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## Resiliency Potential in the Wildfire-Prone Single-Family Market

### Overview

Year-to-date, over 44,000 wildfires have devastated the homes and lives of many families within the United States<sup>1</sup>. The Western United States has been particularly affected experiencing a record-breaking fire season. Wildfires have indirectly impacted counties which represent 88% of Oregon's annual cement consumption followed by California (67%) and Washington (33%). These wildfires have led to deaths and displacement, as well as billions of dollars in property damage. While preventing the occurrence of wildfires is difficult, if not impossible, mitigating the effects of these disasters is achievable. Disaster mitigation strategies can help reduce the number of lives lost, as well as minimize property damage. Some wildfire disaster mitigation strategies utilize cement-based products to aid in the protection of lives and property. Given the recent increase in wildfire devastation, the PCA Market Intelligence Group has updated their study from January 2019 to evaluate the size and potential volume of these cement-based strategies in the current single-family home market segment.

**Findings:** PCA estimates there are nearly 21 million homes located in high-risk, wildfire-prone areas. By 2040, this number is expected to rise to over 24 million. An analysis of cement-based fire mitigation strategies capturing 100% of the siding and roofing market in this residential sector reveals the potential of nearly 10 million metric tons annually by the end of the forecast horizon. The ability to realize such potentials is unlikely. Asphalt is cement's primary competitor in the roofing market and is rated as equal in fire resistance to cement tile roofing systems<sup>2</sup>. Near-term opportunities may exist in the siding market as cement-based products may improve in relative price position compared to wood-based products; however, this is not projected to continue throughout the forecast horizon.

**Mitigation Strategies:** PCA turned to research conducted by the University of California, Berkley and government sources to determine the key residential construction components that are part of an effective wildfire mitigation system. According to this research, the most important components of a residential building in terms of wildfire mitigation are roofing and siding materials. Fiber cement shingles and concrete roof tiles are fire resistant, as is fiber cement siding.

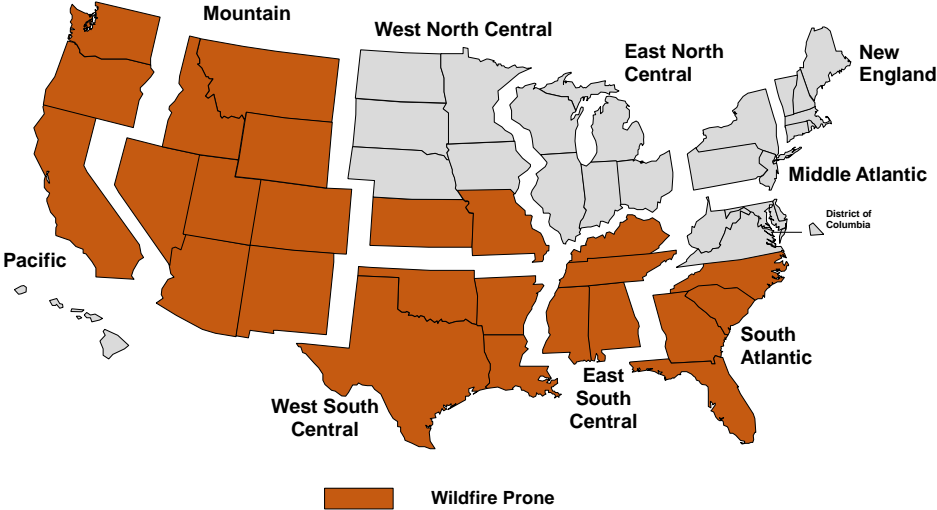


<sup>1</sup> National Interagency Fire Center (Oct. 4, 2020)

<sup>2</sup> See below section: Roofing - Ability to Compete

**Market Size:** To calculate cement potentials, PCA started by first forecasting the number of single-family housing starts and existing homes by state to 2040. Then, drawing from a compilation of research of wildfire activity, an analysis was performed to determine the states most at risk. PCA counts 25 states among those most at risk, with the majority residing in the South and West. The wildfire risk in each state varies throughout its geography. Therefore, just because a house is in a wildfire-prone state does not mean that it is exposed to the same, if any, wildfire risk. In order to narrow in on the amount of housing actually prone to wildfires, the Wildland-Urban Interface (WUI) was used. This provides a much more accurate measure of the amount of at-risk housing in a given state.

