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GREEN BUILDER®

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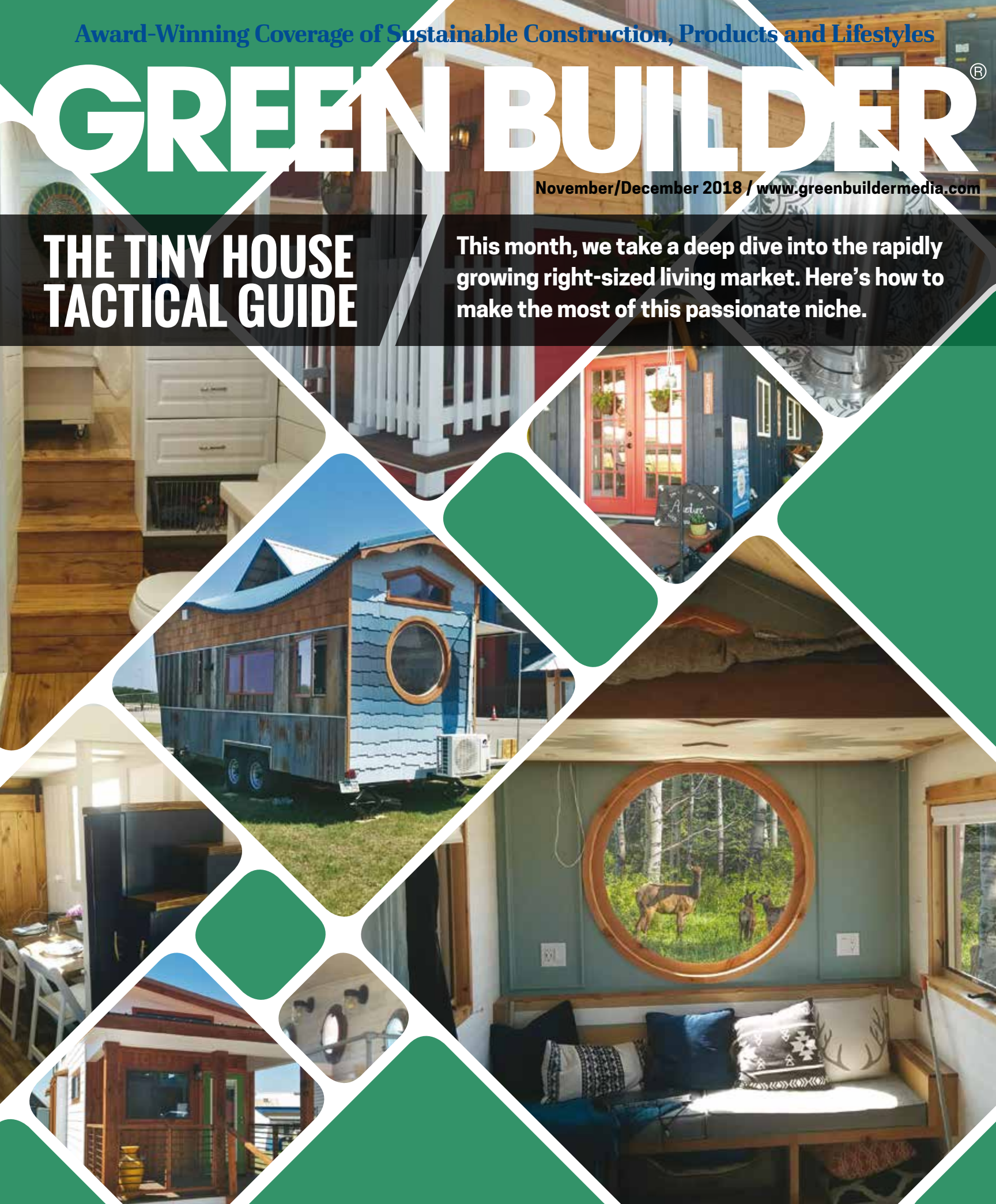
THE TINY HOUSE TACTICAL GUIDE

This month, we take a deep dive into the rapidly growing right-sized living market. Here's how to make the most of this passionate niche.



