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CONSULTANT REPORT

Homebuilding Walls and Attics Market Assessment

Workforce Instruction for Standards and Efficiency
(WISE) Program

Prepared for: **California Energy Commission**
Prepared by: **ConSol & California Homebuilding Foundation (CHF)**



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PREFACE

This report has been prepared as one of four Market Assessments for the Workforce Instruction for Standards and Efficiency (WISE) program. The WISE program is designed to increase knowledge of high performance wall and attic installation for residential new construction in anticipation of updates to California's Title 24 building codes in 2016.

ABSTRACT

This report evaluates the materials and practices currently used in wall and attic construction in residential construction in the largest metropolitan statistical areas of California. It is intended to show the prevalence of high performance walls and attics in the marketplace. Data was collected from on the ground inspections, interviews with builders, and databases of pending projects. The sample contains data from the top ten production homebuilders in five largest metropolitan statistical areas of the State. The study finds that new homes with high performance walls and attics are present only in small quantities through the State and are not currently being offered the by the majority of homebuilders with large market shares.

Keywords: High Performance Walls, High Performance Attics, Energy Efficiency, Residential Construction, Zero-Net Energy

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EXECUTIVE SUMMARY

The results of surveys and inspections of new residential construction throughout California indicate that High Performance Walls and Attics (HPW & HPA) are present in small quantities in one-off demonstration homes and subdivisions. However, the majority of evaluated homes under construction from the top 10 builders in the 5 largest MSA's generally do not include the full array of design features needed to achieve HPA or HPW under the proposed 2016 Title 24 Building Energy Efficiency Standards. Some projects observed in the market do show progress toward implementing HPW or HPA construction methods. For walls, a few builders are using 2"x6" framing partially or throughout the home and stucco with high R-value exterior sheathing. For attics, some builders are installing spray foam, boxed netting, and insulation materials above or below the roof plane to create indirectly conditioned spaces.

Methodology & Limitations of Analysis

Data and analysis for this report evaluated a "snapshot" of homes under construction or recently completed in the building market during the first quarter of 2016. After the top builders in each MSA were determined, the subdivisions from these builders were chosen based on accessibility and state of completion. Each subdivision contained between three and six models. Every effort was made to review construction practices across the subdivision. Data was gathered from homes that were accessible at the time of site visit, from HERS raters and builder information.

This approach provides an accurate assessment of the market at large, but a small possibility exists of overlooking subdivisions from builders not in the top 5 MSAs who are early adopters using construction methods that support- HPA/HPW.

A handful observed subdivisions fell outside of the U.S. Census designated MSA boundaries in Los Angeles and San Diego MSA's, but were still included since they are on the fringe of areas generally recognized as part of the greater metropolitan area.

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CHAPTER 1: Market Assessment of Attics and Walls from the Top 10 Builders in California MSA's

In this analysis recently constructed single family homes from 50 unique subdivisions across the state were selected. Each subdivision was chosen based on a ranking of the top ten homebuilders by market share in California's five largest metropolitan statistical areas (MSA's). Many large production builders are top ten builders in multiple MSAs. The projects sampled represent homes brought to market by builders who collectively produced 39.6% of all single family home construction throughout California in 2014 (Builder, 2015).

1.1 Project Locations

Table 1: Subdivisions Evaluated

| Metro | # of Subdivisions Reviewed | % of market share represented | Total # of Single Family Units produced by Sampled builders |
|--------------------|----------------------------|-------------------------------|---|
| LA/Long Beach/OC | 10 | 70 | 4,846 |
| Inland Empire | 10 | 85.1 | 4,581 |
| Sacramento | 10 | 77.5 | 2,016 |
| SF/San Jose | 10 | 81.5 | 1,726 |
| San Diego/Carlsbad | 10 | 76.4 | 1,530 |
| California | 50 | 39.6 | 14,699 |

Source: Builder Magazine (Builder, 2015)

Table 2: Homebuilders of Projects Evaluated

| | | | |
|----------------|---------------------|-------------------------|------------------|
| Baldwin & Sons | Classic Communities | Cornerstone Communities | DR Horton |
| Elliot | Frontier | Irvine Company | JMC Homes |
| K Hovnanian | KB Homes | Lennar | Meritage |
| Pulte | Richmond American | Shea Homes | Standard Pacific |
| Summerhill | Taylor Morrison | Toll Bros | TRI Pointe Homes |
| Trumark Homes | William Lyon Homes | Woodside Homes | |

1.1.1 Mapped Locations of Evaluated Subdivisions by MSA

Evaluated projects are plotted in the 5 evaluated MSA's in California. Each subdivision is identified as a placemaker in the following maps. The blue overlay in each map is the U.S. Census Bureau's defined boundary of MSA's. For the San Francisco Bay Area, San Francisco-Oakland-Hayward and San Jose-Santa Clara MSA's were combined to include Single-Family homebuilding in the south bay.

