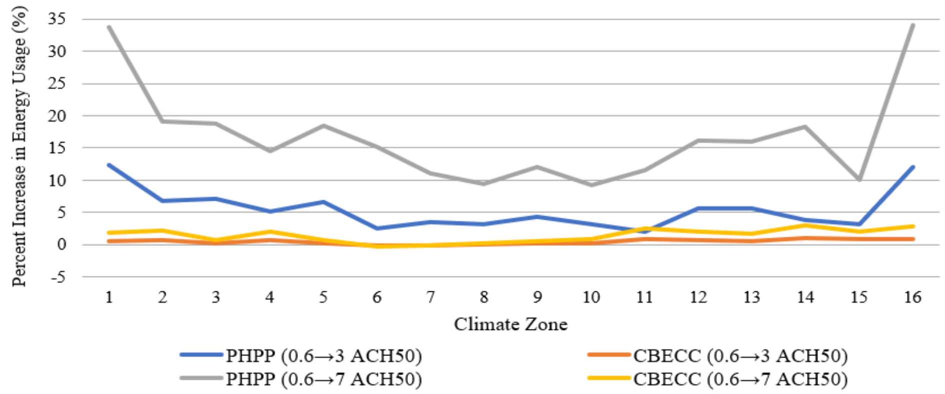

Figure 3. Percent increase in total site energy usage for 3 and 7 ACH50 for low-rise multifamily homes. *Source*: Frontier Energy 2026.

Figure 4 takes a closer look at annual site energy in Climate Zone 12. At the Passive House baseline of 0.6 ACH50, the PHPP and CBECC-equivalent models show a noticeable difference in annual site energy. In CBECC, site energy increases only modestly as ACH50 rises. In PHPP, the increase is more pronounced, with a moderate rise from 0.6 to 3 ACH50 and a sharper rise from 3 to 7 ACH50. This pattern reinforces the broader finding that the CBECC-equivalent models show a weaker site energy response to changes in infiltration than PHPP, particularly within the low-leakage range most relevant to Passive House design.

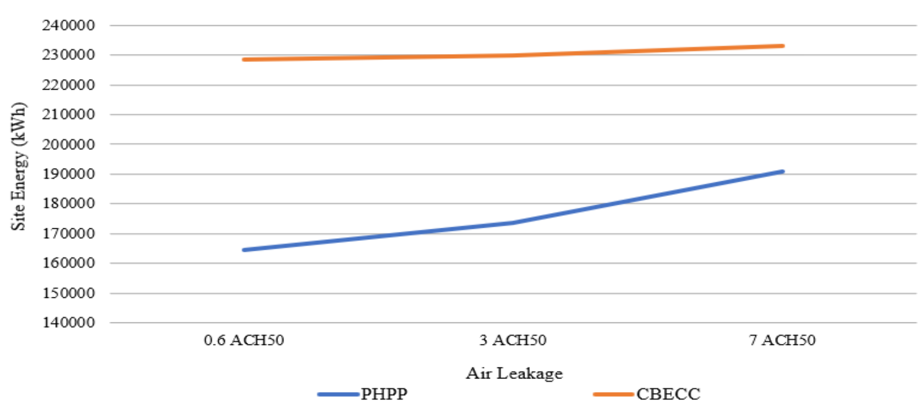

Figure 4. Site energy vs. ACH50 for PHPP and CBECC in CZ12 for low-rise multifamily homes. *Source*: Frontier Energy 2026.

The infiltration sensitivity study highlights an important translation issue for Passive House projects in California. Very low air leakage rates, which are central to Passive House performance, appear to receive low modeled credit in CBECC which is further emphasized in the comparison to the PHPP software. At the same time, PHPP should be interpreted in the context of its intended use: it is optimized for high-performance, low-infiltration buildings and as is built around these assumptions. Even so, the results indicate that differences in infiltration treatment can contribute meaningfully to divergence between Passive House and Title 24 modeling outcomes.

