

Safe Havens in Turbulent Times

RESILIENT HOUSING

From wildfires to coronavirus, extreme weather to monster storms, now is the time to build and rebuild our homes to withstand nature's fury.



INSIDE

- Elevating Block Homes with SIPs
- Metal Roofing Best Practices
- Net-Zero Project Raises the Bar
- Pandemic Preparation Insights

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A NOTE FROM THE EDITOR

Flattening the Resilience Curve

There's never been a better time to talk about resilience: the capacity to recover quickly from unexpected (sometimes shocking) change.

BY MATT POWER, EDITOR-IN-CHIEF

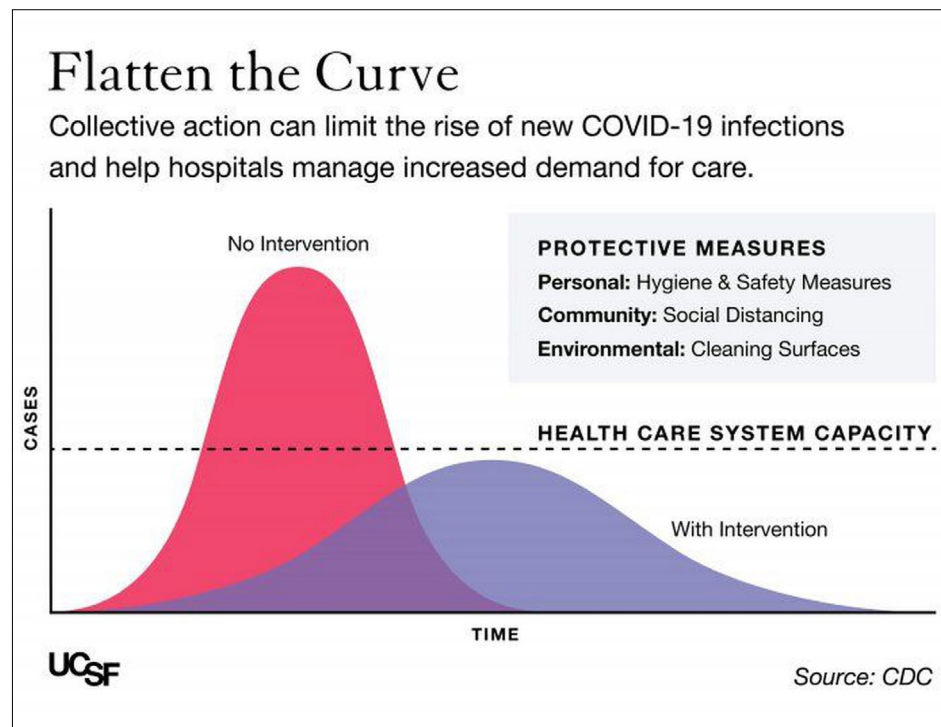
THIS YEAR, INCREASING the resilience of our homes took on heightened urgency. Whatever your opinion about *why* COVID-19 became the global menace that it did, it's unlikely that you escaped repercussions.

Some changes, of course, are more existential than others. Many might argue that a pandemic is the worst-case scenario, and that life-threatening situations are rare. But those who survived the Camp Fire in California in 2018 might disagree. So might homeowners who rode out Hurricanes Andrew or Maria.

There's also the matter of degree. Coronavirus, for example, caused a type of illness far less nightmarish than the bubonic plague of the Middle Ages. However, that doesn't soften the blow for the families of the dead, or those who lost their jobs. We've been issued a dire warning, but not a species deathblow.

There's another threat looming, however, that could wipe us out in far greater numbers: Climate Change. The nature of this man-accelerated threat varies by region, season and sea level. For Californians, it's wildfire, drought and extreme heat. For the Atlantic coast, it's monster hurricanes, persistent flooding, and air pollution. And for everyone, it's the unknown: the next pandemic. War. Mass migration of nations. The list goes on and on.

We may not be able to convince the



Flatter is Better. Managing existential threats means infrastructure is not overwhelmed, and fewer lives are lost.

world's leaders to take dramatic action to slow Climate Change. But we can help builders, architects and savvy homeowners to prepare their homes for both sudden and prolonged challenges.

The term "flattening the curve" has become ubiquitous since the COVID-19 outbreak. In the pandemic scenario, the idea is to slow the transmission of the virus, so that hospitals are not suddenly overwhelmed. In the case of homes in high-risk regions,

flattening the curve might mean elevating coastal homes, or, in drought-prone areas, roofing and siding with more fire-resistant materials, preparing landscapes and installing smart sprinkler systems to ward off wildfires.

Clearly, most people in the U.S. are not prepared for real threats to their normal way of life. Hoarding hundreds of rolls of toilet paper will not make us safer, nor more resilient. Building better homes will. **GB**



Imagine what your house would look like if the greatest minds in sustainability, performance, and design came together to build it – with the goal of remaining within your design parameters and budget.

THE EXPERIENCED PROFESSIONALS at Green Builder Media have joined forces with internationally-acclaimed building scientist and production builder CR Herro (VP Innovation, Meritage Homes) and pioneering green architect Stace McGee (Founder, Environmental Dynamics Inc) to create the VISION House Seattle Cascades: The House the Experts Built.

Located in Enumclaw, WA (the gateway to Mount Rainier National Park) the VISION House Seattle Cascades features the most advanced products, systems, and technologies to achieve extraordinary performance results – all at a reasonable price point. The net-zero, solar powered, high performance, resilient, healthy, and intelligent home boasts stunning design details, an open floor plan, and innovative materials.

Through meticulous planning, space is optimized to significantly reduce material use, jobsite waste, and cost. By deploying advanced building science and superior construction techniques, the home will exemplify resource efficiency and promote occupant well-being.

The result: a simple, replicable template that homeowners and builders can follow, based on decades of experience in the fields of green building, sustainable design, and building science.

FOR MORE INFORMATION:

Look for ongoing editorial coverage about the VISION House Seattle Cascades from Green Builder Media in the coming months. In the meantime, be sure to check out the project microsite at www.greenbuildermedia.com/vision-house-cascades for updated articles, videos, and news about the project.





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Check out the March/April issue of Green Builder® magazine.

2020 Editors' Choice
GREEN BUILDER
HOT50
PRODUCTS

For this year's list of sustainable innovations, it's a brilliant new world for a lot of yesterday's throwaways.

GREEN BUILDER | **2020**
BRAND INDEX

What do green professionals perceive as the most sustainable building products and brands? Find out now.

READERS' CHOICE
2020
GREEN BUILDER

Our professional audience has its own set of preferred brands. Find out which ones had the best sustainability messaging in 2019.

What Makes a Home Resilient?

The right mix of materials and design can mean the difference between survival and total loss.

Renewable Energy
Onsite wind and solar PV systems save energy and turn your home into a "power house" that can potentially feed the grid. Solar shingles or a building integrated photovoltaic (BIPV) system can minimize the aesthetic impact of a solar array.

Right Roofing
Metal roofing is a good choice for both fire and storm resistance. It is also the ideal roofing material for supporting solar PV installations and harvesting rainwater.

Stormwater Management
Directing stormwater to a rain garden, swale or a cistern reduces flooding erosion and water pollution and can recharge groundwater.

Durable Materials
Long-lasting siding materials such as brick, stucco and fiber cement also tend to be fire resistant. Look for products with 50-year warranties. If you do use wood for trim or siding, choose a long-lasting, sustainably harvested species such as cedar.

Rainwater Harvesting
Harvesting and storing water onsite not only saves energy, but ensures your home has a reserve supply if centralized service is interrupted. Recycling graywater and using it to water landscaping or flush toilets will stretch your home's water budget.

Redundant Systems
Back-up power sources ensure your home can ride out storms and other emergencies. Propane or gas-powered generators are a smart option, as are solar thermal systems that can operate independently of the grid.

Stormproof Windows
Reinforced windows with impact glass prevent wind and water from entering the home. A rolling shutter system can protect your windows during extreme conditions.

Smart Siting
Locating homes out of flood and wind zones and siting them to best take advantage of passive solar energy makes them inherently resilient. In the case of this home, its unique circular shape prevents pressure from building up on any one side.

Solid Structure
Reinforced wood framing and alternative systems, such as structural insulated panels (SIPs) or insulated concrete forms (ICFs), are all good options for creating strong, durable buildings.

Multiple Tiedowns
Make sure your home is connected from the roof to the foundation. Metal strapping and hangers help the structure resist seismic forces and high winds.

Firewise Landscaping
Removing brush and kindling around structures minimizes your home's vulnerability to fire. Choose drought-tolerant, fire-resistant native plants for landscaping; visit www.firewise.org for tips on what plants are appropriate for your region.

PANDEMIC-AWARE HOME DESIGN

The next generation of resilient home will need to address new threats such as Pandemics, power outages and food insecurity. We'll cover these in more detail on page 30. Here's a quick checklist:

SMARTER BATHROOMS

From UVC virus-killing lights to self-closing toilet lids, next generation bathrooms allow homeowner to reduce the risk of family transmission of disease.

ISOLATION ROOMS

When one family member is sick, many HVAC systems could quickly spread contagions throughout the home. Zoning the home with smart dampers or choosing individual heating modules such as heat pumps can minimize the risk of spread.

FOOD SECURITY

During long periods of quarantine or "social isolation," the quantity and quality of food becomes a priority concern. Homes may require additional refrigeration, storage space for supplies and generator or batter backups to keep systems operating in a prolonged power outage.

WATER ACCESS AND PURIFICATION

Fresh drinking water is even more important than food during a long quarantine. Resilient homes include water filtration, and, if possible, a backup method of acquiring water, such as a well or rainwater collection.

HOME SECURITY

As much to reduce anxiety as to head off real threats, home security systems can deter looters, alert residents to trespassers and alert local authorities if a real breach happens. New systems include camera surveillance and allow for remote monitoring and interaction with mail carriers and visitors as well.

ENERGY EFFICIENCY

A home that requires less energy to heat, cool and power is simply a safer place to be when the world is in chaos. If resources become tight, there will be less belt tightening necessary to survive and stay safe.

Above the Fray: Concrete Block Meets SIPs

Adding a second floor to an existing block home can be a cost-effective and speedy method of reducing flooding damages. SIPs make that process easier.

FLOODING RISK HAS NEVER BEEN HIGHER in built-up coastal and flood plain areas of the U.S. A [Texas study](#), for example, found that the State is six times more likely to see cyclonic flooding than it was in the 1990s.

The trouble with many coastal regions is that new building codes only apply after the fact. The neighborhoods in places like Miami, Tampa or New Orleans are already built out, with little new construction unless a flood wipes out the old stock.

Another challenge is that the further South you go, the more likely the existing home will be built with concrete block. In South and Central Florida, for example, block homes have dominated for decades.

This changes your options when elevating the structure is the last, best option to save a home from flooding. A frame home can often be raised and even moved to a new location without damaging the existing structure. With concrete, however, you have to repurpose the original home entirely, using the first floor as an unconditioned staging area for the real living space, which begins where the first story ends.

FRAMING AND SIPS

The cost of elevating a home varies widely, from as little as \$5,000, to about \$100,000.

When adding a second story to an existing concrete home, you have many options. You can simply continue the block walls another story, frame it up with traditional 2x6 material, or build with SIPs.