Figure 1: San Francisco and San Jose MSA Evaluated Subdivisions

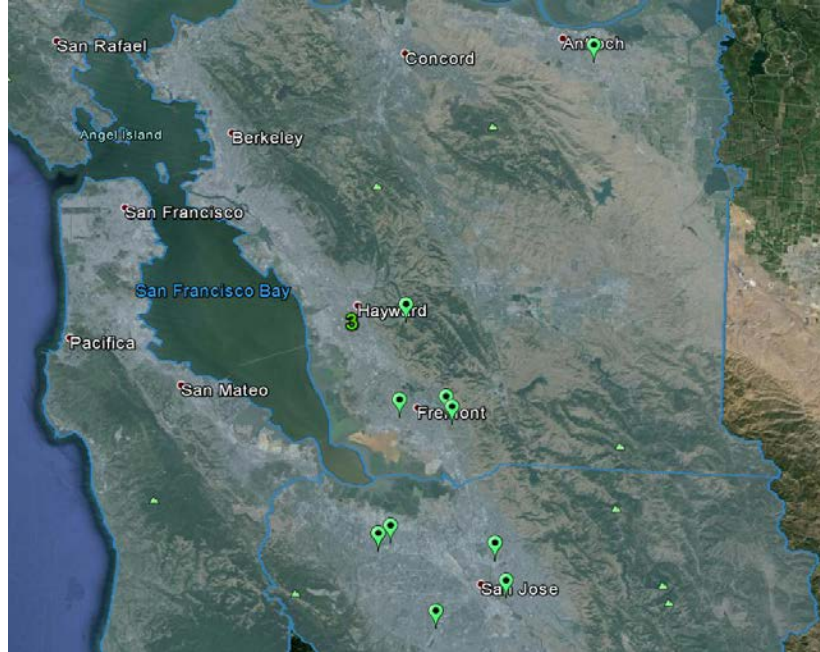


Figure 2: Sacramento MSA Evaluated Subdivisions



Figure 3: San Diego MSA Evaluated Subdivisions



Figure 4: Riverside MSA Evaluated Subdivisions

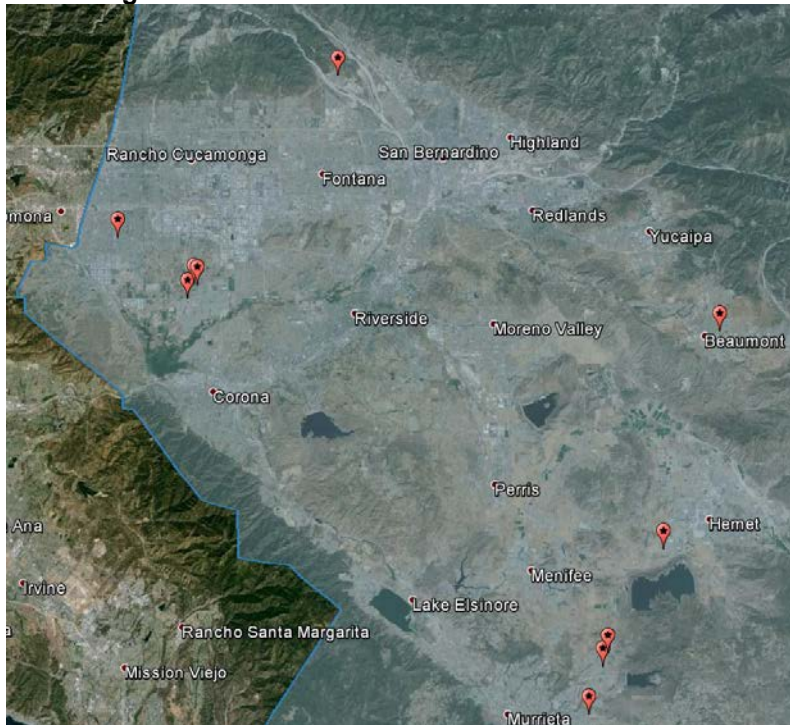
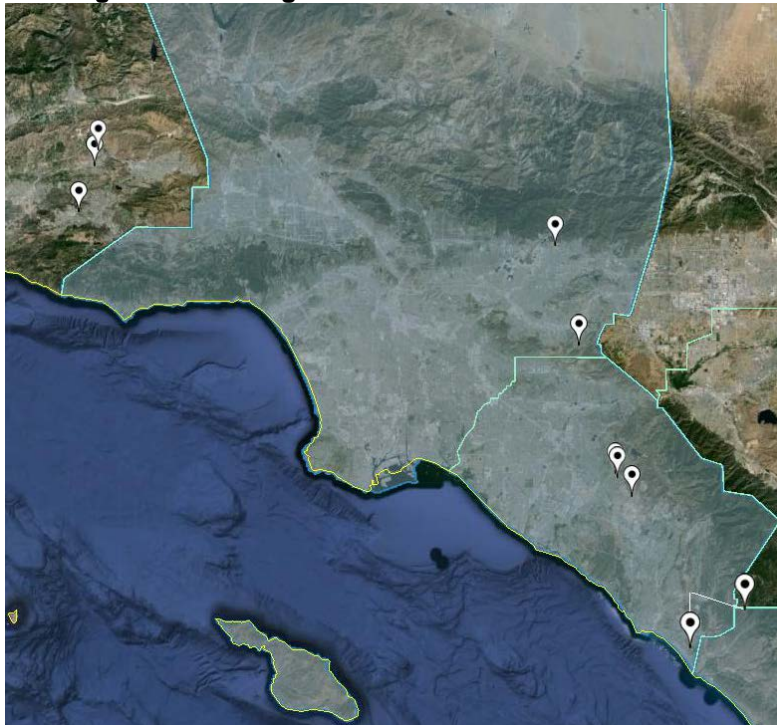


Figure 5: Los Angeles MSA Evaluated Subdivisions



1.1.2 Evaluated Project Locations by Climate Zone

Projects evaluated spanned a wide range of climate zones throughout the state. The following figures display the sampled subdivisions by MSA along with their respective climate zones. Generally, HPA/HPW performance is increased when applied in regions with extreme temperature variations and less effective in milder, coastal climate zones. For this reason, some coastal climate zones are exempted for HPA or HPW requirements in 2016 Title 24 energy code. These include parts of the San Francisco Bay Area, Los Angeles Orange County and San Diego MSA's. Of the subdivisions reviewed, 68% were located in climate zones where both HPA and HPW would be required in the 2016 Building Energy Efficiency Standards. Statewide the HPA and HPW are required in climate zones that account for 66% of the state's building starts (CIRB, 2015) so this survey is representative of residential construction that would fall under the new requirements.

Table 3: Subdivisions Evaluated by Climate Zone

| Climate Zone | # of Subdivisions Reviewed | HPA/HPW Exemptions in 2016 Title 24? |
|--------------|----------------------------|--------------------------------------|
| 3 | 4 | Yes, HPA |
| 4 | 5 | |
| 7 | 5 | Yes, HPA & HPW |
| 8 | 7 | Yes, HPW |
| 9 | 5 | |
| 10 | 13 | |
| 11 | 5 | |
| 12 | 6 | |
| Total | 50 | |