HRV/ERV

The sensitivity analysis for balanced ventilation systems examines how each tool responds to changes in ventilation recovery efficiency. The analysis focused on sensible recovery efficiency (SRE) and its effect on annual site energy. In both the PHPP model and the CBECC-PHPP model, only the SRE value was varied while all other building characteristics remained unchanged. Figure 5 shows total electric use for HRV efficiencies ranging from 60 percent to 90 percent in both PHPP and CBECC. In both tools, increasing recovery efficiency results in moderate reductions in annual site energy. The trends are generally similar, with PHPP showing slightly lower electricity use than CBECC at efficiencies above roughly 75 percent.

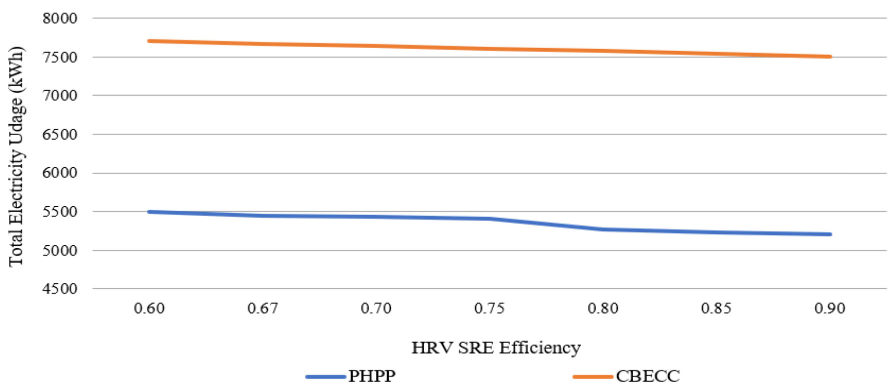

Figure 5. Total electricity usage vs HRV efficiency for CBECC and PHPP in CZ12 for single family homes. *Source*: Frontier Energy 2026.

This suggests broadly similar treatment of balanced ventilation systems in CBECC and PHPP. However, an important limitation in CBECC is the inability to represent ERV latent recovery effects. Figure 6 shows CBECC results across all climate zones for balanced ventilation systems with efficiency values varying from 60 percent to 90 percent. The models shown are the CBECC-Phius equivalent models, which all include balanced heat recovery systems. In the Phius models developed in WUFI Passive, the systems were ERVs; however, in the translation to CBECC, latent recovery cannot be modeled, so the CBECC equivalent treats these units as HRVs. The results show only slight changes in annual site energy with changing HRV efficiency. In milder climate zones such as Climate Zones 6–8, the effect is especially small, suggesting limited benefit from higher heat recovery efficiency in those climates.

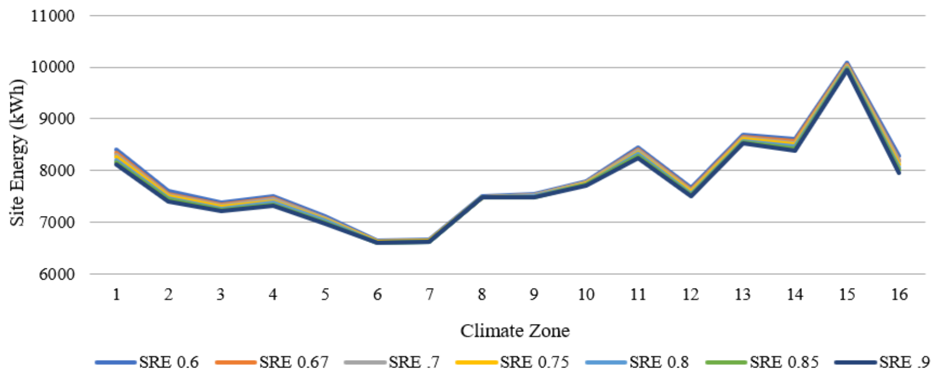

Figure 6. Site energy usage vs. HRV efficiency for single family homes in CBECC for all climate zones. *Source*: Frontier Energy 2026.