**Wildfire-Prone States**



**Methodology:** PCA calculated cement consumption potentials based on single-family home starts and existing stock by state. The housing figures used were those considered to be in wildfire-prone states. From this sample, a determination was made as to the percentage of housing most at risk of wildfire damage. Using data from the National Association of Home Builders (NAHB), the shares of cement-based roofing and siding were calculated. Additionally, the volume of cement tonnage from siding and roofing per home was measured. These metrics were combined to establish the potential of these products in these markets. An estimate of the 100 percent potential of the market assumes 100 percent market share capture for the cement-based products.

Given this approach, the 100 percent potential for cement consumption was 9.2 million metric tons annually in 2020, reaching 10.1 million metric tons annually by 2040. Roughly three quarters of potential cement consumption is in existing homes as the housing stock dwarfs the amount of new starts per year. The large potential does not imply realization of these tons, but it shows areas where gains may be accrued.

<b>(Roofing + Siding)</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>Existing Homes</b>	6,972	7,473	7,614	7,761	7,909
<b>New Construction</b>	2,324	2,619	2,188	2,230	2,236
<b>Total</b>	9,296	10,092	9,802	9,992	10,145

**Wildland-Urban Interface:** The US Forest Service defines the Wildland-Urban Interface as the place “humans and their development meet or intermix with wildland fuel.”<sup>3</sup> There are two subcategories to the WUI: Intermix and Interface.

- **Intermix WUI** is defined as lands that contain at least one housing unit per 40 acres, in which vegetation occupies at least 50% of terrestrial area.
- **Interface WUI** is defined as lands that contain at least one housing unit per 40 acres, contain less than 50% vegetation, but lie within 2.4 km of a heavily vegetated area. A heavily vegetated area is an area containing over 75% wildlife vegetation which occupies an area of at least 5 km<sup>2</sup>.

Both of these categories were included in calculating the percentage of at-risk homes. Using the most recent data, published by the University of Wisconsin, the percentage of homes in the WUI were applied to the existing home and starts estimates to reveal the total number of houses at risk from wildfire.

According to a study posted on the SILVIS Lab website, “Wildfires frequently burn houses in the WUI, and are most difficult to fight there. Furthermore, the WUI is where people often ignite wildfires, and the vast majority of fires are human-caused. While fires are an integral part of many ecosystems and the Earth system as a whole, humans have changed fire regimes globally and throughout the United States, and climate change will increase fire frequency in the future, including in the WUI.”<sup>4</sup>

High-risk areas within wildfire-prone states currently contain roughly 21 million existing homes. Based on PCA’s state-by-state housing projections, an estimated 280,000 new homes are estimated to have been built in wildfire-prone areas in 2020. Starts in these regions are expected to reach 316,000 homes in 2025 and 268,000 new homes in 2040. These starts projections are added to existing stock to yield housing stock estimates, after accounting for the demolition rate. According to PCA calculations, the existing housing stock is expected to grow to 22.9 million homes by 2025 and 24.2 million homes by 2040.

## Housing in the Wildand-Urban Interace

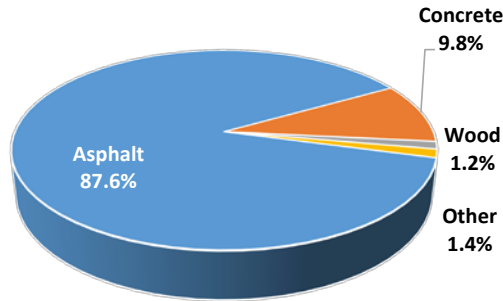
<b>(Thousand Homes)</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>Existing Homes</b>	21,416	22,928	23,353	23,791	24,235
<b>New Construction</b>	280	316	261	267	268
<b>Total</b>	21,696	23,244	23,614	24,058	24,503

<sup>3</sup> USDA’s “Wildfire, Wildlands, and People: Understanding and Preparing for Wildfire in the Wildland-Urban Interface

<sup>4</sup> Rapid Growth of the U.S. Wildland Urban Interface Raises Wildfire Risk. Proceedings of the National Academy of Sciences, 115(13): 3314-3319 2018