According to [Tom Moore](#), structural engineer and Partner at Pinnacle Engineering in Cincinnati, using SIPs to add elevated living

“SIPS ACT LIKE MORE OF A SOLID UNIT, INSTEAD OF MANY PIECES, THAT ROOF HAS TREMENDOUS UPLIFT RESISTANCE.”

—TOM MOORE,
STRUCTURAL ENGINEER

space in high risk zones offer several advantages: They’re fast to assemble, exceptionally strong in terms of wind resistance, and the roofs avoid a common weak point exploited by high winds.

“When a hurricane happens,” he explains, “the first place you see trouble is when the roof peels away, and the pressure inside goes up by 30 percent—and you’re done...but the way SIP roof panels are attached, they leave no gaps. They sit directly on top of the SIP walls...long screws go right down through the structural lumber in the tops of the walls.”

He says that while it’s possible to achieve similar strength using tie-downs with framing lumber, the job has to be done perfectly, with no missed connectors or half-finished nail schedules. Builders, he notes,

can also increase SIP strength even more by ordering them with an extra plate in the bottom and top of the panel.

“SIPs act like more of a solid unit, instead of many pieces,” he explains. “That roof has tremendous uplift resistance.”

The key to preventing water infiltration in high-wind storms, he says, is to install a water drainage barrier beneath the siding—one that allows the material to dry out later.

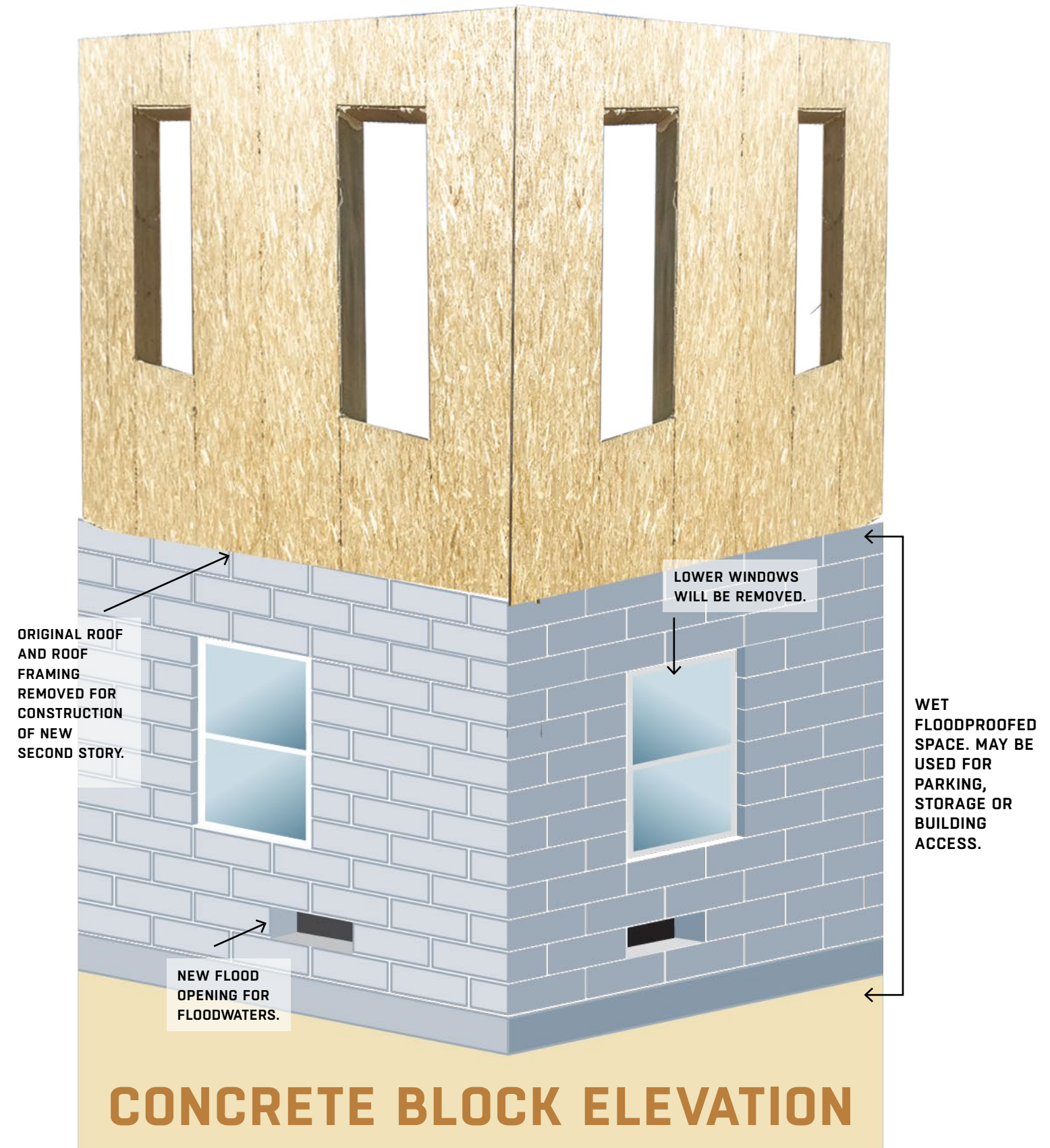
“There have been tests done on SIPs where they are completely saturated, then allowed to dry a while and retested at 95 percent of their load, and they do fine.”

One well-documented SIP project, The Not So Big House, built by Steve Cameron, survived three consecutive hurricanes while under construction in 2004. That house was built with Insulspan SIPs, a long-time member of SIPA.

There have also been anecdotal accounts of SIP homes surviving Tornadoes, including a direct hit in Tennessee. According to AcmePanel:

“Mac and Kim Chelsey built their two story home out of SIPs, because the material promised more durability, energy efficiency, and a quieter environment than found in stick built homes. They did not expect to be woken by the horrendous noise of a tornado barreling down on their new home. Imagine their relief when their SIP home withstood the 200 mph winds and the only damage to their house was two broken windows and a few loose roof shingles.”

For specs and more information on SIP building for Resilience, visit the Structural Insulated Panel Association: www.sips.org





Net Zero House: Surviving in Style

Master builder Ted Clifton built this SIP home for resilience, without sacrificing comfort.

BY GREEN BUILDER STAFF

WHEN TED L. CLIFTON was asked to design a net zero home for clients in very Northwestern Wash., he already knew the goals he had to meet. This wasn't his first such dwelling; it wasn't even his first in the tight-knit city of Anacortes, population 18,000-plus.

Energy efficient.

Cutting-edge appliances throughout the kitchen, including Bosch ovens and a Samsung induction cooktop, reduce overall energy demand.

Local lumber.

Locally sourced and produced wood for cabinetry keeps the house modern and the area economy strong.

LEDs with style.

The Anacortes Triple Zero Home features manufacturer-varied LED lighting throughout, in different sizes and shapes—and great energy and dollar savings.

Smart plumbing.

The home's water fixtures feature short plumbing runs, which results in faster warming and less waste.



After all, being net zero really means being exceptionally efficient with a home's components. In this case, the goal was triple zero, as in zero energy, zero water and zero carbon emissions. Again, not impossible if done right, he notes.

But this dynamic living quarters—dubbed “The Anacortes Triple Zero Home”—gave

Clifton, founder and chief designer at Zero-Energy Home Plans, LLC, and his builder partner, David Wallace of CVH Inc./Clifton View Homes, a few things to think about. There wasn't much property to work with, and owners wanted a premium view of Lake Erie, one of Skagit County's lowland lakes.

“We needed to fit on a very tiny, narrow lot, while staying at least 100 feet back from Lake Erie, and not taking up the same space as the already-in-place on-site septic system,” Clifton notes. “[Ultimately] we were able to fit a three-bedroom, three-bath luxury home into less than 1,900 square feet of conditioned living space, while minimizing exterior surface area with [a] rounded shape.”

GREEN DESIGN IS IN THE DETAILS

The key starting point in the Triple Zero Home's construction came with the use of structured insulated panels (SIPs) and their composition: a structural insulating foam core sandwiched between two structural facings—typically a composite board such as oriented strand board (OSB).

Clifton View Homes notes that SIPs are manufactured under factory controlled

Project Stats

NAME: Anacortes Triple Zero Home, Anacortes, Wash.

ARCHITECT/DESIGNER: Ted L. Clifton, Zero-Energy Home Plans, LLC

BUILDER: David Wallace, CVH, Inc. dba Clifton View Homes

PHOTOGRAPHER: Ted L. Clifton

conditions and can be fabricated to fit nearly any building design. The result is a building system that is extremely strong, energy efficient and cost effective. Building with SIPs can actually save time and money because the components come ready to install and don't require extra labor for each component, the company states. The large panel sizes also contribute to a very tight building envelope.

“The use of SIPs allowed us to go places with the design that would not have been possible using conventional framing methods,” Clifton says.

NATURAL LIGHTING AND MORE

Solar power became another key component in the home's construction. Triple-pane high solar heat gain windows, combined with the Triple Zero Home's long south-facing

overhangs, allows owners to collect lots of passive solar heat during the winter, while minimizing solar gains during the summer.

There were also internal atmospheric conditions to meet. With a blower-door test just over 1.0 ACH50, developers provided fresh air through a MERV 21-powered HEPA filter, which also serves to balance the range fan. A Panasonic *WhisperGreen* bath fan provides the ANSI/ASHRAE Standard 62.2 make-up air requirement, using a High-efficiency particulate air (HEPA) filter as its conduit for fresh air to enter the home. And the COP 3.92 Chiltrix *Air-to-Water CX34* heat pump reheats the incoming air more efficiently than it could be recovered using any currently available heat recovery ventilator (HRV), Clifton notes.

“The home was [also] built without any material containing volatile organic compounds (VOCs) inside the building envelope, possibly making this house a ‘Quadruple-Zero’ house, if anyone is counting,” he notes.

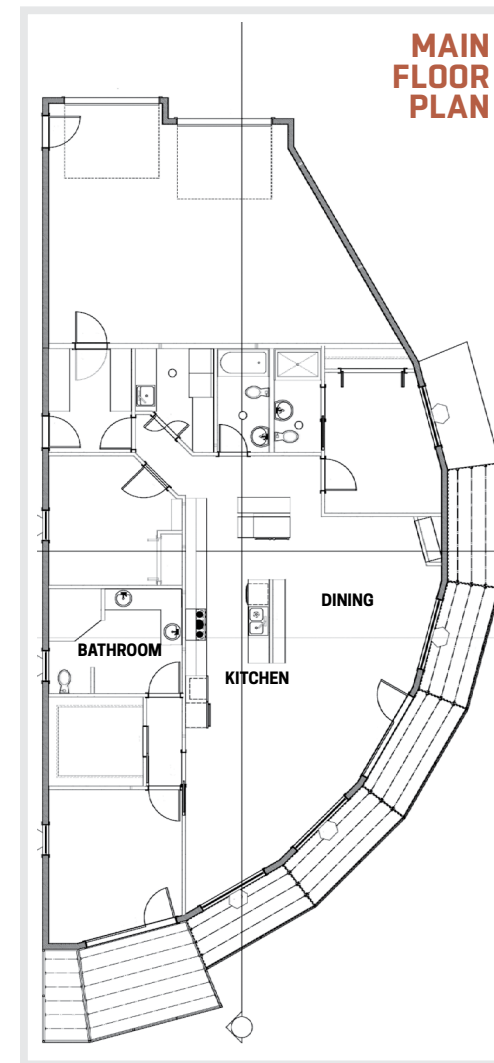
SECONDARY LIVING IMPROVEMENTS

Clifton and Wallace also tackled two key green areas that are outside the main living area.