For the multifamily models, a similar exercise varying HRV efficiency was completed to evaluate the impacts in the PHPP and CBECC-PH equivalent models. Figure 7 compares normalized site energy in CBECC and PHPP relative to a baseline of 60 percent SRE. This normalization was used to compare the sensitivity of the two tools independent of the gap in absolute energy values. As in the single-family results, PHPP shows a stronger response to increasing HRV efficiency, while site energy in CBECC remains nearly constant.

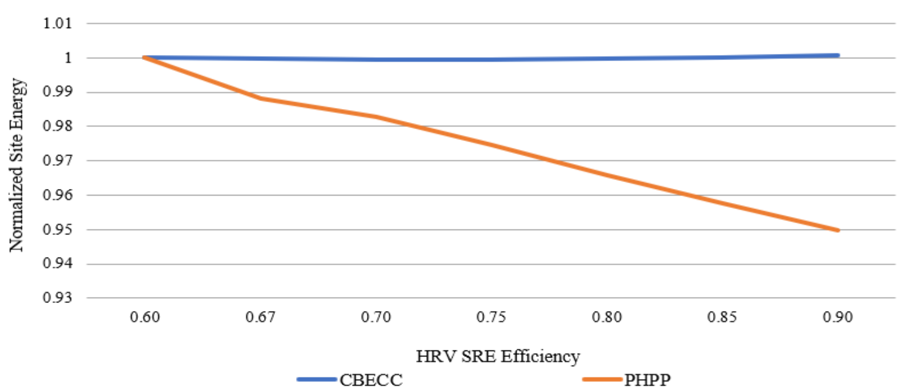

Figure 7. Normalized site energy vs. HRV SRE efficiency for single family homes in Climate Zone 12. *Source*: Frontier Energy 2026.

Figure 8 compares CBECC-equivalent models in Climate Zones 12 and 16 to show the effect of increasing HRV efficiency on annual site energy. Climate Zone 16, a heating-dominated climate, shows a relatively steady decline in site energy as HRV efficiency increases from 60 percent to 90 percent. Climate Zone 12, which experiences substantial heating and cooling loads, follows a more curved pattern, with minimum site energy occurring near 75 percent SRE and increased site energy at higher efficiencies. In both climate zones, heating energy decreases as HRV efficiency rises, but in climates such as CZ12, where cooling loads are also significant, higher efficiency is not always beneficial. Without an economizer, opportunities for free cooling are reduced when the HRV recovers heat from the exhaust stream.

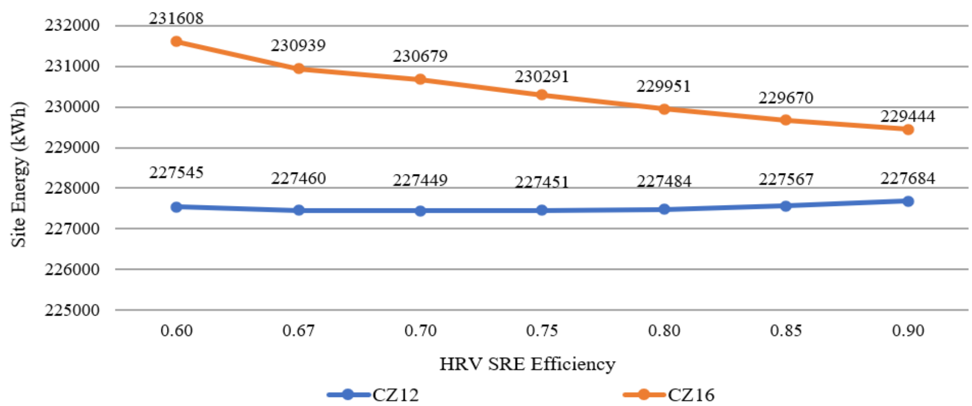

Figure 8. CBECC equivalent models total site energy vs. HRV SRE efficiency for low-rise multifamily homes in climate zones 12 and 16. *Source*: Frontier Energy 2026