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- **General Wesley Clark (ret.)**, four-star general, former Army Chief of Staff, Presidential advisor, and fervent climate action advocate
- **Bill Walton**, NBA All-Star icon and passionate sustainability enthusiast
- **Susan Kucera**, award-winning Director, Cinematographer, and Producer of eco-films including "Breath of Life" and "Living in the Future's Past" (co-produced with Jeff Bridges)
- **Gwen Migita**, Social Impact & Inclusion Vice President and Chief Sustainability Officer, Caesars Entertainment
- **Ron Jones**, Founder/President Green Builder Media and industry provocateur

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9:00 am–5:30 pm

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EDITOR'S NOTE

The Inside Scoop

By Matt Power
Editor-in-Chief

Wanted: A Code for Tiny, Resilient Structures

Tiny homes are cool, but right now, they're caught in code limbo.

I RECENTLY ATTENDED the Tiny House Jamboree in Austin, Texas, where I spoke on the topic of conforming tiny homes to site-built IRC codes while retaining the light weight that guarantees their mobility. My construction effort proved to be a daunting challenge. I managed to knock about half the weight off a typical 12,000-plus-pound tiny home. But it's hard to get much lower. It's also not the direction the new Tiny Home Industry Association (THIA) is moving toward.

Instead, THIA would like to see a tiny-house-specific code—special rules for a special class of buildings. Right now, in the Wild West of tiny home certification, most so-called tiny houses on wheels (THOWs) are certified to ANSI standards, the same as RVs. That means they don't meet HUD standards for manufactured homes, so you can't put them in a mobile home park. And, many cities have strict rules limiting how long you can live in an RV. Also, RVs are not supposed to be lived in year round (although many RV parks operate in the gray area of whether tiny homes are truly "RVs").

CREDIT: MATT POWER

No detail too small. One of the most-popular homes at the Tiny House Jamboree was this exquisitely crafted project by Rocky Mountain Tiny Houses. It includes 1,800 watts of solar panels.

The alternative—tiny homes that meet IRC codes for permanent dwellings—often weigh up to 24,000 pounds (12 tons). That's where many tiny home builders are operating. But many buyers think they're buying a "mobile" structure.

Another key element in the tiny house explosion is the entry of RV manufacturers into the market. At the shows, so-called "Park Models" often outnumber "tiny" homes. These 10-foot-wide units, under 400 square feet, feel spacious and appeal to a wider audience. But they too are ANSI-compliant and not built for year-round occupation, nor with extreme storm resilience.

The reality is that there is no code specific to tiny housing, just an appendix in the 2018 IRC that spells out certain details. Creating a new code is a daunting task, but perhaps not impossible. Most THOWs are super energy efficient, operating at or near net zero. With just a little planning, a small solar array can push them into net-zero-plus territory.

The right combination of innovative materials, in my view, could make them far stronger, lighter and more weather resistant than current RV codes require. I would especially like to see a "hybrid" code classification: A tiny home that can roll out when a monster storm surge threatens, but is anchored to a permanent foundation if the owner wants to stay put. I'm agnostic about whether the code should be part of the current IRC or a standalone specification.

The deeper you dig in to the tiny house "movement," the more you realize that it's not a fad. It's the natural, safe harbor from the shifting cultural and financial landscape of the United States. It's no coincidence that The Align Project, our exhibition home at the NAHB International Builders' Show in Las Vegas next February, will feature a tiny Kasita home that's a fraction of the size of the annual "American Home" monstrosity presented by our competitors.

The reality of the marketplace is shifting. That's why we've written the *Tiny House Tactical Guide*, included in this issue. We hope you'll join us in embracing the tiny trend. High-performance compact homes are what people want, and they're willing to pay for quality. Let's make that goal easier. **GB**

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Where Will the Hammer Fall?

Environmental groups are bracing themselves for a tough time in the nation's top court.