In the basement, there is 20,000 gallons of fresh water storage, along with a rainwater treatment system. The basement also houses the buffer tanks and pumps for the hydronic air-to-water heating system, providing heat and hot water to the home at an efficiency of 392 percent.

And in the garage, two 240V, 40A charge ports provide enough energy with only the first two-thirds of the photovoltaic system installed to power an electric car for about 6,000 miles per year. With the other one-third of the solar array installed, the home would power itself and two electric cars for more than 30,000 miles per year. It's a key point for anyone who wants a truly sustainable home, Clifton stresses. “In our opinion, you are not zero until your house *and* your car are zero,” he says.

Overall, Anacortes Triple Zero Home showcases Zero Energy Home Plan's philosophy. “We get a kick from hearing customers stories about no energy costs,” the company notes. “We hear how some homes have excess solar production and are ‘fueling’ their electric cars; they tell us how they love the floorplan, and the way the house ‘lives.’ This helps affirm that we are providing real value in our home designs.” **GB**



From the Judges

“This home had to be shoehorned into a narrow site with constraining setbacks. The round form of the floor plan minimizes exterior walls and takes advantage of solar exposure for PV and passive gain in the winter while providing shade in the summer.”

Key Components

ALTERNATIVE BUILDING SYSTEMS: Graphite-infused structured insulated panel (SIP) construction for walls and roof

APPLIANCES: Bosch ovens, Samsung induction range, Bosch dishwasher, Sub-Zero refrigerator, Bosch laundry pair

AUTOMOTIVE: Two 40A electric car charging stations in garage

BUILDING ENVELOPE: James Hardie *Hardiplank* siding over Kimberly Clark *BLOCK-IT House Wrap*; 6 1/2-inch graphite-infused SIP walls; half-inch Gypsum Wall Board (GWB) interior; R-28 wall assembly; 10 1/4-inch graphite-infused SIPs roof; Grace Ice & Watershield underlayment; standing-seam roofing from Taylor Metal; 5/8-inch Type X GWB interior; R-46 assembly

CABINETS, SHELVES, MILLWORK: Custom cabinets from Woodhouse of Anacortes

CAULKS AND SEALANTS: SIP sealants from Premier Building Systems, Puyallup, Wash.; zero volatile organic compound (VOC) siding and interior sealants from GE.

CENTRAL VAC: Rough-in only.

COUNTERTOPS: Granite

DECKS: Sustainably harvested eucalyptus wood decking

DOORS AND HARDWARE: Vinyltek exterior *Euro Twist* glass doors; Codel *C6P* and *SF61* other exterior doors with Schlage hardware; Masonite interior doors with Schlage hardware

ELECTRICAL: 100 percent LED lighting; wireless repeaters in every room for optimal performance

EXTERIOR FINISHES: Sherwin-Williams zero-VOC exterior and interior paints

FIRE PROTECTION: Uponor fire sprinkler system

FLOORING: Finished concrete, surface ground finish.

GARAGE DOORS: Clopay R-18 panel doors

HOME CONTROLS: Integral to HVAC system

HVAC/DUCTS: In-floor radiant system, Chiltrix *CX34* air-to-water heat pump

INSULATION: R-38 closed-cell spray foam insulation under floor; the rest is SIP except for air-sealing of rim-joists and other minor areas also using closed-cell spray foam

LANDSCAPING: By owner, native trees or semi-dwarf fruit trees closer to house

LIGHTING: 100 percent LED, various manufacturers

PAINTS AND STAINS: Sherwin-Williams zero-VOC products (no stains)

PLUMBING/PLUMBING FIXTURES: Nebia shower valves and heads, Kohler wall-mounted toilets, Kohler sinks,

Moen faucets

RENEWABLE ENERGY SYSTEMS (SOLAR, WIND, ETC.): 9,450 kW solar array, with room for another 4,725 watts for future car charging

ROOF: Taylor Metals standing seam steel

STRUCTURAL COMPONENTS: Boise Cascade *BCI* joists, *Glulam* beams

TELECOMMUNICATIONS: By owner, custom computerized system

VENTILATION: Fantech *CM200* HEPA filter, coupled to Fantech *RVF6* range fan for balance; Panasonic *WhisperGreen* bath fan; HEPA filter; Chiltrix *CX34*

WATER FILTRATION: Part of rain-water catchment system designed by RainBank of Seattle

WATER HEATING: Chiltrix *CX34*

WATER MANAGEMENT (INDOOR/OUTDOOR): Overflow water used for outside irrigation, with a 3,000-gallon tank for storage; indoor water is managed by low-flow faucets and short plumbing runs; hot water circulation system on timer to limit wasting of water while waiting for hot

WINDOWS, SKYLIGHTS, PATIO DOORS: Vinyltek triple-glazed Triple-Low-E glass, U-value average 0.16, high SHGC for optimum passive solar heating of concrete floor; large overhangs to limit excess summer solar gain and help with rain water collection.

Defying the Inferno

Only a small percentage of homes in wildfire areas are currently built to new codes.

This has to change.



Fire Shield. One of the most effective material upgrades in a home is the addition of a quality metal roof. When combined with fire-resistant siding, fire-stopping soffit vents and other products, a home becomes far more resistant to wildfire destruction.

PHOTO: FOLLANSBEE STEEL



BEFORE

Coffey Park in Santa Rosa was leveled by fire (left). Unfortunately, say NFPA fire experts, they are rebuilding without using wildfire-resistant standards, which leaves the area vulnerable to future fires. PHOTOS: GETTY IMAGES

BY MICHELE STEINBERG

OUR LAST E-BOOK about wildfire, “[Design With Fire In Mind: Three Steps to a Safer New Home](#),” was issued in 2015. In it, we described the significant risk that homes face across the nation from wildfire ignition, and laid out the basic steps for builders, developers, and homeowners to take to make new construction more fire resistant.

Design With Fire In Mind noted that nearly every place in the United States has a risk from wildfire, and documented the decades of scientific research involved in the steps that people should take to design, build, and maintain homes in safer, more sustainable ways. The book also urged people to engage across neighborhoods to act to reduce ignition risks, using such programs as Firewise USA®.

So what’s different four years later? Wildfire still obeys the same laws of physics, and ignites and spreads according to the conditions for combustion. Our national

experience since 2015, however, has been traumatic, painful, and eye opening.

In 2016, a single wildfire complex across Gatlinburg and other communities in Sevier County, Tenn., took 14 lives and destroyed an estimated 2,100 structures. Back-to-back record-setting wildfire seasons in California in 2017 and 2018 destroyed more than 25,000 residential structures, took more than 100 lives, and resulted in an estimated \$24 billion in insured property losses.

Post-fire scenes read like a textbook on how NOT to design and build communities in areas of high wildfire risk. Communities in Tennessee, California, Colorado, and Utah—the [top states when it came to home destruction from 2013 to 2018](#)—had a lot in common with one another. In some of the most naturally fire-prone areas, steep terrain and heavy vegetation made fires that started in those communities very hard to control. In addition, many homes, most built without the benefit of codes addressing ignition resistance, were located on slopes

that made them more vulnerable to fire, and much harder to reach for any responders attempting to protect them.

In many of the fires of the last few years, homes were also located close enough to one another to make them highly vulnerable to structure-to-structure ignition, resulting in total devastation in places like the Coffey Park subdivision in Santa Rosa, Calif., and much of the town of Paradise in California’s Butte County.

Photographs taken after the fires attest to the atom-bomb hellscape that remains after this type of urban conflagration. It also demonstrates clearly that homes were more flammable than the trees and shrubs surrounding them, still standing in the midst of the devastation.

OBSERVATIONS FROM RECENT WILDFIRE HOME DESTRUCTION EXPERIENCE

What have we found after these disasters? Much of what the science predicts came to

AFTER



pass, and history was repeated, with horrific results. Codes did make a difference, in the few pockets where they were applied, but did not eliminate the likelihood of home destruction. Businesses and critical facilities were damaged and destroyed: In the case of the 2018 Camp Fire in Butte County, a major hospital lost its entire cardiac wing; in the 2017 Tubbs Fire in Sonoma County, a large Kmart store and a hotel in a well-known chain were both destroyed.

Firewise USA sites had mixed results, possibly because wildfire risk reduction was taking place in open-space areas rather than focused on homes and their immediate surroundings. Essentially, far too few homes and businesses built in these vulnerable sites had any kind of design features to help them survive. And far too few neighborhoods have taken the serious steps necessary to resist the destruction of entire subdivisions and communities.

To truly protect people and property, however, takes everyone coming together

to raise awareness and bring the necessary solutions to the table. To that end, the National Fire Protection Association® (NFPA®) is promoting a holistic approach to the wildfire problem via its Fire & Life Safety Ecosystem, acknowledging that a single weak link opens the whole system to catastrophic failure. These recent experiences demonstrate that many elements of the system must be strengthened.

So are disasters like this avoidable in the future? The evidence points to a qualified yes—if builders, developers, and home buyers insist on a greener, safer, more sustainable way of building and rebuilding our neighborhoods in high-risk areas.

WHAT WE LEARNED FROM THE FIRES

Since 2013, the California Department of Forestry and Fire Protection, better known as CAL FIRE, has used a standardized method of collecting data about structures within the perimeter of major wildfires. Over the course

of six years, the agency captured information from 98 major wildfires. Structures within fire perimeters are classified from the worst case, “destroyed,” which are structures suffering an estimated 50 percent or more damage, to major (26–50% damage), minor (10–25% damage), affected (1–9% damage), down to “no visible damage.”

NFPA and CAL FIRE combined this information from recent fires in California (the 2017 Tubbs, Atlas, and Nuns Fires) with environmental, neighborhood, and property information to explore indicators of structure survivability.

Early findings indicate that predictors of home destruction include the combination of the position of structures on slopes (structures on east-facing slopes during fires where the wind was pushing flames from east to west fared the most poorly) and high-density development of wood frame structures. [An analysis of the same damage information for the Camp Fire by Sacramento-based publishing company McClatchy](#) showed



that newer homes—specifically those built after the passage of California’s 2008 Building Code that required specifics for design and construction of homes in designated fire hazard areas—survived with much greater frequency than older homes nearby.

More than half of those homes were undamaged, while the survival rate for the pre-code construction was a meager 18 percent. But only 350 of the more than 12,000 homes in the wildfire’s perimeters were built recently enough to benefit from the code.

While only 1 to 2 percent of destroyed buildings in the 2017 and 2018 wildfires were commercial buildings, the fact that a hospital, a major retail store, and a hotel all suffered major damage or destruction was surprising to some observers, especially when noting that many similar structures survived. Just like homes, commercial structures can be vulnerable to ignition depending on their siting, design, maintenance, proximity to flammable vegetation and other structures, and their ability to withstand the onslaught of embers.