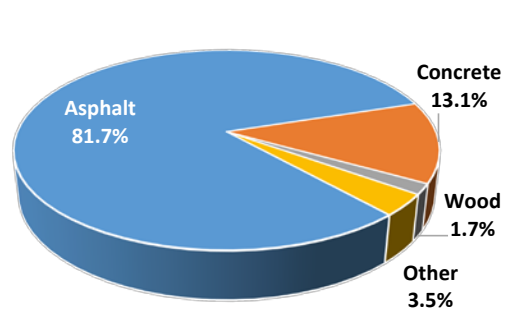
**Roofing Market Potentials:** Asphalt shingles dominate the roofing market for newly constructed homes. Across the United States in 2016, 87.6 percent of single-family homes were built with asphalt roof shingles, and 9.8 percent were built with cement-based roofing systems. However, in wildfire-prone states the percentage of homes using asphalt roof systems dropped to 81.7 percent, while cement roof systems increased to 13.1 percent indicating a more receptive market for concrete roof products.

**Roofing Material Market Share in The United States**



Source: National Association of Home Builders

**Roofing Material Market Share in High-Risk Wildfire States**



Source: National Association of Home Builders

Completely capturing all material segments in the new residential construction roofing market in fire-prone areas calculates to 675 thousand metric tons annually in 2020. In 2025, this potential is expected to grow to 757 thousand metric tons annually. By 2040, total wildfire potentials are expected to be 641 thousand metric tons annually.

### 100% Roofing Cement Potential

(Thousand Metric Tons)

<b>New Homes</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>100% of Market</b>	675	757	627	640	641
<b>10% of Market</b>	68	76	63	64	64
<b>1% of Market</b>	7	8	6	6	6

According to PCA calculations, a 100 percent market share in the replacement roofing system market would yield 2,028 thousand metric tons of cement consumption in 2020. By 2025, this potential is expected to reach 2,173 thousand metric tons. Finally, in 2040, maximum potential is expected to reach 2,298 thousand metric tons annually. This assumes a roofing replacement rate of 25 years.

### 100% Roofing Cement Potential

(Thousand Metric Tons)

<b>Existing Homes</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>100% of Market</b>	2,028	2,173	2,214	2,256	2,298
<b>10% of Market</b>	203	217	221	226	230
<b>1% of Market</b>	20	22	22	23	23

**Roofing - Ability to Compete:** Asphalt shingles hold a large majority share in wildfire-prone areas. According to PCA calculations, if cement-based roofing systems were used instead of asphalt shingles in wildfire-prone states, it would result in an increase of over 500 thousand metric tons of cement in 2020. The remaining roofing material competitors represent just over 5.2% of the market.

Cement-based wildfire mitigation potentials are based on the material’s ability to withstand fire as well as its relative cost position. In terms of the ability to resist wildfires, there are three categories for roofing fire systems according to the American Society for Testing and Materials (ASTM): A, B, and C. The test conducted for a Class A rating is conducted over the course of two hours. A contention with the test is that a home under siege of a wildfire is likely to be under duress for a much longer time period. Under a longer test horizon, many experts believe asphalt shingles would fail, resulting in the home giving way to fire's destructive forces. For the most part, all traditional roofing materials with the exception of wood are rated Class A.<sup>5</sup> This means that an asphalt roof system is rated as effective in reducing the risk of wildfire damage as concrete roof systems. ***This rating effectively puts asphalt and cement-based roofing systems on the same level given a promotion message aimed at wildfire mitigation.***

Given this performance parity, the main differentiation for material selection in roofing systems is assumed to be relative cost. Concrete roof tiles are roughly 140 percent more expensive than asphalt shingles per square (100 square feet).<sup>6</sup> The raw material, asphalt, is expected to show a modest increase in relative price from 2020 levels through 2040.<sup>7</sup> Non-price factors that could contribute to the ability to compete are the vulnerability of asphalt shingles to hail damage, as well as their inability to be recycled given environmental concerns. However, given the significant price difference between asphalt and the nearest priced concrete roofing system, it is unlikely that cement-based roofing products will be competitively priced. ***On a price-basis, concrete roof tiles are not expected to compete effectively in the roofing market.***

## Wildfire Market Summary: Roofing

	2020	2025	2030	2035	2040
<b>Market Size (000)</b>					
Existing Homes	21,416	22,928	23,353	23,791	24,235
New Construction	280	316	262	267	268
<b>Potential (000 MT)</b>					
Existing Homes	2,028	2,173	2,214	2,256	2,298
New Construction	675	757	627	640	641