BRETT KAVANAUGH'S APPOINTMENT to the Supreme Court is expected to have major repercussions on environmental policies. The question is whether things will be good or bad for anyone who thinks green.

On one hand, Kavanaugh—previously a U.S. Circuit Court judge named to the nation's highest court in October—has a history of deciding against environmental causes. According to reports by Bloomberg and NRDC, the new Justice's record includes his 2017 decision to strike down an EPA requirement that companies swap out hydrofluorocarbons for safer alternatives; his 2014 ruling that the EPA should consider the potential price tag of a rule limiting power plant emissions before implementing it; his 2012 argument that the EPA had overstepped its authority by determining greenhouse gases are pollutants that can be regulated under the Clean Air Act; and his effort to trash the EPA's 2011 Cross-State Air Pollution Rule, related to power plant emissions that drift from one state to the next.

"On the bench, (then Circuit Court Judge) Kavanaugh wrote opinions that consistently put the interests of corporate polluters before the public interest," NRDC stated in a report prior to his confirmation. "His opinions could make it difficult, if not impossible, for citizens and public interest groups to use our laws and courts to hold polluters to account; make it harder for federal agencies to protect the environment and public health and make it easier for industry to get away with violating environmental laws."

But Kavanaugh has acknowledged that global warming is real—something President Trump has denied exists—by stating verbally and in written opinion over the past several years that there is an "urgent and important" need to deal with the problem at the national and international level, according to a report in *The Atlantic*. And he has "historically shown some respect for environmental litigants, even if he almost never rules for them," *The Atlantic* notes.

CREDIT: NINIAN REID/FLICKR

Green breaker. New Supreme Court Justice Brett Kavanaugh's anti-green stance will pose major problems to groups tailored to promoting sustainability.

His views on de-regulation have made him popular with various business groups. "Kavanaugh [has] established a strong record of curbing regulatory overreach," NAFB stated in a pre-confirmation release. "While not always siding with NAHB's position, Kavanaugh has consistently viewed agency rulemakings with a healthy dose of skepticism."

The overall impact of Kavanaugh's appointment remains to be seen. But environmental experts such as Patrick Parenteau, a professor of law and senior counsel at Vermont Law School's Environmental and Natural Resources Law Clinic, are not optimistic. "You've just got to hope that he can be persuaded that the courts really do have a legitimate role in democracy to assert themselves when they see abject failure of government to address [environmental] problems," Parenteau said in a report in *The Revelator*. "[In the meantime] we're going to have to be really careful with the language we use, the cases we pick, the face of the case, and who's bringing the case. We are going to have to stay out of the Supreme Court as much as we possibly can." **GB**

Out With the Bad Air

Here's a new guide that makes it easier to cut back on carbon emissions.

THE ROCKY MOUNTAIN INSTITUTE (RMI) has unveiled the *The Carbon-Free Regions Handbook: An Action Guide for States, Provinces, and Regional Governments*, designed to help local, state and federal lawmakers "place communities on an actionable path toward sustainable, low-carbon economies."

According to RMI CEO Jules Kortenhorst, the handbook contains 30 ready-to-implement solutions to issues, such as planning for net-zero buildings, how to properly upgrade existing structures to green status, deploying an all-electric fleet of vehicles, and how to effectively launch the use of community solar projects. "Local governments all over the world are already taking ambitious action to reduce carbon while also strengthening their ability to thrive in the 21st century," Kortenhorst says." Other governments can learn from their peers, adapt these best practices, and progress faster."

While there are hundreds of possible ways a government may try to reduce carbon emissions, *Regions* limits its recommendations to ones that can make an immediate, significant impact, can be launched within a year, are economically viable, and are relevant to most regions, Kortenhorst adds.

The guide is a companion to *The Carbon-Free City Handbook*, released by RMI in late 2017. That publication focused its clear air emissions tips on city governments and businesses.

CREDIT: ROCKY MOUNTAIN INSTITUTE

Greener days ahead? The Rocky Mountain Institute's latest guide to managing CO_2 emissions gives governments a chance to improve their green status.