Significant business-related impacts beyond destruction of physical facilities included disruption of business operations due to closed roads, power outages,

contaminated water, displaced customers, and displaced or homeless employees.

WE REPEAT: THE KEYS ARE MATERIALS, DESIGN, LANDSCAPING, AND MAINTENANCE

A well-built home or business with landscaping modified to reduce ignition potential, that is maintained carefully over time, will fare better in a wildfire. As noted in *Design With Fire In Mind*, taking the fire science research into account when siting, designing, building, and maintaining homes is not difficult, but does take some careful planning. It’s important to realize that embers from a wildfire can travel over a mile before landing on roofs, in gutters, and in landscaping materials around homes. To prevent ignition from embers and flames traveling across grass or in nearby vegetation, consider the following:

- Use non-flammable roof and ignition-resistant construction elements including siding, decking, and windows.
- Understand that openings in the home—vents, doggie doors—are potential ember entry points and protect accordingly.
- Review roof/gutter/vent design carefully. For example, complex roofs pose more

hazards; edges are vulnerable, including skylight edges; gutters can collect debris; gable end vents are most vulnerable to ember entry from wind. The best solutions include simple roofs, no gutters (if practical), no vents (if practical) or under-eave vents.

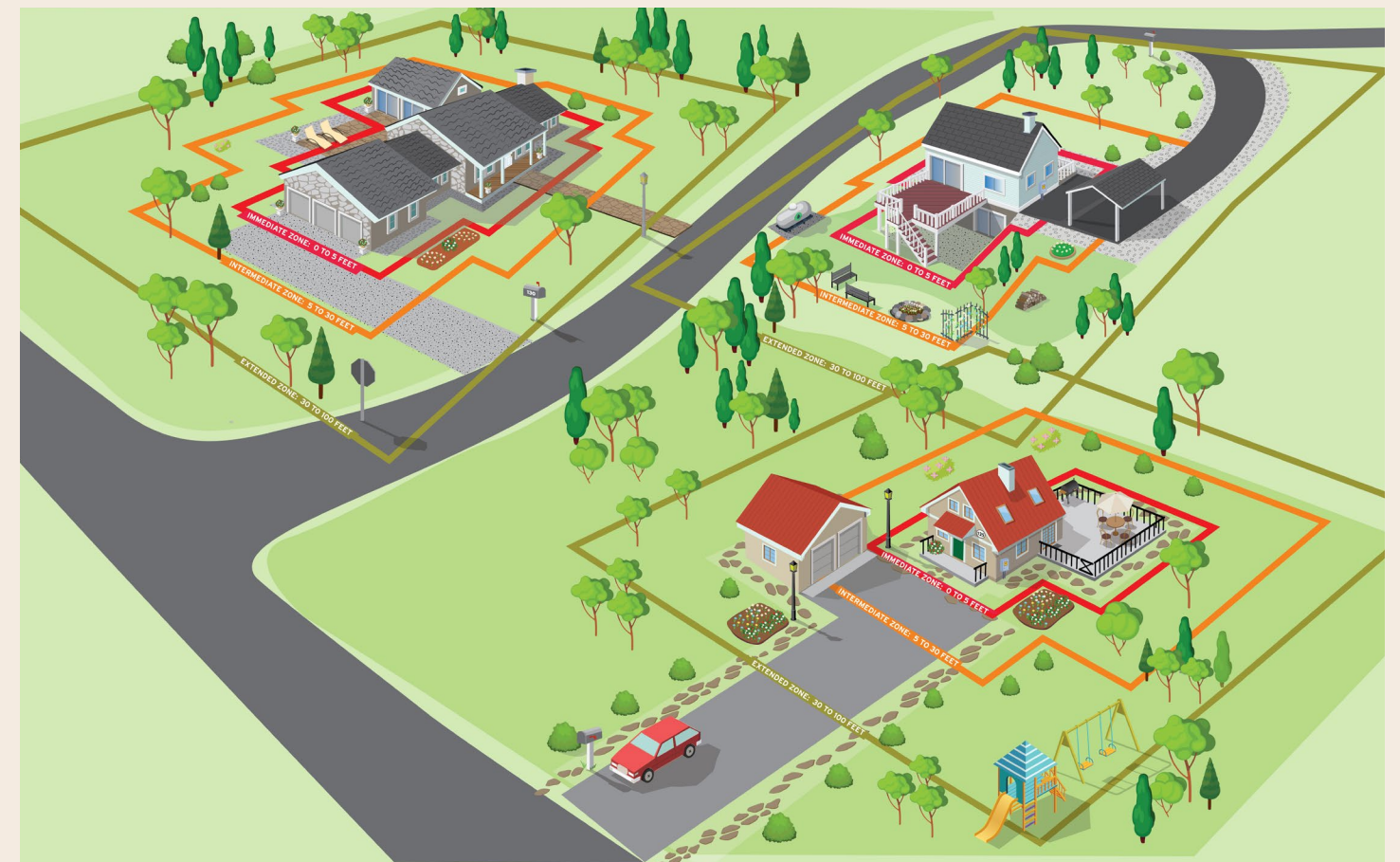
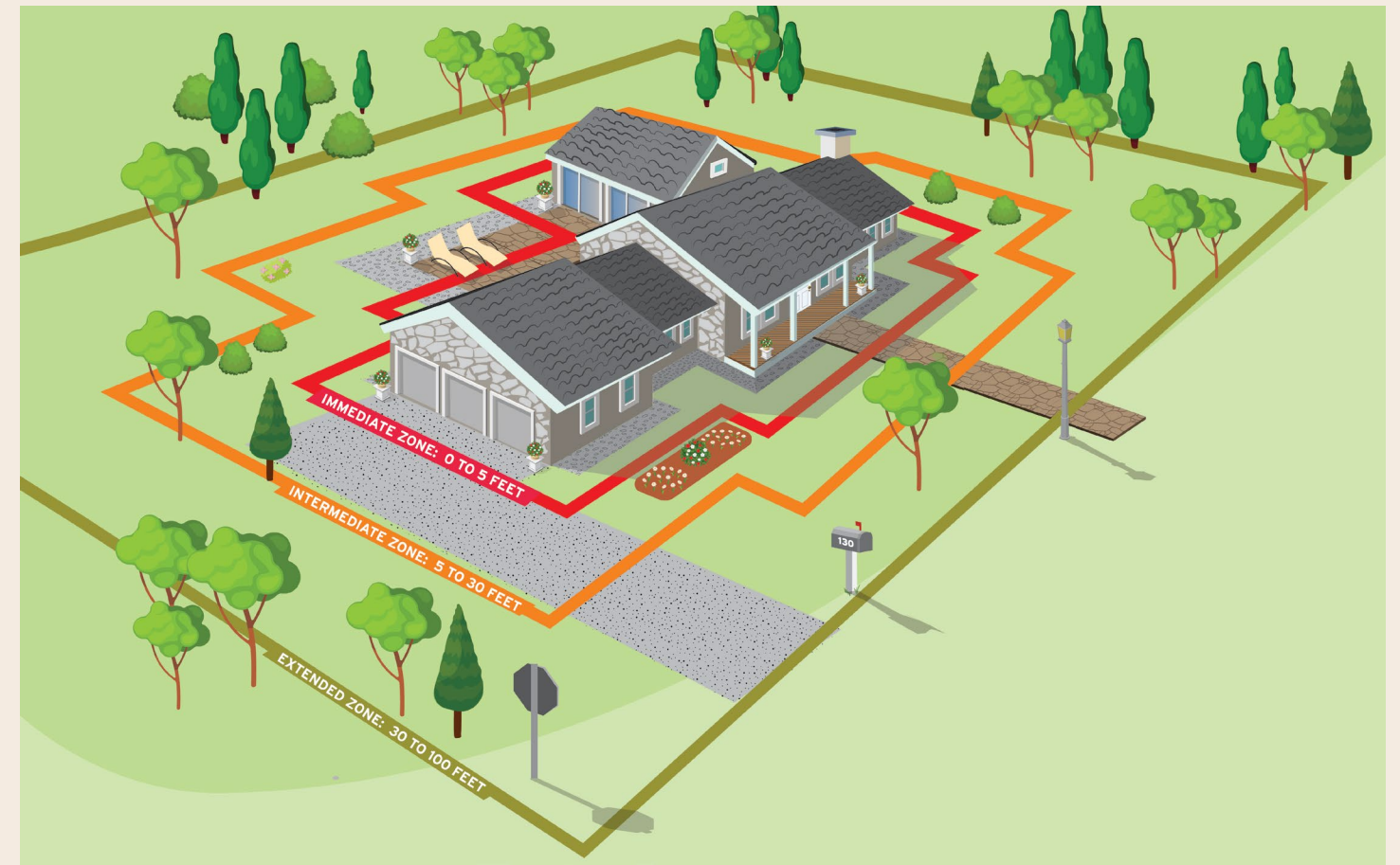
Remember that attachments—porches, decks, fences—are physical extensions of the home that can also be points of ignition that can carry fire to the main structure. Those must be designed with ignition resistance in mind as well.

Addressing both landscaping and construction in making structures safer is critical. The concept of the home ignition zone—the home itself and everything around it within up to 100–200 feet—is what should be addressed in new construction as well as in retrofit and home maintenance. These basic principles also apply to commercial buildings.

Key home ignition zone concepts are explored in more detail on NFPA’s website on preparing homes for wildfire [here](#).

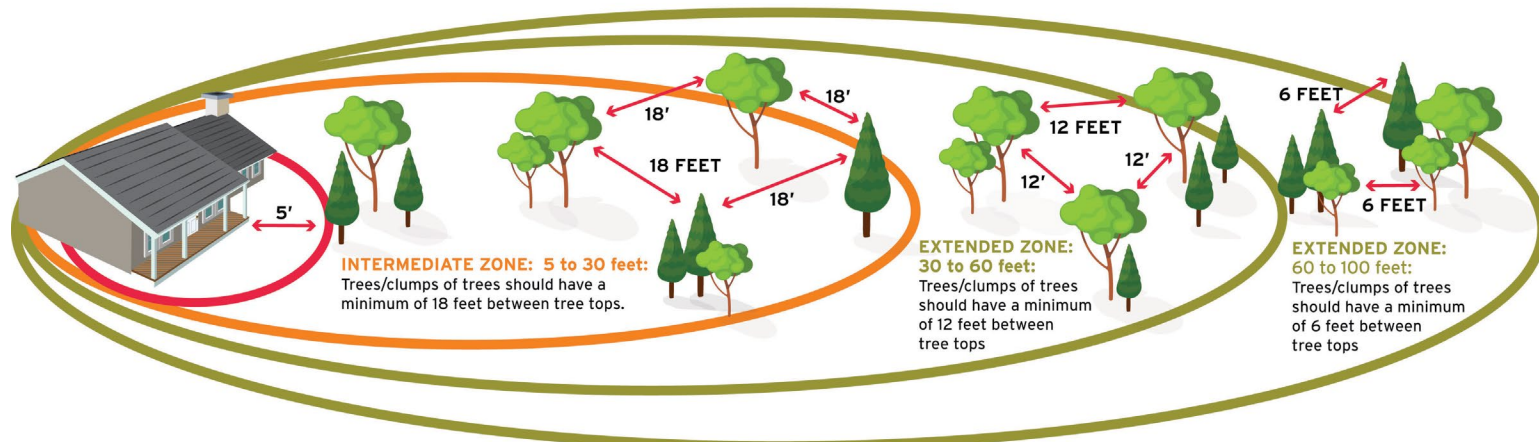
NEW RESEARCH EMPHASIZES THE IMPORTANCE OF THE HOME IGNITION ZONE

Since 2015, the Insurance Institute for Business & Home Safety (IBHS) has



These diagrams are examples of ignition-resistant construction and design. Home ignition zones often overlap onto adjacent properties. This makes the conditions of neighboring homes and vegetation a part of the wildfire threat. It’s extremely important that neighbors work collaboratively with each other to reduce their shared risk. PHOTO COURTESY OF NFPA

TREE SPACING



Source: National Fire Protection Association®. All rights reserved. Visit www.nfpa.org

Developments that incorporate ignition-resistant design may also help set a new aesthetic for communities, particularly with regard to the immediate landscaping around the home. Rather than the uninterrupted fuel bed that wood mulch, grasses, and dense shrubs present, design of the landscape can open up tree canopies, and use less thirsty mulches and ground covers.