PCA recognizes there are significant challenges to making inroads into the wildfire roofing market, but acknowledges that a small increased percentage of consumers in WUI areas already choose cement-based roofing products in spite of the cost difference. ASTM Standard E108 dictates that asphalt shingles and cement-based products are grouped together among fire related roofing systems. However, there is a fire performance difference between asphalt and certain cement-based products. A typical asphalt roof system will convey more heat through to the subsurface than a typical raised concrete tile system. This distinction could provide a competitive edge in promoting cement-based roof systems as a superior disaster mitigation product compared to asphalt.<sup>8</sup>

<sup>5</sup> Colorado State Forest Service, Roofing Materials, 1999 Firewise Community Fire Prevention Partnership, <http://csfs.colostate.edu/pdfs/roofing.pdf>

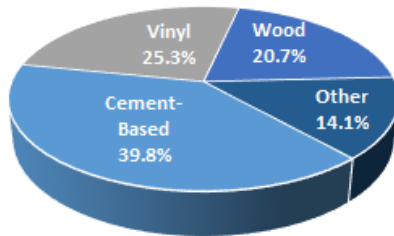
<sup>6</sup> RS Means Residential Cost Data 2012

<sup>7</sup> Competitive Materials Report, Portland Cement Association, Ed Sullivan and Trevor Storck, October 2018 release

<sup>8</sup> University of California, Steven Quarles, Fire Performance Testing: Roofs, UC Agriculture and Natural Resources

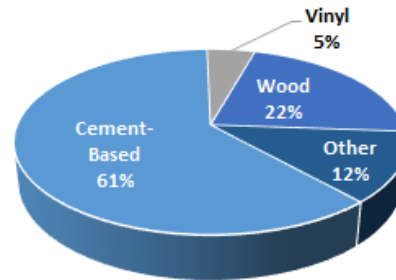
**Siding Market Potentials:** Siding systems that incorporate cement-based materials include brick, natural stone, manufactured stone, cement stucco, concrete block, and fiber cement siding. Market share for cement containing systems is expectedly greater in wildfire-prone states – estimated at 61.3% of new homes built.

**Siding Material Market Share in The United States**



Source: National Association of Home Builders

**Siding Material Market Share in High-Risk Wildfire States**



Source: National Association of Home Builders

The composition of material market share is very different in wildfire-prone states as compared to the U.S. as a whole. The United States as a whole uses more vinyl products than wood products for residential siding. The difference between wildfire-prone states and the national composition indicates a possible trend in material selection toward wildfire resistant systems.

For new construction, PCA estimates that a 100 percent market penetration for cement-based siding products in wildfire-prone areas would yield an incremental gain of 1.65 million metric tons of cement consumption in 2020. This potential increases to 1.86 million metric tons in 2025 and arrives at 1.60 million metric tons by 2040.

### 100% Siding Cement Potential

(Thousand Metric Tons)

<b>New Homes</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>100% of Market</b>	1,649	1,862	1,561	1,591	1,595
<b>10% of Market</b>	165	186	156	159	160
<b>1% of Market</b>	16	19	16	16	16

In the existing home construction segment, PCA estimates that capturing the entire market in wildfire-prone states would yield 4.9 million metric tons in 2020 and 5.3 million metric tons in 2025. By 2040, this market potential grows to 5.6 million metric tons in high risk, wildfire-prone areas. This assumes a siding replacement rate of 25 years.

### 100% Siding Cement Potential

(Thousand Metric Tons)

<b>Existing Homes</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>100% of Market</b>	4,945	5,300	5,401	5,505	5,611
<b>10% of Market</b>	495	530	540	551	561
<b>1% of Market</b>	49	53	54	55	56

**Siding - Ability to Compete:** Wood-based siding makes up the majority of the remaining market in high-risk wildfire areas. It makes up over 50 percent of the non-cement-based market. In order to assess cement-based products' ability to compete, they must be assessed against wood-based products. Given vinyl's small market share, particularly in wildfire-prone states, it will be excluded from this analysis.