Both handbooks are available for free download at www.rmi.org. **GB**

Skilled Worker Problem Gets Worse

As the construction industry's labor shortage grows, so do safety hazards.

LABOR SHORTAGES are more than just a manpower problem for the construction industry. They're also creating a safety hazard for the workforce that exists. According to the latest commercial construction index from Dodge Data & Analytics, 58 percent of contractors consider the lack of skilled workers to be the No. 1 reason for jobsite safety risks.

In addition, nearly 40 percent of contractors are "highly concerned" over the safety impacts of worker use and addiction to opioids, followed by alcohol (27 percent) and marijuana (22 percent). Most contractors say they have strategies in place to reduce the safety risks from those substance abuse problems, although they are clearly less equipped to take on the opioids crisis, according to Dodge.

CREDIT: JOHN JONES/FLICKR

Risky business. Worker safety rivals the lack of skilled labor as the construction industry top concern heading into 2019.

The opioid epidemic cost the construction industry $95 billion in 2016, and could account for approximately 20 percent of the observed decline in men's labor force participation, according to Neil Bradley, chief policy officer of the U.S. Chamber of Commerce, a co-sponsor of the Index with USG Corporation.

As for skilled labor, 88 percent of contractors believe they will experience at least a moderate impact from not having enough help. Fifty-seven percent expect the impact to be very high, according to Dodge.

"The commercial construction industry is growing but the labor shortage remains unresolved," says USG Corporation President and CEO Jennifer Scanlon. "As contractors are forced to do more with less, a renewed emphasis on safety is imperative to the strength and health of the industry. It continues to be important for organizations to build strong and comprehensive safety programs." **GB**

The *Q3 2018 USG Corporation and U.S. Chamber of Commerce Commercial Construction Index* **is available for download at https://uscham.com/2CBUHT1.**

CREDIT: NASA

Storm warning. Disasters like Hurricane Florence in 2017 are driving up insurers' costs—which will most likely be passed on to customers.

Global Warming May Turn Insurance Into High Stakes Roulette

A growing string of natural disasters may lead to huge insurance increases for businesses and homeowners.

CLIMATE CHANGE MAY TURN INTO A GOLD MINE for insurance companies, who may begin raising rates once they finish recalculating their catastrophe models. According to a report in the *Wall Street Journal*, a growing number of global warming-induced natural disasters have insurers looking for ways to recover their costs, as well as predict how they will change in the future.

Insurance losses from just two of last year's hurricanes—Harvey and Irma—surpassed $100 million combined, according to global reinsurance brokerage and consulting firm, JLT Re. This year's most-recent hurricanes, Florence and Michael, could double that total. Wildfires, such as the slew that hit California this past fall, will tack on at least another $1 billion in claims, according to the state's insurance commission.

"It takes a lot of premium, a lot of margin, to account for this increased uncertainty, and I'm not sure we're doing a good job of reflecting this and charging appropriately for it," Arch Capital Group CEO Marc Grandisson says. "We need to incorporate a greater range of possible outcomes into our pricing."

Expect insurance rates, which thus far have posted modest increases, to eventually be jacked up based on forecasts, the *Journal* notes. In addition, rates are re-evaluated yearly, so increases are likely to continue for quite a while. Those rates changes could go across the board, impacting homeowner's, automotive, business and liability coverage.