PHOTO COURTESY OF NFPA

conducted hundreds of tests involving embers and home structures at its Research Center, resulting in a series of Wildfire Research Fact Sheets created in partnership with NFPA. These help to translate the scientific findings about ignition potential for structural elements of the home, possible mitigation activities and their relative effectiveness, and strategies that builders and owners can take to design, retrofit, and maintain structures for greater safety.

Some of the key findings include the importance of preparation of the home ignition zone—again, the home structure itself and everything around it within about 100–200 feet. Within this space, modifications to the immediate area around the home—from the perimeter of the structure out to about 5 feet—have proven critical to preventing or minimizing ignitions. More than 180 tests conducted by IBHS vividly demonstrate the difference in results when this immediate zone contains no flammable mulch or other material that can burn and thus ignite the side of the house. Testing has also shown that corners of a building can experience both higher temperatures when exposed to flames and faster flame spread if mulch or other flammable material is on the ground.

While preparation of the area within 5 feet of the home and its attachments is critical, design for ignition resistance doesn't stop there. Careful plant and landscaping choices for the area surrounding the home out to 100–200 feet are also very important

to break up paths where fire will ignite grasses, shrubs, or trees and to minimize the accumulation of overgrown vegetation, grasses, or woody debris.

To see the other structure elements that IBHS has tested, check out the free [IBHS/NFPA Wildfire Research Fact Sheets](#).

RISK MAPS ARE NOT REFLECTIVE OF THE SCIENCE OF HOME IGNITION

Post-fire investigations since the 1960s have shown that home destruction during wildfires is not only a function of fire in vegetative fuels, but also—and often—a result of structure-to-structure ignition. Wood-framed (and sometimes wood-roofed) homes within 50 feet of one another can pose ignition risks once one ignites and begins to burn.

Unfortunately, neither the impact of embers nor the potential for structure-to-structure ignition is considered in traditional risk mapping, which is usually based on the assumption that fire will spread directly from vegetation into the community due to the proximity of flammable structures to the radiant heat from a wildfire. This gap in our ability to visualize and communicate risk has proven severely detrimental to places like Santa Rosa, where the densely developed Coffey Park subdivision was zoned as “urban” (read “unburnable”), yet suffered catastrophic losses when embers from the Tubbs wildfire on the ridge above the city center rained down onto vulnerable

landscapes and structures, causing an urban conflagration.

In the absence of more accurate risk mapping that takes embers and structure-to-structure fire spread into account, what can a builder or developer do? One publicly available resource is historical fire maps, images, and accounts. In the case of the Tubbs Fire, different decisions may have been made had local authorities understood fire history, and that the 1964 Hanley Fire had burned in the very same area.

Decision makers may have done things differently had they recognized that wildfire will return to the same locations over time, and that a fire's fuel is not limited to vegetation. The laws of combustion mean that wildfire will continue to burn if fuel is available, and flammable structures—homes and businesses—equate to fuel in this scenario.

BUILDING RIGHT THE FIRST TIME IS EASIER THAN REBUILDING

Past decisions on where and how to build significantly affect not only whether structures will survive or burn, but how rebuilding will proceed.

Historical patterns of development on steep slopes, or on ridgetops, or closely massed wood-frame buildings simply aren't sustainable when trying to rebuild in a safer manner. However, most homeowners are locked into this pattern because of the land they own and often due to insurance

requirements or lack of coverage that limit their options for rebuilding more safely and sustainably. In areas where many homes are destroyed in a single event, the whole community is invested in a speedy rebuild to get people rehoused and to limit the impact on property tax revenue.

Even in areas where circumstances force rebuilding in the same lot line, more can be done to ensure a safer future. Applying the sound principles of ignition resistance need not require regulatory changes. However, it's important to note that having codes in place before a disaster occurs helps to level the playing field for redevelopment. When all rebuilt structures meet minimum standards for wildfire ignition resistance, it contributes to a safer community as recovery progresses.

Another big benefit to having codes or ordinances already on the books before wildfire occurs is in relation to insurance requirements. Savvy homeowners who have opted for insurance coverage that pays for any additional cost to meet updated codes for rebuilding or repair (known as ordinance or law coverage) will benefit by having a way to pay for required safety upgrades.

Developments that incorporate ignition-resistant design may also help set a new aesthetic for communities, particularly with regard to the immediate landscaping around the home. Rather than the uninterrupted fuel bed that wood mulch, grasses, and dense shrubs present, design of the landscape can open up tree canopies, use less thirsty mulches and ground covers in arid regions that also reduce ignition potential, and take maintenance of the surroundings into consideration. If it is easy to maintain, residents will have an easier time keeping their ignition potential low. Builders have an opportunity to strengthen the use of design standards like these by doing their part to work with like-minded groups to tackle the wildfire problem as they address existing weaknesses in the Fire & Life Safety Ecosystem. (For more on this framework, [click here](#).)

IGNITION-RESISTANT BUILDING CAN BE AFFORDABLE—MUCH LESS COSTLY THAN REBUILDING

For years, NFPA and other organizations have held that, especially for new construction, ignition-resistant buildings need not be expensive. Because so many building materials, especially fire-resistant roofing, are common and affordable, it stands to reason that constructing an ignition-resistant home is not going to be out of range for builders or buyers.

In 2018, Headwaters Economics, an independent, non-partisan research organization, [published a report](#) confirming that the cost of building a new structure with ignition-resistant materials and design could

“We are witnessing the power of denial as local officials and residents try to get back to “normal” by rebuilding essentially the same type and arrangement of structures that existed before the fires, with no indication that they are willing to accept the reality of living in a fire-prone environment.”

—Michele Steinberg, Wildfire Division Director, NFPA

actually cost less than building a traditional home of the same size.

The study points out that affordability can make the important step of requiring ignition-resistant construction much easier for local governments to enact. Without the barrier of excessive cost, builders can also employ these methods even in the absence of local regulation, to provide a safer property. The study indicates that some of the materials recommended may also extend the life cycle of the home and reduce needed maintenance.

The Headwaters Economics study does point out that retrofit of existing structures can be costlier to do for ignition resistance, particularly for the roof, as it incorporates design elements like gutters and vents that are more specialized. It details strategies for retrofit for the maximum protection and cost savings, but acknowledges that in some cases a complete exterior retrofit could be

more expensive than building a new home. However, property owners can break retrofit priorities into smaller projects, and possibly accrue financial breaks, including reduced insurance premiums, for improving the ignition resistance for their roof.

The cost of building flammable new structures or failing to retrofit existing vulnerable homes is usually only starkly clear when the wildfire home destruction disaster occurs. Certainly, the wildfire response and suppression elements of such disasters are costly to the federal, state, and local governments, but according to [more research by Headwaters Economics](#), more than 20 percent of the short-term costs for wildfire disasters include home and property loss. Very little

of the money to rebuild homes and lives comes from government aid, since insurance covers the building loss.

Unfortunately, [nearly two-thirds of American homeowner insurance payers lack adequate insurance](#) to cover the significant costs of rebuilding a home destroyed by wildfire or other natural disaster. Without adequate insurance, homeowners must dig into any

personal savings or opt to start over again in a different place and potentially at a different standard of living.

COMMUNITY-WIDE MITIGATION AND MAINTENANCE EFFORTS ARE CRITICAL OVER TIME

As we've experienced from the last few years of wildfire disasters, individual homes and businesses designed to resist wildfire impacts may perform better, but surroundings—neighboring homes and landscapes—must also be prepared for ignition resistance to improve the odds that homes survive wildfires.

Home ignition zones often overlap onto adjacent properties. This makes the conditions of neighboring homes and vegetation a part of the wildfire threat. It's extremely important that neighbors work collaboratively with each other to reduce their shared risk.



The Texas A & M Forest Service conducts an assessment of the 7R Ranch, providing suggestions for reducing the properties' vulnerability to fire. NFPA provides tools to help in these kinds of assessments, such as its fact sheet [How to Prepare Your Community for Wildfire](#).

COURTESY OF TEXAS A & M FOREST SERVICE



MICHELE STEINBERG is the Wildfire Division Director at the National Fire Protection Association (NFPA), leading a team dedicated to wildfire safety outreach. NFPA's wildfire-related projects cover a broad spectrum of safety education, advocacy, professional training and international outreach, including the Firewise USA® recognition program and the Wildfire Community Preparedness Day campaign. She serves on the Board of Directors of the International Association of Wildland Fire and on the Executive Advisory Committee of the Hazard Mitigation and Disaster Recovery Membership Division of the American Planning Association, and holds a Master of Urban Affairs degree from Boston University.

FACTS FOR LOCAL AUTHORITIES

A RECENT FACT SHEET from NFPA's Fire & Life Safety Policy Institute addresses the need for local authorities to know the facts about wildfire disasters and calls on them to prepare their communities now.

According to Institute director Meghan Housewright, "Elected officials and local government staffers need to understand what's at stake in a major wildfire disaster. The lives of both residents and first responders are at grave risk, and hundreds to thousands of homes and businesses can be destroyed in a single wildfire event. After a destructive wildfire, communities will struggle to reopen businesses, rebuild homes, and retain residents."

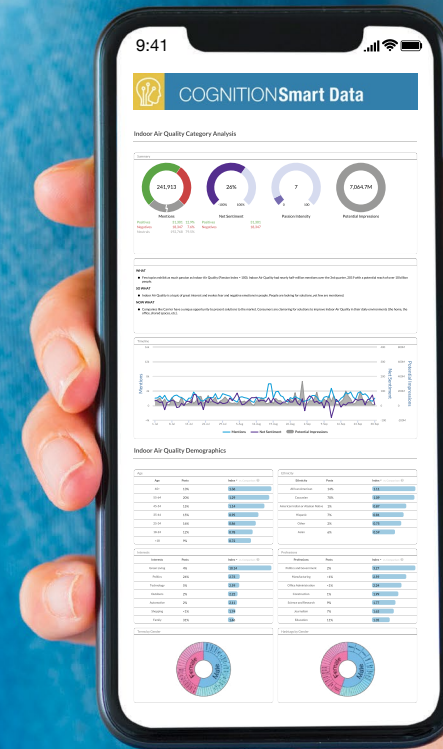
The document urges leaders to assess vulnerability, develop a comprehensive regulatory framework for risk reduction, educate residents, plan for evacuations, and provide local fire services with appropriate training and equipment. [Learn more here.](#)

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Not All Metal Roofs are Equal

When selecting a metal roof for resilience, look for key indicators of quality and durability.