Figure 6: San Francisco San Jose MSA Evaluated Projects by Climate Zone



Figure 7: Sacramento Area MSA Evaluated Projects by Climate Zone

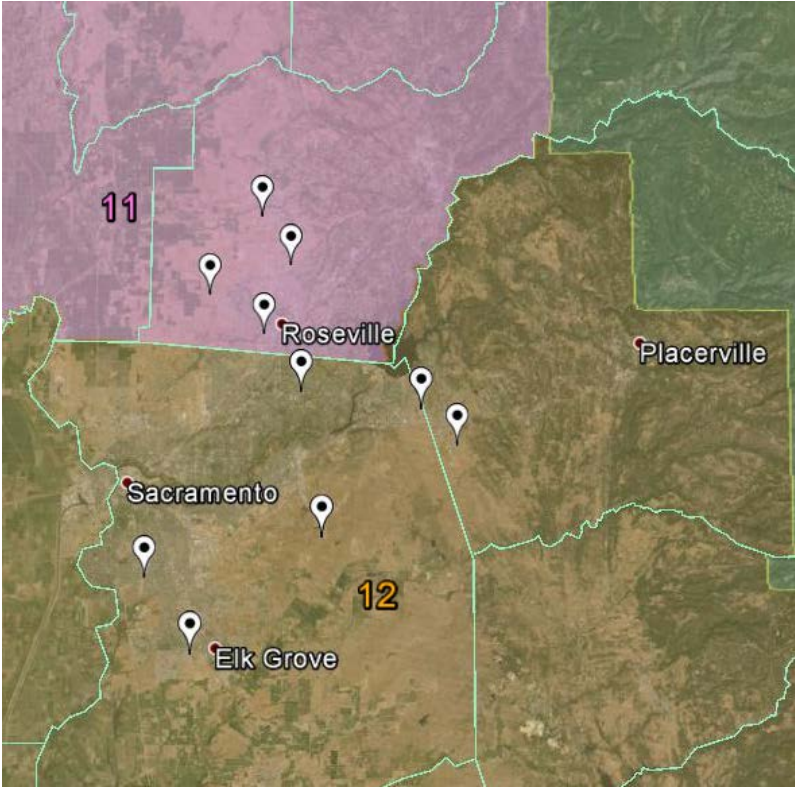


Figure 8: San Diego Projects Evaluated by Climate Zone

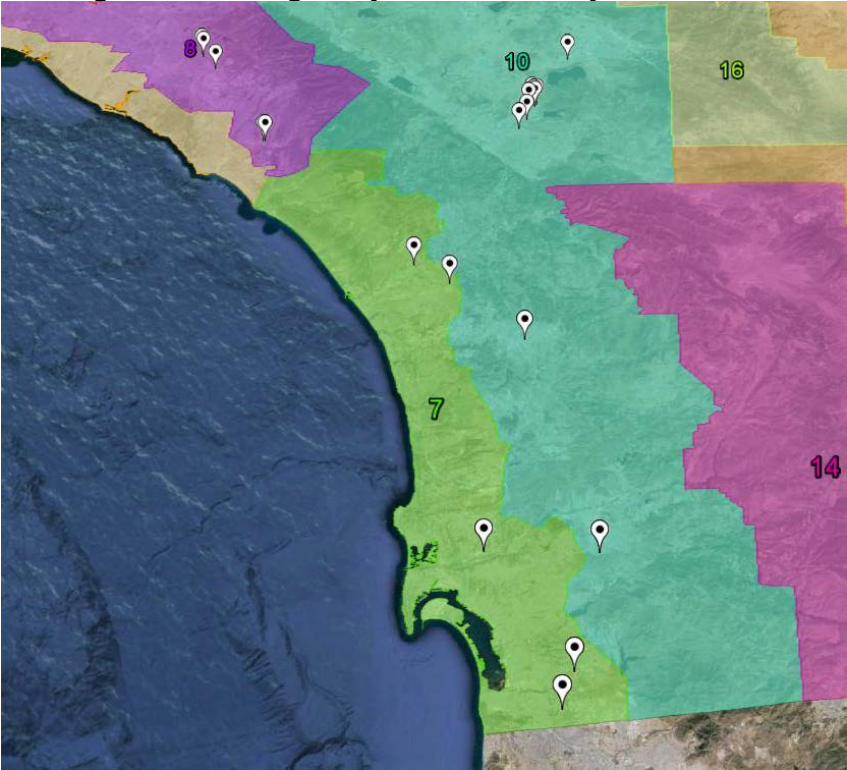
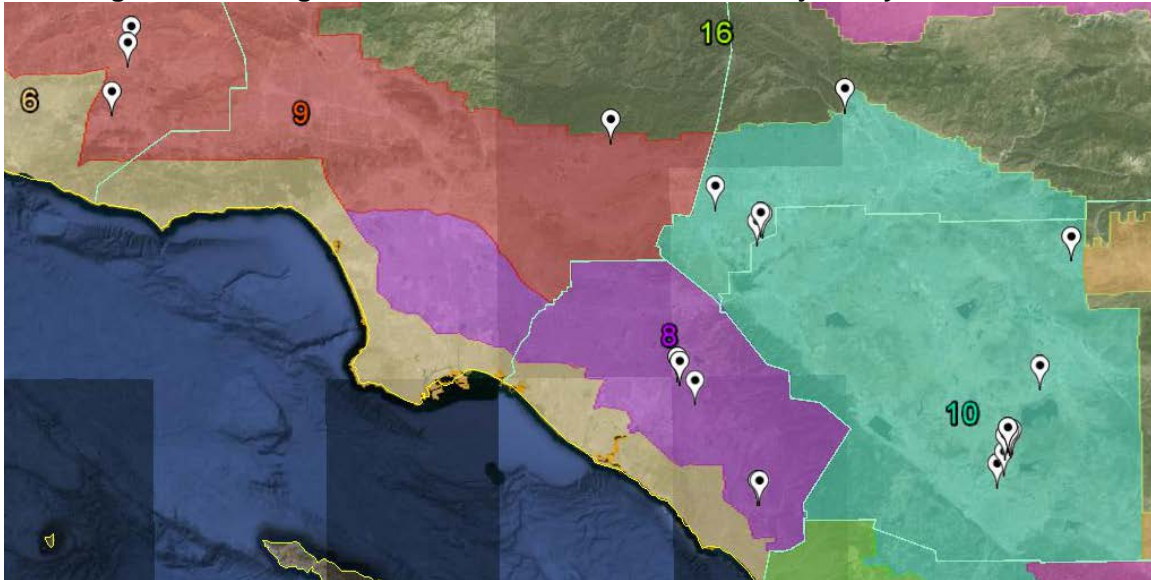