"We don't discuss the question anymore of 'Is there climate change,'" says Munich Re CEO Torsten Jeworrek, a seller of insurance for insurers. "For us, it's a question now for our own underwriting." **GB**

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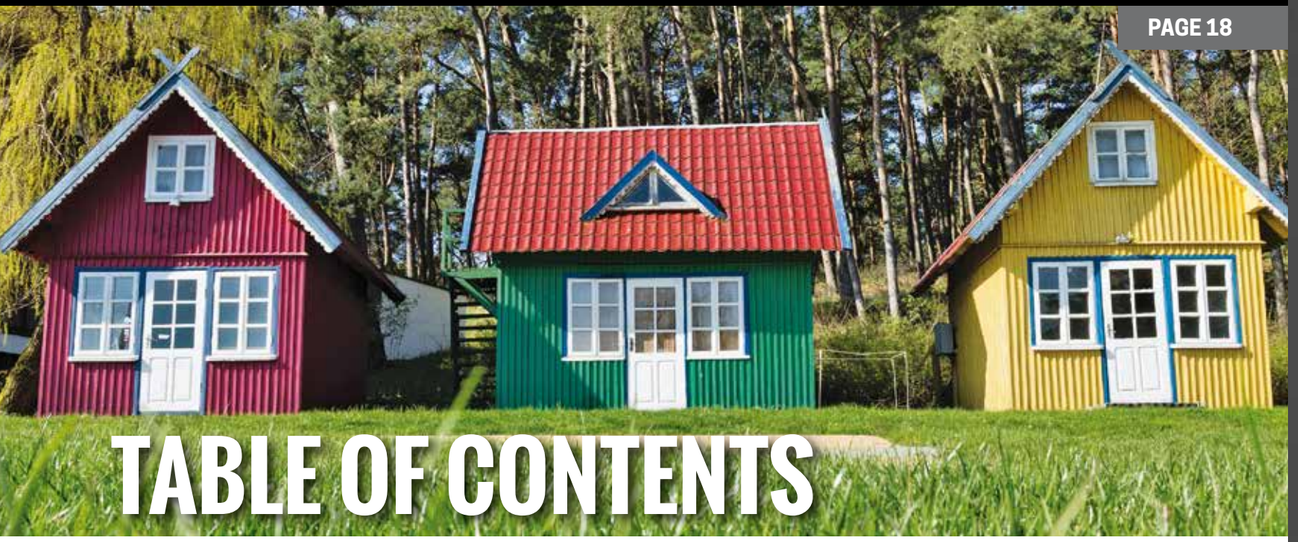

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

HERE'S A SAMPLE OF WHAT'S INSIDE

"When it comes to the inner sanctum of our homes, people are cautious. They don't want more complication added to their lives, and they don't want Google ogling them (or *Alexa* giggling at them), especially in their living room or bedroom."

(p.13)

ON THE COVER

THE TINY HOUSE TACTICAL GUIDE

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THE TINY HOUSE TACTICAL GUIDE

FIRST EDITION / 2018

Hands-On Ideas, Tips, Products, Code Updates and Radical Ramblings to Help You Make the Most of the Right-Sized Shelter Revolution

EDITED BY MATT POWER, EDITOR-IN-CHIEF, GREEN BUILDER MAGAZINE

Personal flair. Tiny house advocates worry that as big business co-opts interest is compact living, creativity will be curtailed.

PHOTO: TINY HOUSE COMMUNITY

Vive la Petite Maison!

It's time to push the tiny house revolution to the next level.

The Tiny House Tactical Guide isn't a coffee table design book. It's a call to action, for everyone who wants the freedom to build small, to live differently—to challenge the status quo of taxes, debt and the right to grow old in a safe, affordable home.

What you'll learn (as we did, compiling the *Guide*) is that the deck is often stacked against would-be tiny house owners and builders--and that simply living in a tiny house does not guarantee you'll achieve a greener, leaner, affordable lifestyle. Local politics, code definitions and zoning matter—as does every decision you make about how to occupy your new right-sized home.

In the *Guide*, we're not pretending we all have equal opportunities. The vast income gap between the top and bottom is forcing Americans young and old to look more seriously at small homes. The middle has been hollowed out, and the old American dream of a big house in the 'burbs is now largely a fantasy for those on the outside, looking in.

But there may be a silver lining. Living small, done right, can greatly reduce our impact on wildlife and natural resources. Small homes also open up new doors to young adults caught in the hamster wheel of stagnant incomes and overpriced rentals. They offer affordable housing to low-income citizens and new Americans—and also can offer a new kind of independent living as we navigate our twilight years.