AT FIRST, JAYNE Sventek and her husband thought they might be seeing things.

Their home's sparkling white metal roof, only just eight months old, had begun to show a distinctive black tinge creeping over the surface like a five o'clock shadow. As the weeks and months went by, it was clear that something was seriously wrong. The black fungus menace began to grow thicker, until the entire roof was nearly covered with a mottled, ugly discoloration.

The nightmare didn't end there for these Naples, Florida homeowners. In fact, it was just beginning. For nearly five years, Jayne desperately tried to get the original local installers to stand behind their work and fix the problem. She called building officials and worked to hunt down the manufacturer of the roof's material, all to no avail. Cleaning the roof wasn't an option, for fear of voiding any warranty that may have been in place. In the region's warm, humid climate, the fungus continued to thrive.

More research confirmed what Jayne and her husband were beginning to suspect: the installer had used an inferior material from an unknown manufacturer with a sub-quality, under-cured foreign paint system. The problem wasn't going to go away, it was only going to get worse unless the roof was replaced.

Out of options, the Sventeks happened to get in touch with the Metal Roofing Alliance and subsequently, **Drexel Metals**, a leading metal roofing systems and custom fabrication company with an excellent reputation. Drexel worked closely with the homeowners to ensure the replacement product would withstand the region's environmental conditions. The Sventeks installed a beautiful Drexel Metals Mansard Brown standing seam metal roof that came complete with a 35-year warranty and



PHOTO: MRA

Valspar's Fluropon® 70% PVDF coating, a highly-durable finish designed stand up to severe climate conditions, including saltwater, humidity and storms. While a darker color, the coating on the Sventeks' new roof also provides cooling benefits, helping reflect the sun's rays and saving energy.

The Sventeks couldn't be happier with their new roof, but the true test came in 2017 when Hurricane Irma, an extremely powerful and catastrophic hurricane, hit Naples. Winds up to 130 miles struck the region, leaving massive damage, downed trees, and homeowners like the Sventeks without power for 10 days. Miraculously, even with all the surrounding destruction, their house was not only still standing, the roof was intact and in great shape.

"That was a true test," said Jayne. "Our new roof looks and performs beautifully. It's great peace of mind for us to know that now, the roof will not only stand up to the test of time, but to Mother Nature as well." **GB**

METAL ROOFS AND HEAT REFLECTION

Metal roofing, when coated with solar reflective coating can be a highly effective energy saver. Research shows that even having a light-colored metal roof, installed with an airspace between the roof deck and the metal, can save up to 30 percent on cooling in hot climates. That number can go even higher with "cool-metal" roofing that is coated with special paint to increase solar reflectance. Many cool-metal roofing systems are also ENERGY STAR® certified and may qualify for tax incentives.



Timely Upgrade. Shortly after this inferior quality roof in Naples, Florida was replaced, it withstood Hurricane Irma with no damage.

LESSONS LEARNED

- **Do installer due diligence:** Reputation is everything. Before you start a re-roofing project, be sure your installer is licensed, bonded and has strong experience in the type of roof you want to install. Make sure they guarantee—in writing—their work and the materials they plan to use. If they won't, don't hire them. Industry involvement also is important; find out if they are members of organizations such as the MRA and that they are willing to provide references.
- **Complete your homework:** Ask and get source verification for the proposed material and do some research yourself to evaluate the finish, warranties and regionally proven performance. Consider what key factors are important to you, such as durability in severe weather, protection in extreme conditions (wildfires, hail storms), energy efficiency, sustainability, low maintenance and more. Invest in the best quality roof you can afford that aligns with your priorities and the climate conditions in your region.
- **Get at least three references:** Get local referrals of completed projects and contact them to ask how satisfied they are with their roof. If possible, ask for and do a drive-by of other projects that use the same material and have been completed by the installer to ensure you will be happy with the curb appeal of the work and the product.

For more information about metal roofing, visit www.metalroofing.com



Metal Roofing Over Asphalt Shingles: A Win-Win

Upgrading an old, flammable asphalt roof that's vulnerable to hurricanes and wildfire easier than you think.

BY TODD MILLER

I frequently am asked whether homeowners and contractors should remove roof shingles from a home's roof before a new metal roof is installed. My answer often surprises people. However, it is based upon experience with tens of thousands of installations over many years.

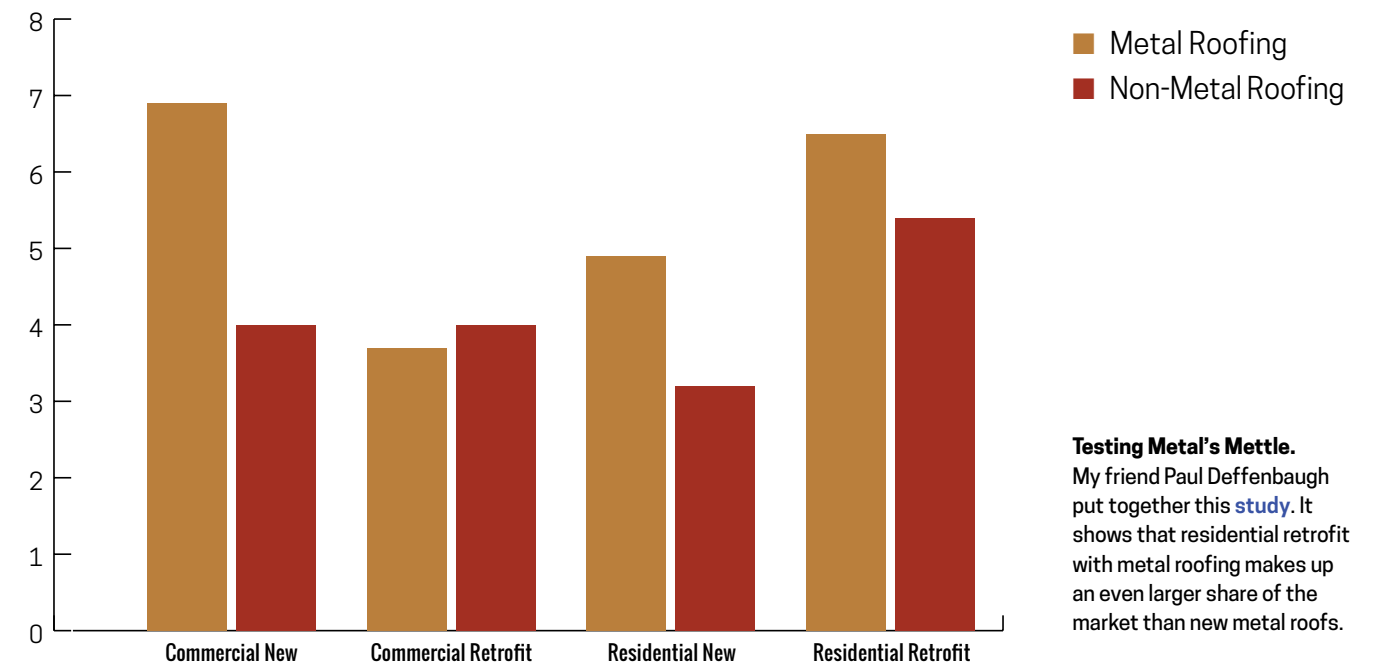
MY EXPERIENCE

The vast majority of installations of the metal roofing systems produced by my company are over existing shingles. The low weight of metal roofing is one thing that encourages this. Steel shingles weigh about ¼ what asphalt shingles weigh and aluminum shingles weigh about ⅓ what standard shingles weigh. I would say that in most cases, less weight is being added to the home by the new metal roof than what the current shingles have lost due to granule wear and oil evaporation. In other words, the total roof weight was probably greater when the last layer of shingles was installed than it will be when the metal roof is completed.

ASPHALT OVER OLD ASPHALT? NO.

One important thing for folks to keep in mind if they are trying to decide what

Mean Number of Projects Completed by Project Type



Testing Metal's Mettle. My friend Paul Deffenbaugh put together this [study](#). It shows that residential retrofit with metal roofing makes up an even larger share of the market than new metal roofs.

type of roof to buy is that new asphalt shingles should not be placed on top of old asphalt shingles. With most asphalt shingle manufacturers, doing so will void the warranty on the new roof. This is partly because the old shingles will not allow the sun's heat to pass so easily into the attic, so the new shingles end up staying at a warmer temperature, shortening their life.

WHY IS METAL DIFFERENT?

That is not the case with metal—temperature does not damage the metal or the paint finish. The warranty on your new metal roof, at least from my company, will not be impacted at all by going over the old shingles.

In over 30 years and tens of thousands of installations over old shingles, I have yet to go back on a job later and find myself saying "Hmm ... maybe the old shingles should have been removed." It just never becomes an issue. And many of those installations actually have been over wood shingles and thinner wood shakes! I have also re-roofed personal properties with our products five times now over the years—every time was over the old shingles, and no regrets.

I like going over the old shingles for 3 reasons:

1. It stops the need to fill up landfills with old shingles. It ultimately increases the thermal resistance (R-Value) of the roof assembly, actually increasing energy efficiency compared to tearing off the old shingles. The benefit of this is during the summer.
2. It allows the property owner to spend discretionary dollars on a better roof rather than on removing the old roof and disposing of it.
3. Going over the old shingles also avoids the potentially damaging issues that can occur, like unexpected rainstorms, when old roofs are torn off.

Still, ultimately, it is the property owner's decision, but I would have no qualms about going over a layer of old shingles in most cases. It's not uncommon to go over multiple layers either actually. On older homes, of course, I do put the caveat out there that if there are signs of an existing weight issue or old leaks, those need to be addressed and that may require removing the old shingles. If there are concerns about the

integrity of the roof decking, then pull-out resistance tests using the roof fasteners can be performed.

One other thing to keep in mind is that building codes, where active, usually require no more than two layers of roofing of any type on a structure. There have been instances of building inspectors waiving that requirement, but that is not an easy thing to get accomplished.