The HRV/ERV sensitivity study highlights slight differences between CBECC and Passive House tools in how the model results are impacted by changing recovery system efficiency values. Additionally, climate-specific trends showed the effects of different system efficiencies and the impact on site energy results. The largest gap identified in the study is the gap in modeling ERVs in CBECC where latent recovery effects are not counted. However, additional research would need to be done specifically for California climates to understand potential needs and benefits from further investigating this capability in California compliance software.

Thermal Bridging

An additional review was completed to understand how thermal bridging is represented across the modeling tools. In the PHPP models used for this study, many thermal bridge effects are incorporated directly into component-level inputs such as window U-values. Those adjusted values were then entered into the CBECC models, meaning that a portion of thermal bridge effects is already reflected indirectly in the compliance models.

However, some discrete thermal bridges are treated separately in Passive House workflows and are not easily represented in CBECC. These include elements such as plumbing stacks, roof drains, and mechanical curbs. In the prototypes evaluated here, these individual thermal bridges are relatively small in magnitude, but they still point to a broader modeling limitation: CBECC does not provide a straightforward way to explicitly account for certain localized thermal bridge conditions that may be tracked more directly in Passive House analysis.

Software Inspection Findings

The comparative modeling analysis and software review indicate that several inputs central to Passive House performance are represented in CBECC with different levels of specificity than in Passive House design tools. This does not mean the underlying building physics are absent from either modeling environment. Rather, the inspection found that the tools differ in how key effects are entered, tracked, isolated, and reflected in outputs. Passive House tools are structured to evaluate measure-level effects associated with enclosure continuity, low air leakage, thermal bridge mitigation, high-performance windows, and balanced ventilation with heat recovery. CBECC, by contrast, is structured around California-specific ACM rules, standardized compliance assumptions, and more aggregated input categories.

Airtightness is one of the clearest examples of this difference. Both CBECC and PHPP respond to changes in infiltration, but the sensitivity results show a smaller change in CBECC as leakage rates increase from Passive House-level airtightness to higher ACH50 values. This difference is most visible at very low leakage levels and in climates with meaningful heating demand, suggesting that CBECC can represent infiltration changes but may not capture the same incremental value of very low air leakage as Passive House modeling workflows.

Thermal bridging is represented less directly. Some thermal bridge effects were carried into CBECC through adjusted assembly or component properties, including modified fenestration inputs. However, discrete conditions commonly tracked in Passive House workflows, such as penetrations, curbs, roof-to-wall transitions, and some slab or foundation details, do not have a comparable explicit input pathway in CBECC. These effects may therefore be embedded indirectly, simplified, or excluded depending on how the modeler translates the design.

Balanced ventilation is partially represented across tools, but with important limitations. CBECC and Passive House tools both recognize sensible heat recovery, although their responsiveness varies by building type and recovery efficiency. The larger limitation is that CBECC does not currently capture latent recovery benefits from ERVs, which can affect how Passive House-equivalent designs are represented where latent loads or multifamily ventilation assumptions are important.

Overall, the software inspection found that the translation gap is driven less by whether CBECC can model high-performance strategies in general, and more by the level of input specificity available for particular Passive House measures. Current compliance software can represent many related effects, but not always with the same measure-level visibility or fidelity used in Passive House workflows. This distinction is important for interpreting the comparative results: differences between Passive House tools and CBECC often reflect software structure and input pathways, not disagreement about the value of the underlying building measures.

Recommendations for a Compliance Translation

The findings suggest that California does not need a new compliance framework to better account for Passive House measures. A separate Passive House-based compliance pathway is a reasonable alternative to consider, particularly as a longer-term policy option. However, in California, such a pathway would need to demonstrate equivalency with Title 24 performance requirements, align with California-specific compliance metrics, and be reviewed through the state’s compliance software and approval infrastructure. If Passive House software were used directly for compliance, version control, approval of software updates, documentation standards, enforcement procedures, and reviewer training would all need to be addressed.