At the same time, tiny homes are just plain cool. They fuel our human need for novelty and change.

So join us as we explore this fast-changing shift in American housing. Whether you're part of the supply chain or just fascinated with the possibilities of going small, you'll find something in *The Tiny House Tactical Guide* that you can apply to your own vision of living smaller.

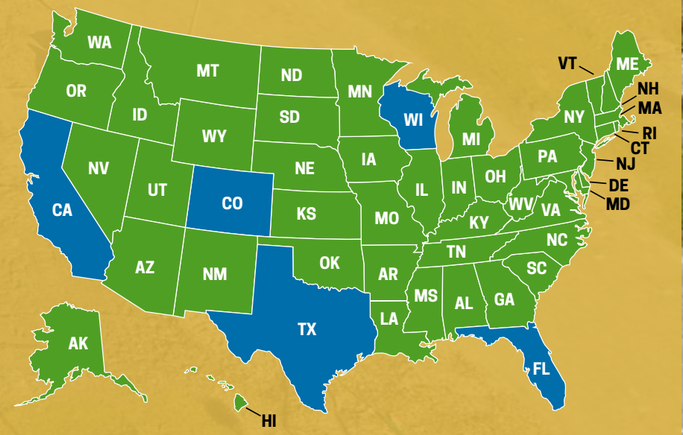
— MATT POWER, EDITOR

Grounded. To meet building codes, most tiny homes are anchored to permanent foundations.

The beauty of utility. A combination of hip, custom design and affordability have captured the imagination of millennial buyers.

HOT SPOTS

There are tiny house builders scattered across the country, with dense populations in **Colorado**, **Florida**, **Texas**, **Wisconsin** and **California**.



SOURCE: TEXT AND IMAGES DERIVED FROM THEMORTGAGEREPORTS.COM

Let's Roll. Many tiny house companies will ship a tiny house anywhere.

15% Yes. 15 percent of 18- to 34-year olds in the U.S. say they'd definitely live in a tiny house.

19% Maybe. Of that same group, another 19% say they would seriously consider a tiny house.

Rent Fatigue. More than 50% of 18- to 34-year-olds rent say they rent housing only because they can't afford a down payment to buy a home.

Manifesting density. Tiny house villages are springing up internationally and around the U.S., including in Orlando, Austin and Salida, Colo.

CHAPTER 01

FREE THE TINY HOMES

Confined by archaic zoning laws and overzealous subdivision rules, compact homes need to be set free and seen for what they are: the last, best hope for affordable, flexible ownership.

TOO OFTEN, THE MORE-AFFLUENT MINIONS of the mainstream media don't seem to"get" or even like the tiny house movement. In their world of gated communities and three-car garages, living small represents a threat—a nose-thumbing at the status quo of suburban living. Who could possibly live in a house smaller than Kris Jenner's pool cabana? *Forbes* magazine, for example, whose average reader is 47 years old and makes about $94,000 a year, calls tiny homes a fad that is "wildly impractical" and "won't be around for long."

The numbers say they're wrong. A new market report from Technavio, for example, (highlights shown at right) says the global tiny homes market will continue to grow at a compound annual growth rate (CAGR) of approximately 7 percent from 2018-2022. *Business Wire* offers a more-honest assessment of the motivators of tiny living, explaining that "a key factor driving the market's growth is the cost-intensive construction of conventional houses. The demand for tiny homes is mainly driven by the high cost of conventional site-built homes. The prices of the latter are increasing at rates higher than the increase in the income levels of people, which is encouraging customers to opt for tiny homes that are less expensive living solutions than constructing a house."

THE CURRENT HOUSING LANDSCAPE

America has a housing problem. A big one. The 1950s dream of a big house in the suburbs has receded out of reach for most people.