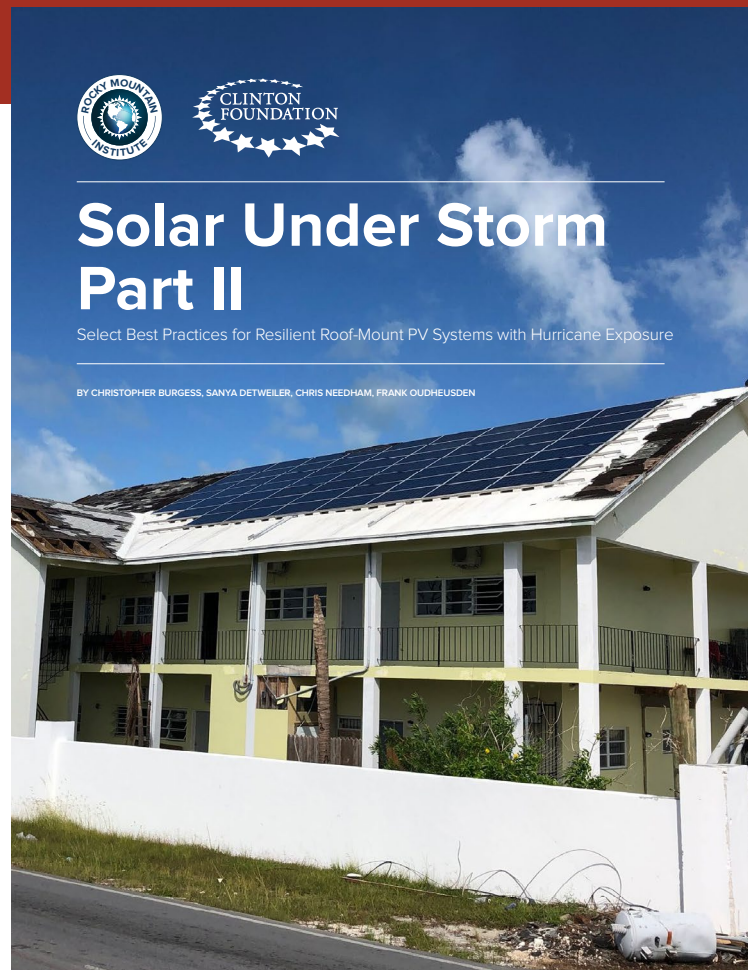
Remove Roof Shingles Before Installing a Metal Roof?

In a typical year, approximately 90 percent of the roofs our company manufactures are installed over old shingles. In my opinion, going over the old shingles is worthy of consideration. Every roof needs to be evaluated individually. Please feel free to email me your questions or circumstances for my input. My email is todd@asktoddmiller.com

Todd Miller is president of **Isaiah Industries**, an organization recognized as one of the world's leading metal roofing manufacturers. Todd is currently Vice President of the MRA ([Metal Roofing Association](#)).

STUDY: Solar Panel Attachment for Extreme Wind

A new resilience concern has arisen because of the exponential growth of PV installations in past years: panels are often destroyed or damaged by hurricanes and other powerful storms. A new study, titled *Solar Under Storm, Part II (Roof Mount Systems)* from Rocky Mountain Institute, describes how to protect PV panels from extreme wind destruction. Their research found that most panels suffered heavy damage because of *top down clip failure* and related impacts, such as flying debris.



Blowback. Powerful winds have been thrashing solar PV panels on roofs. Researchers found out why.



Rough ride. PV panels are often damaged by flying pieces from other panels.

SIMILARITIES OF FAILED PV ROOF SYSTEMS

- Top-down or T-clamp cascading
- Lack of vibration-resistant connections
- Corner of the array overturned due to incorrect design for wind
- Insufficient structural connection strength
- Roof attachment connection failure
- System struck by debris/impact damage, especially from liberated (dislodged) modules
- Failure of the structural integrity of the roof membrane
- PV module design pressure too low for environment

SIMILARITIES OF SURVIVING PV ROOF SYSTEMS

- Appropriate use/reliance on ballast and mechanical attachments
- Sufficient structural connection strength
- Through-bolted module retention or four top-down clips per module
- Structural calculations on record
- Owner's engineer with QA/QC program
- Vibration-resistant module bolted connections

Read the [Full Report Here](#).



THE PANDEMIC-READY House

Hard lessons learned from COVID-19 point to proactive measures for current and future home design and products.

ONE OF THE MOST EFFECTIVE FORMS OF RESILIENCE IS EFFICIENCY. A home that requires less energy to heat, less water to operate toilets and showers, less maintenance is naturally more resilient. But it needs to go further. It needs to have rooms that can effectively be cut off from ambient air in the rest of the home, easy-to-clean bathrooms, backup power and water systems. Before we look at solutions, let's take a quick look at filters—one of many products that are only part of a complete home pandemic strategy.



Hot Spots. The bath tends to be where many contagions are passed on to family members. But you can reduce the risk with the right behavior and product design.

BATHROOMS: GROUND ZERO FOR VIRAL INFECTION

For several reasons, bathrooms tend to be a toxic playground when someone at home is sick. Because of the way viruses are transmitted, virtually every surface and fixture in the bath is a health risk. Sink and toilet handles can harbor contagions, as can toilet bowls and shower walls. Even the walls of the room may be unsafe to touch. Here are some key precautions and design considerations.

No Touch Lid. An auto-opening, auto-closing toilet lid is one of the best ways to reduce spread of viral contagions in the bathroom. An unsanitized toilet, flushed while the lid is open, can keep spreading particles for days.



www.greenbuildermedia.com

Toilets: Flush Only with Lid Closed

Flushing Uncovered toilets have been shown to **blast disease causing particles into the air**, including norovirus, influenza and more.

One option is to install automatic seat-closing technology. There are many models available, and some are completely hands-free. For example, the itouchless lid, available for about \$120.00 as an add-on, includes sensors that make it self-opening as well as self closing.

Bidets: Toilet Tissue be Gone

You saw the images: people carting hundreds of rolls of toilet paper home to wait out the COVID quarantine. Can't we do better? Bidets have been around for decades, but Americans refuse to get on board with this cleaner, more efficient way of sanitizing their bottoms.

The old excuse about high prices no longer applies. Almost every major plumbing maker has a wide range of prices and luxury features, all the way down to add-on basic bidets for about \$50 on Amazon. If every person in the house uses the national aver-



Banish Toilet Paper Anxiety. Standalone and add-on bidet seats such as this self-sanitizing C3-155 unit from Kohler mean you will never have to stand in line for toilet paper again. **Priced under \$500 at Lowes.**

age amount of toilet paper, about \$10 per month, a household of 3 people can pay off the seat in two months. And that's not even considering the high environmental cost of producing toilet paper. As much as two gallons of water is wasted to produce a single sheet on a roll.



Lighting: Sunlight, Yes, but UVC is Coming

If you're lucky enough to have the option, design bathrooms with as much natural daylight flooding the space as possible. Many viruses and bacteria can't survive in sunlight, although too little is known about COVID-19 to know if normal sunlight will do the job.

A better approach may be to install a special form of UV light in the bathroom that you switch on when family members are sick, and it automatically kills every viral pathogen in the room. This light doesn't exist for home use yet, but affordable variations may not be too far off.

At present, many types of UV light sanitizers exist, but they tend to require manual operation, or are small, self-contained devices. The type of UV they put out is harmful to people.

But research on a less dangerous spectrum of UVC (ultraviolet light with wavelengths

Burn, Baby Burn. Soon, a new form of human-safe ultraviolet lighting may be available that can kill even the most resistant strains of bacterial and viral pathogens.



Lonely Days. Social isolation is no fun, but infected family members need a room that does not share airflow with other parts of the house.

between 200 – 280 nanometers (nm)) is well underway. According to [Nature](#): "Our results indicate that far-UVC light is a powerful and inexpensive approach for prevention and reduction of airborne viral infections without the human health hazards inherent with conventional germicidal UVC lamps. If these results are confirmed in other scenarios, it follows that the use of overhead very low level far-UVC light in public locations may represent a safe and efficient methodology for limiting the transmission and spread of airborne-mediated microbial diseases. Public locations such as hospitals, doctors' offices, schools, airports and

airplanes might be considered here. This approach may help limit seasonal influenza epidemics, transmission of tuberculosis, as well as major pandemics."

ISOLATION ROOMS

When one family member is sick, many forced-air delivery HVAC systems can quickly spread contagions throughout the home.

It's important then, to be able to contain and isolate airflow in one or more bedrooms. As we noted above, filters are not sufficient to capture 100 percent of virus particles, and single

Zoning the home with smart dampers or choosing individual heating modules such as heat pumps can minimize the risk of spread.

CLEARING THE AIR: FILTRATION PLUS DIFFUSION

Let's drill down a little deeper into managing indoor air. At present, building codes focus primarily on maintaining adequate indoor air quality to remove dust and other nuisance pollutants. For builders, that

typically means meeting the ASHRAE 62.2 ventilation requirement for a given number of air changes per hour (ACH). But many clients will want to raise the bar on this basic standard, after experiencing the anxiety of COVID-19.

For example, they may want to install a MERV 12 or higher filter in their furnace, or as a standalone unit in a bedroom.

The problem with this approach, as explained in the sidebar on filters, is that viruses are small, and no filter gets 100 percent of every contagion. One solution then, is to combine filtration with active ventilation that exchanges indoor and outdoor air in the isolated bedroom. This would increase diffusion of any rogue particles, and reduce chances of caregivers entering the room catching the illness (mask wearing is still recommended, of course.) A good product candidate for ventilating in this manner would be one of Panasonic's small FV-04VE1 ERV units, which run continuously.

Do Virus Particles Stick?

Another unanswered question about filters is whether virus particles, once trapped, will stay lodged in the filter matrix long enough for them to die naturally. We know, for example, that COVID-19 can survive for several days on some surfaces. If the airflow is suddenly changed, could it dislodge a deadly particle?

FILTERS: AN IMPERFECT BARRIER

Effectively removing viral particles depends on speed of airflow, filter size, and luck.

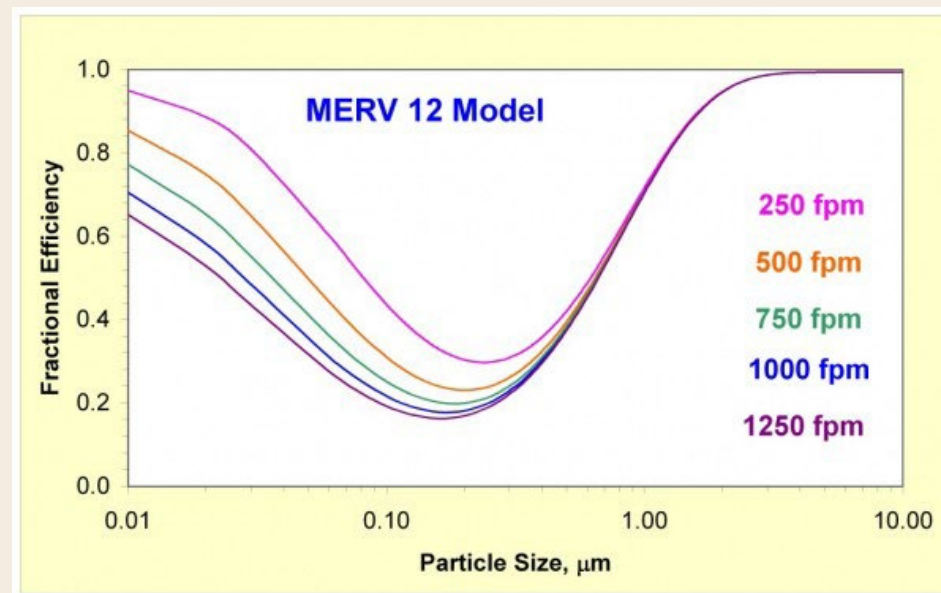
IS IT POSSIBLE TO FILTER VIRAL particles such as coronavirus out completely using common residential filters, such as HEPA or MERV products?

In short, the answer is "not always." The problem is that no filter removes 100 percent of viral particles. That doesn't mean they don't greatly reduce the number of pathogens floating in the air, and some work much better than others. But according to [research conducted in 2009](#), a single virus particle is enough to infect someone and lead to full-blown symptoms.