For this reason, a Passive House-specific pathway may be valuable as a longer-term policy option, but it is not necessarily the fastest or lowest-burden near-term solution within California’s statewide Title 24 framework. The more immediate need is to improve how Passive House-equivalent measures are translated into existing compliance tools. This approach also has broader market value beyond Passive House projects. Improvements to the representation of airtightness, thermal bridging, slab-edge heat transfer, and balanced ventilation would benefit any project pursuing high-performance enclosure or ventilation strategies, whether or not the project seeks Passive House certification.

A first priority is clearer guidance for how Passive House-equivalent measures should be entered, documented, and reviewed in compliance models. Many of the challenges identified in this study stem from the fact that the same design strategy is represented differently in Passive House tools and in CBECC. More standardized direction for measures such as airtightness, high-performance windows, slab and foundation insulation, thermal bridge adjustments, and balanced ventilation would improve consistency and reduce uncertainty during compliance review. Worked examples for both single-family and multifamily projects would be especially useful.

A second priority is targeted compliance software refinement where key Passive House measures are not fully captured. The analysis indicates that some of the largest translation gaps occur with very low infiltration levels, thermal bridging, slab and slab-edge heat transfer, and ERV performance. Refinements in these areas would help compliance models better reflect high-performance enclosure and ventilation strategies without changing the overall structure of Title 24.

Implementation will also depend on how these measures are modeled, reviewed, and verified in practice. Training for compliance modelers, plan reviewers, raters, and other practitioners would help create more consistent interpretation of Passive House-equivalent inputs and reduce friction during project approval, particularly for multifamily buildings where ventilation assumptions and internal loads can have a larger effect on compliance results. The most practical near-term path is to improve how Passive House measures are translated into California's existing compliance tools rather than create a separate pathway. With clearer guidance, targeted software updates, and stronger alignment among practitioners, California could recognize high-performance enclosure and ventilation strategies more consistently within the current Title 24 framework.

Conclusion

This study finds that the principal barrier to more consistent recognition of Passive House-level performance within California's compliance environment is not a lack of demonstrated benefit, but a lack of alignment between design-oriented and compliance-oriented modeling frameworks. Passive House tools and Title 24 compliance tools are designed for different purposes: one supports design optimization and certification, while the other supports standardized statewide compliance, enforcement, and comparability. As a result, the same building measures can be represented differently across modeling platforms, even when the underlying design intent is consistent.

When these two systems are applied to the same building, differences in model structure can obscure or reduce the visible credit assigned to key Passive House measures. The comparative modeling and sensitivity results show that this translation gap can affect how high-performance enclosure and ventilation strategies appear in CBECC. In particular, measures such as low infiltration, thermal bridge mitigation, foundation detailing, and balanced ventilation may not receive the same level of visible credit in the compliance model that they receive in Passive House tools. In these cases, the divergence between Passive House tools and CBECC is best understood as a limitation of representation, not as evidence that the underlying building measures lack value.

The comparison completed in this study identifies where Passive House and Title 24 modeling approaches align, where they diverge, and where clearer guidance or targeted software refinements could improve consistency. This approach is not intended to serve as a one-to-one conversion method between Passive House software and CBECC, but rather as a way to understand and narrow the translation gap.

As California implements the 2025 Energy Code and evaluates Passive House standards under AB 368, improving this translation infrastructure will become increasingly important. Currently, Passive House projects in California require separate modeling workflows which increase costs and can result in more burdensome compliance review. The translation gap between Passive House and Title 24 is ultimately both a technical and practical market issue. Clearer documentation pathways, targeted software updates, and aligned practitioner training could help ensure that Passive House-related measures are assessed based on their modeled and verified performance, while also improving recognition of high-performance strategies for projects that do not pursue Passive House certification.

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