Figure 9: Los Angeles and Riverside MSA Evaluated Projects by Climate Zone



1.2 Wall Construction

1.2.1 Wall Insulation Types

Three types of wall insulation were observed in the sample of homes; fiberglass batt, spray foam and blown-in cellulose. Of these, fiberglass batt was the most common type of wall insulation occurring in 47 of the 50 homes.

Figure 10: Percentage of Wall Insulation Types

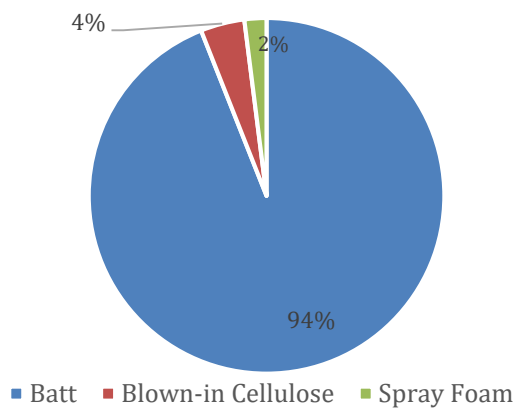


Table 4: Wall Insulation Types

| Type | N. CA | S. CA | CA # | CA % |
|--------------------|-------|-------|------|------|
| Batt | 17 | 30 | 47 | 94% |
| Blown-in Cellulose | 2 | 0 | 2 | 4% |
| Spray Foam | 1 | 0 | 1 | 2% |

1.2.2 Wall Insulation

For exterior walls R-13 was the most common insulation, however 30 homes (60%) had combinations of both R-13 and R-19 insulation installed in exterior walls. Thicker R-19

insulation materials were generally used in the area of the home requiring 2x6” framing to accommodate plumbing for kitchens or bathrooms. This 2x6” framing is typically found in areas of the home where the garage and living spaces adjoin. Based on feedback from field raters, homes with mixed R-value materials and framing had an estimated ratio of 85% R-13 insulation using 2x4” framing and 24% R-19 insulation using 2x6” framing. Wall insulation and framing size were only reported for exterior or garage walls.

Figure 11: Wall Insulation and Framing

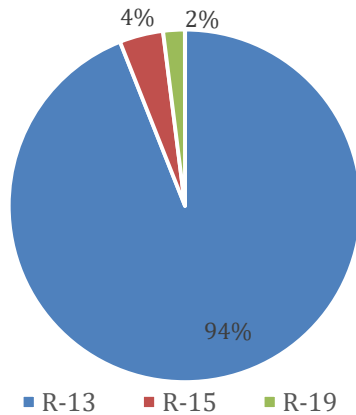


Table 5: Wall Insulation and Framing Types

| Type | N.CA | S.CA | CA | Percent |
|-----------|------|------|-----|---------|
| R-13 | 17 | 30 | 47* | 94% |
| R-15 | 2 | 0 | 2 | 4% |
| R-19 Only | 1 | 0 | 1 | 2% |

* 30 of these projects also include small sections of R-19 and 2x6” framing to accommodate plumbing.