Let's look at the two best filtration technologies, HEPA and MERV filters:

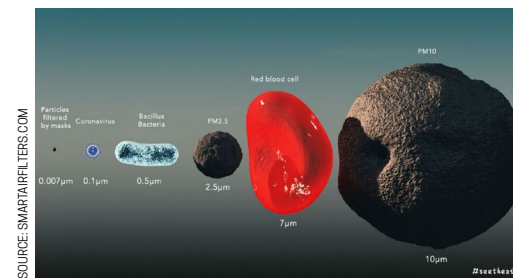
HEPA—According to [Australian researchers](#), "HEPA filters may not provide adequate protection for all threats: viruses are submicron in size and have small minimum infections doses (MID50). Thus, an appropriate viral challenge may yield penetration that will lead to infection of personnel."

MERV—Several factors impact how well MERV filters work, not just the rating of the filter. For example, with MERV filters, the speed of airflow



Speed Matters. In this model, a MERV filter works most efficiently when airflow is slowest. [Source](#)

through the filter impacts how much of the virus it collects. The example above shows that at slower airspeeds, a MERV 12 filter is much more effective (with "1" being 100% effective).



Tiny Killer. You can see why coronavirus particles might occasionally slip through a HEPA or MERV filter.



Deep Larder. A large pantry, particularly in a below-grade room, can serve as both canned good storage and fresh vegetable parking area.

FOOD SECURITY

During long periods of quarantine or “social isolation,” food quality must be maintained. It’s always a good idea to grow some of your own produce of course. But not everyone has that option. Apartment dwellers, or homeowners on tight lots, for example, may have to rely exclusively on what foodstuffs they can squirrel away indoors. This means that dwellings may require additional refrigeration, storage space for supplies and generator or battery backups to keep systems operating in a prolonged power outage.

What might food storage look like in a pandemic-prepped home?

- **Pantries.** Extra storage for dried and can goods, preferably made with natural materials and finishes that will not offgas and taint foods with unwanted odors/tastes. If you have a basement, consider installing a

space that can serve in part as a root cellar, where you can at least prolong the shelf life of certain fresh foods.

- **Energy Star Freezer.** Energy efficient upright and chest freezers are a fast and convenient way to store foods, including fresh produce from home gardens. They do come with an inherent risk, however—they stop working if the power goes out. A long-term power outage is probably a longshot risk unless you live in a remote rural area, however. If we reach that point as a society, a freezer probably won’t be enough to ensure your home’s resilience.

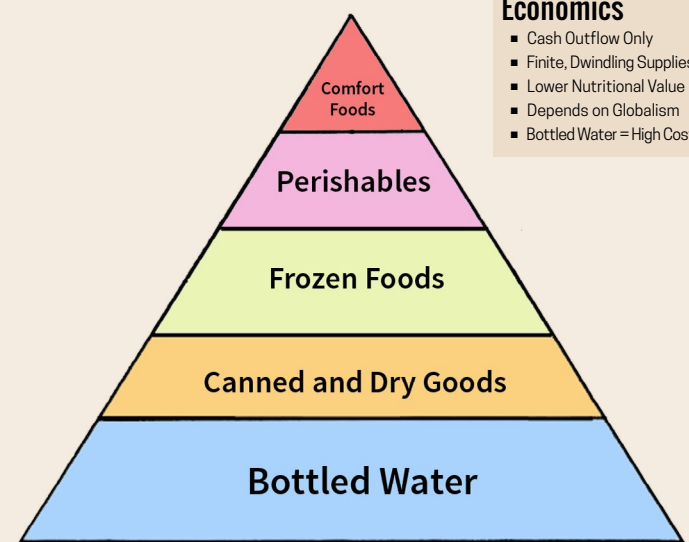
- **Backup Power and DC Freezer.** For short-term outages, however, you might consider some solar panels, some battery storage, and a DC-powered freezer, such as the [SunDanzer](#), which run on 280 watt hours per year. Gasoline and Propane

powered generators are also an option, but you’ll be at the mercy of the marketplace if fossil fuel supplies run short. The sun isn’t affected by the Stock Market.

- **Low-Energy Cooking.** Don’t forget, many foods need to be cooked. The easiest option is a propane tank and an inexpensive burner, but again, this setup is fossil fuel dependant. Another option is to buy or build your own [rocket stove](#). I’ve used a [homemade version](#) effectively to cook with wet wood in a rainforest! They seem able to burn in almost all conditions, with any type of wood or dried organic material as fuel. Finally, If you have a reasonably sized solar array and battery bank, you could pick up an electric induction cooktop and cook with that. You can run the induction at peak solar hours straight from the panels. You can find [models that work at about 800 watts](#) for one burner.

The Crisis Pantry

Finite, Vulnerable, Dependent



The Resilient Pantry

Sustainable, Interdependent



The Food Security Pyramid

The first of these two pyramids illustrates how most Americans approached food security during the COVID-19 pandemic. In the Crisis Pantry scenario, stocking up on cans, frozen food and dried goods offers a short-term solution—but supermarket shelves can quickly empty due to hoarding and panic buying. Also, relying on freezer storage adds another level of vulnerability, until and unless backup power systems are in place. Bottled water is about ten times more expensive than tap water.

With the Resilient Pantry approach, societal shocks can be absorbed more easily, even if they go on for months. This approach to food security emphasizes home food production, local specialty farms (dairy, bread, etc.) and actually creates a surplus of food that can be used to barter for other necessities, or exchanged for cash in a crisis scenario. If local tap water is suspect, reverse osmosis filtration can render it cleaner than most bottled water.

WATER ACCESS AND PURIFICATION

Fresh drinking water is even more important than food during a long quarantine. Resilient homes include water filtration such as reverse osmosis filters, and, if possible, a backup method of acquiring water, such as a well or rainwater collection.

If you’re not lucky enough to have a well, or a shallow, easily accessible water table, a good rainwater harvesting system on your home can supply both potable and non-potable water. Keep in mind that to drink this water, you’ll need to filter it. As rainwater expert Doug Pushard explains, “Almost all systems use multiple filters. For example, after gutter screens and/or a first flush device, a system often includes two in-line filters of increasing fineness, a carbon filter and a UV light. Each of these are

described below to assist you in evaluating what might be the right alternative for your planned water use and required water quality.”

This [site](#) has loads of information about setting up a rainwater collection tank that will serve all of the water needs of a family.

Even if you don’t use it for potable drinking water, you can put it to work every day flushing toilets and watering your new victory garden.

HOME SECURITY

As much to reduce anxiety as to head off real threats, home security systems can deter looters, alert residents to trespassers and alert local authorities if a real breach happens. You can take this as far as you want. I recommend starting simple, with



First Flush. With a rainwater system, one of the most important components is a diverter that “dumps” the first gallons of water from the roof, removing bacteria, soot and other pollutants before they reach the tank and filters. [Source](#)

DIY Security. Affordable security systems such as Samsung's SmartThings ADT Home Security Starter Kit offer peace of mind whether or not you're at home during a crisis.



motion-sensing floodlight and a video camera with two-way audio for your front door, and adding components from there if you feel you need them.

After that, in order of priority, I would recommend a camera surveillance system,

programmable keypads on all entry points, a couple of low-cost sirens, some window and door break alarms, and a backup power system that keeps the flood lights on if the power goes out.

When choosing cameras, I would

recommend a hard-wired plug-in camera system, rather than one of the battery-powered units with optional A/C power. The Arlo line of cameras, for example, seems to fail in a regular cadence, and the power cables have often (and unforgivably) been incompatible with the batteries. That being said, I have had a good experience with another brand: the Ring camera with solar charger. It never seems to lose its charge and has operated smoothly for about a year.

Another feature to consider is a weatherproof package locker at your front door. Give the UPS carriers a passcode, and have supplies delivered into a secure location. For extra peace of mind, install a UV light inside the locker.

EFFICIENCY: THE BOTTOM LINE

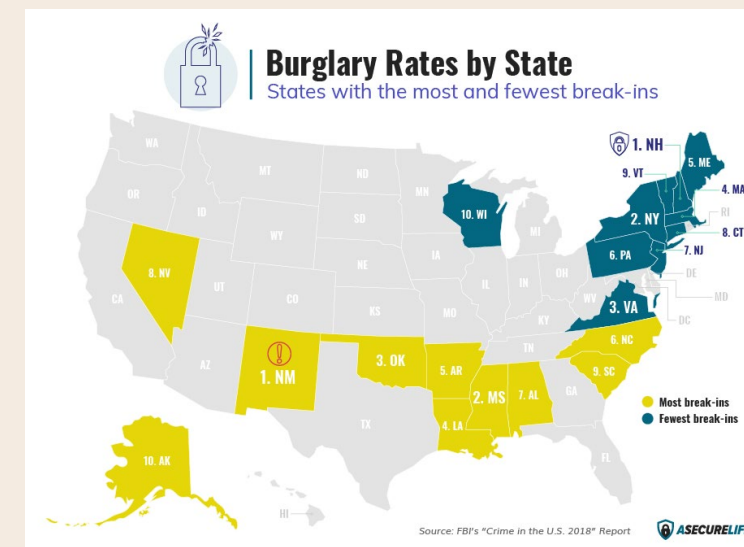
Among the many aspects of home design and products that enhance resilience, one underlying theme is constant: A home that requires less is a home that serves its occupants best. Less energy to heat and cool. Less water and energy to run basic systems. Less mental energy to safeguard, clean, maintain and repair. In times of stress, the last thing we need is a home that causes us more stress. A home should be a place of safety, solace and peace. With careful planning, the right priorities, and attention to what really matters, we can all have a safe haven to return to, when life takes us into places we never expected to go. **GB**



Lockdown. Packages are important in times of stress. Personal lockers keep them safe until you're ready to retrieve them.

SOURCE: RTSI HOME ACCENTS

Easy Pickings. Burglars look for open doors and windows in unoccupied homes, they say. They want nothing to do with cameras and alarms.



REAL SECURITY

Which Features Work? Ask a Burglar.

THIS ANONYMOUS SURVEY of prison inmates discovered surprising reasons why certain homes get targeted and others don't. "Jewelry, electronics, cash and credit cards are all attractive to burglars. Inmates also added collectibles and guns," noted KTVB7, the news organization that did [the survey](#). All of the burglars knocked on the front door before breaking in to the house.

- **Guns Attract.** Burglars love reselling guns. An NRA bumper sticker means "lots of valuable guns to steal and sell."
- **Lunch Hour.** Between 12:30 and 2:30 is the best time to break in, before the kids get home from school and while adults are at work.
- **Dogs: Size Matters.** Big dogs scare away burglars. Small dogs are just a nuisance.
- **Alarms work.** Most burglars would leave immediately if an alarm went off.
- **Cameras deter.** Burglars don't like cameras, but said they also signal valuables inside the house.
- **Radios and TVs Work.** Almost all burglars said they would not break into a house where a TV or radio could be heard.
- **Vehicles Matter.** A car in the yard is an almost surefire no-go.
- **Unlocked doors and windows=preferred entry points.**
- **Porch lights.** If the porch or carport light is on and the house is dark with blinds closed, that's an invitation to burglarize.



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