Cement-based wildfire mitigation potentials are based on the material's ability to withstand fire, as well as its relative cost position. In terms of the ability to resist wildfires, siding systems are classified by ASTM in a similar way as roofing systems. Classes run from A to C, with A being the most fire resistant and C being the least. All cement-based products are rated Class A. Wood systems are rated Class C.<sup>9</sup>

In terms of wildfire mitigation, cement-based products possess a competitive edge over wood based siding as many of the products are fire-resistant or non-combustible. This competitive advantage could mean little if the cost of cement-based products was significantly greater. However, wood siding materials are generally more expensive than most cement-based siding products. Compared to fiber cement siding, wood siding was 41 percent more expensive in 2012 according to RS Means data. Despite the near-term price advantage — the relative price of lumber to concrete has increased in recent years — relative price is projected to trend in favor of wood in the long run.

## Wildfire Market Summary: Siding

	2020	2025	2030	2035	2040
<b>Market Size (000)</b>					
Existing Homes	21,416	22,928	23,353	23,791	24,235
New Construction	280	316	262	267	268
<b>Potential (000 MT)</b>					
Existing Homes	4,945	5,300	5,401	5,505	5,611
New Construction	1,649	1,862	1,561	1,591	1,595

### Wildfire: Total Market Potentials

Given these assessments, PCA estimates there was a maximum potential of 9.3 million metric tons of cement that could have been consumed in 2020 if wildfire mitigation strategies used only cement-based siding solutions. By 2025, this potential becomes 10.0 million metric tons. At the end of the forecast horizon in 2040, total potential reaches 10.1 million metric tons in wildfire-prone regions. If we assume an increase in cement's market share by 1 percent in these areas, the resulting gain in cement consumption is calculated at 93,000 metric tons in the current residential market. This jumps to 100,000 metric tons in 2025 and 101,000 metric tons in 2040.

### Wildfire Market Outlook

There is a considerable difference between maximum potential and a realistic ability to garner incremental cement tonnage. The market potential for cement tile roofing, for example, is estimated at more than 2.9 tons annually by 2040. Unfortunately, asphalt roofing materials are rated as equal in fire resistance to cement tile roofing materials. The cost premium associated with cement-based products is not expected to come down to a level that is believed to be competitive with asphalt roof shingles due to

<sup>9</sup> Colorado State Forest Service, Firewise; Community Fire Prevention Partnership, August 2005



relative parity in concrete and asphalt producer price indices' projections. As such, a market-based approach suggests very little gain, if any, can be achieved in this market.

The siding market for wildfire mitigation strategies contains a larger maximum potential than roofing. PCA estimates the siding market in wildfire-prone regions could reach roughly 7.2 million metric tons by 2040. Favorable price points for cement-based products compared to wood-based products make this market the more promising in the near term; however, given producer price index projections for concrete and lumber, this may not hold true by the end of the forecast horizon.

### 100 % Cement Potential

<b>(Roofing)</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>Existing Homes</b>	2,028	2,173	2,214	2,256	2,298
<b>New Construction</b>	675	757	627	640	641
<b>Total</b>	2,703	2,930	2,841	2,896	2,939
<hr/>					
<b>(Siding)</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>Existing Homes</b>	4,945	5,300	5,401	5,505	5,611
<b>New Construction</b>	1,649	1,862	1,561	1,591	1,595
<b>Total</b>	6,594	7,162	6,962	7,096	7,206
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<b>(Roofing + Siding)</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>	<b>2040</b>
<b>Existing Homes</b>	6,973	7,473	7,615	7,761	7,909
<b>New Construction</b>	2,324	2,619	2,188	2,231	2,236
<b>Total</b>	9,297	10,092	9,803	9,992	10,145

**Risks:** Building material selection is not the only way that wildfire destruction can be reduced. Indeed, the most recommended ways to mitigate wildfire destruction are proper roof and gutter maintenance, enclosing eaves, soffits, fascias, and vents.<sup>10</sup> Additionally, removing near-house vegetation is a leading way to mitigate wildfire destruction. According to the Florida Department of Agriculture, roofing material selection is the fourth highest priority and siding material selection is the eleventh highest priority out of a list of 12 suggestions of beneficial strategies for wildfire risk mitigation. Additionally, FEMA suggests several relatively inexpensive means to reduce wildfire risk that contain no building material selection guidance.

<sup>10</sup> Florida Department of Agriculture and Consumer Services, Building Construction to Reduce Wildfire Risk