To achieve the u-value of .051 needed for HPW standards in 2016 Title 24 Building Code, single family homes generally need 2x6” framing and R-19 insulation throughout the entirety of the building’s exterior, not just in portions of the home. Only one observed project exclusively used 2x6” framing and R-19 insulation throughout the exterior. However, the sophistication of this design was limited by using conventional 16 inch-on-center framing rather than 24 inch, which can provide additional benefits for HPW construction by significantly reducing lumber use. In 14 of the 30 homes with partial 2x6” framing, 24 inches on center was confirmed to be used.

1.2.3 Sheathing and Stucco

Previous studies have indicated that builders in southern California have historically showed reluctance to use one coat stucco, because of perceived durability and liability issues stemming from class action lawsuits involving water intrusion (PG&E, 2014). Of the 30 homes evaluated in southern California in this report 15, or 50% used one-coat stucco. Of the 20 homes evaluated in northern California, 9 were shown to use one-coat stucco or 45%. Northern and southern California has similar percentages of one coat stucco applications.

Figure 12: Exterior Type

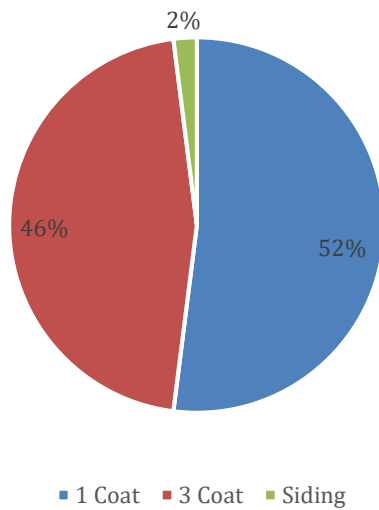


Table 6: Exterior Type

| Type | N.CA | S.CA | CA # | CA% |
|--------|------|------|------|-----|
| 1 Coat | 9 | 17 | 26 | 52% |
| 3 Coat | 10 | 13 | 23 | 46% |
| Siding | 1 | 0 | 1 | 2% |

Figure 13: Wall Sheathing

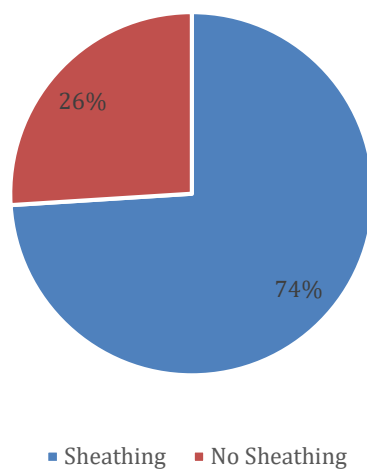


Table 7: Wall Sheathing

| | N.CA | S.CA | CA # | CA % |
|--------------|------|------|------|------|
| Sheathing | 11 | 26 | 37 | 74% |
| No Sheathing | 9 | 4 | 13 | 26% |

1.3 Attic Construction

1.3.1 Ceiling Insulation Types

Four types of ceiling insulation were observed from the sampled projects; blown-in fiberglass, blown-in cellulose, spray foam and batt fiberglass. Blown-in fiberglass was the most common type of ceiling insulation material, occurring in 41 of the homes evaluated. In Northern California, 70% of evaluated homes had blown in fiberglass, 15% have blown in cellulose, 10% had batt insulation and 5% used spray foam. In Southern California 90% of evaluated homes used blown-in fiberglass, and 10% used blown-in cellulose.

Figure 14: Statewide Ceiling Insulation Percentages

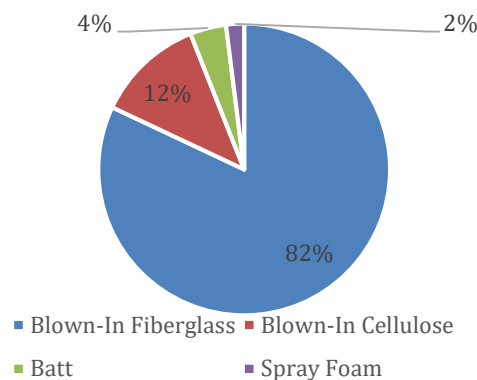


Table 8: Ceiling Insulation Types

| Type | N. CA | S. CA | CA | CA Percent |
|---------------------|-------|-------|----|------------|
| Blown-In Fiberglass | 14 | 27 | 41 | 82% |
| Blown-In Cellulose | 3 | 3 | 6 | 12% |
| Batt | 2 | 0 | 2 | 4% |
| Spray Foam | 1 | 0 | 1 | 2% |

1.3.2 Ceiling Insulation

R-Values for ceiling insulation were split almost evenly between R-30 and R-38. The vast majority of roofs were vented attics, with only two unvented attics observed, both in Northern California. In Northern California 75% of evaluated homes had R-38 and 25% had R-30 insulation. In Southern California, 37% of evaluated homes had R-38 and 63% had R-30 insulation.

Figure 15: Statewide Ceiling Insulation

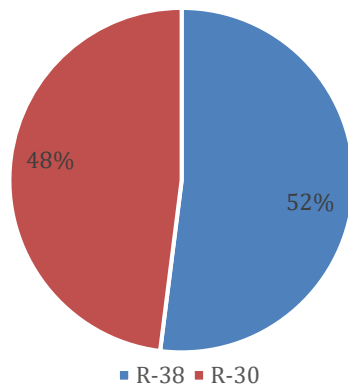


Table 9: Ceiling Insulation R-Value

| Rating | N. CA | S. CA | CA | CA Percent |
|--------|-------|-------|----|------------|
| R-38 | 15 | 11 | 26 | 52% |
| R-30 | 5 | 19 | 24 | 48% |

Chapter 2: Observed HPA/HPW Applications in Homebuilding Market

While the production homes evaluated in the market sampling from Chapter 1 showed limited progress toward HPA/HPW construction in mainstream market offerings, several builders in the state are offering advanced and zero-net energy ready homes in smaller quantities that include high performance building envelopes. These efforts are often aligned with supportive programs lead by agencies and utilities such as the California Advanced Homes Program (CAHP) and the U.S. Department of Energy's Builder Challenge and Zero Energy Home Programs.

In the Los Angeles, Sacramento and San Diego markets, KB Homes is engaged in the construction of single family detached homes that have received negative HERS ratings - an extremely high level of performance. This performance was achieved in part by utilizing a variety of innovative attic configurations. Attics of homes in all three locations received insulation under the roof decks, held in place by boxed netting. The Sacramento home opted for an unvented configuration with batt fiberglass and spray foam sealing the gaps. The Los Angeles project used reflective roof tiles to reduce heat absorption. Walls for these projects remained using 2x4" framing, allowing a maximum of R-15 insulation, enhanced with R-4 exterior foam board. The use of conventional framing in these homes shows that in the most advanced homes complete 2x6" 24" OC with R-19 insulation is a rare occurrence in the California production home markets.

An active adult community by Shea Homes near the San Francisco Bay Area is also implementing conditioned attics in their SheaXero brand of homes using fiberglass insulation placed under the roof deck.

Spray foam attics are being implemented by Meritage Homes in all of their production homes, which included 167 units in the Sacramento market in 2014. These are unvented attics with open cell spray foam that greatly increase the R-values. Spray foam is also being used in the walls.

Some smaller builders are experimenting with high performance building options. DeYoung Homes in Fresno is including high attics in their Sierra Crest subdivision. The attics for these homes are using batt insulation installed under the roofdeck to create a sealed and conditioned space.

The ABC Green Home program in Southern California includes a series of Zero-Net Energy pilot projects incorporating HPA/HPW into the design. Three phases of ZNE type homes are being produced by a group comprised of utilities, designers and builders, and include affordable housing projects constructed for the Habitat for Humanity. For the walls of these homes 2x6 24 inch-on-center walls have been used throughout the exterior framing, combined with spray foam insulation, and exterior rigid foam in various thicknesses.

CHAPTER 3: Conclusion

High performance wall and attic construction is available and is being actively promoted in the state by various manufacturers; however, these practices are not being used widespread by top homebuilders with significant market share. The discovery of 2x6" and R-19 construction techniques in partial applications show at least some proficiency in the installation of these materials is present in the labor market. If HPW/HPW is to become mainstream, builders will need to be educated on how to adopt the practices that have been successfully implemented in one-off projects throughout the state.

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