On one hand, that might not be a bad thing. Greenfield development is notoriously resource intensive. It wipes out ecosystems and often doesn't deliver the promised happiness to its auto-dependent, energy-intensive new residents. Also, the cost of building a new home keeps rising as the double whammy of high land prices and cost-raising political actions—such as President Trump's lumber tariffs on Canadian softwood—ripple through the building industry. Labor is also a huge problem. Much of the nation's new housing stock rests on the guarantee of reliable, low-cost immigrant labor. But skilled immigrants are lying low, understandably shaken by the politics of division and family separations.

Tiny houses offer a partial solution to some of these social and economic problems. But they've been hamstrung by a frustrating maze of zoning, building codes and homeowner association (HOA) rules.

Here's the problem: If you don't already have a site-built house on property you own, there's often no place you can legally put a tiny house. Even if you own an empty parcel, many townships and HOAs have rules about minimum square footage.

Further confusing would-be-owners: These rules apply differently depending what type of small dwelling you build (or buy). For example, a tiny house on wheels is actually classified as an RV. But you can only live in an RV that's not in an RV park for a certain number of days per year. And manufactured homes, modular homes and site-built homes all play by different rules.

Tiny home enthusiasm sometimes leads to changes in local zoning to allow for more-flexible use of accessory dwelling units, or accessory dwelling units (ADUs). Some municipalities have taken this a step further.

For example, in British Columbia, the town of Nelson has adopted a "Laneway Housing" ordinance that makes it much easier to add a tiny home-type dwelling next to an existing home. While this change is welcome, it's low-hanging fruit for planners—hardly radical or especially progressive.

PHOTO: TEN FOLD ENGINEERING

Self starter. Unusual technology—and structures like this box that unfolds into a tiny home in a mere eight minutes—can't help but get our attention.

THE NOVELTY FACTOR

ECONOMIC FRUGALITY AND NECESSITY are not the only factors driving interest in tiny homes. For every Clarence Thomas, who likes to save money boondocking his RV in Wal-Mart parking lots for free (**https://bit.ly/2QsttBq**), there are others drawn in by the clever products and design elements associated with tiny living.

The late George Basalla wrote the book on why and when people adopt new technologies (*The Evolution of Technology*: **https://bit.ly/2DSYxJc**). After decades of research, Basalla concluded that one of the few constants in the adoption of new technology is the human attraction to novelty. We simply can't resist the "next big thing." Show us something shinier, faster or just different, and most of us will pounce on it—even if it's not always in our best interests.

NAME THAT HOUSE TYPE

DIFFERENT HOUSING TYPES HAVE to adhere to different building codes. This makes sense when the code is intended to increase safety and building resilience. But these rules are sometimes arbitrary and class centric. Jefre C. Outlaw, a financier with a keen interest in tiny homes, offers the following list of housing types to help clarify the current options. Not included are tiny site-built homes, which generally must be built to the same building code as other, larger site-built homes.

1. **THOW (tiny house on wheels):** Usually under 400 square feet. Built to the ANSI 119.5 certification standard (RVIA). Steel frame with wheels and a VIN, and legally viewed as an RV. Built to last 30 years. Up to 12-year loan with not-so-great terms. Cannot live in them permanently (more than six months) per federal laws.
2. **Modular Home**: Also referred to as a tiny home on foundation (THOF). IRC certification state by state. Typically over 400 square feet, enabling you to get a 15- or 30-year mortgage through the secondary market (Fannie Mae/FHA). Built to last 50 years.
3. **Manufactured Homes (HUD homes)**: Single wide, double wide, etc. Built to a generally lower standard than site-built homes. Some zoning prohibits them, even when attached to a foundation. Not recommended for areas vulnerable to high winds unless they are built "above code."
4. **Prefab Component Build (PCB)**: Also referred to as a flat pack build. Made with SIPs and dried in approximately three days. Sized 400 square feet to 1,400 square feet. Solves many problems when building ADU's/"Granny Flats". Building code jurisdiction is local city/county/state regs. Built to last 50-plus years.
5. **Park Model RVs**. Larger in width and interior headroom than road-ready RVs, these units typically can only be placed in RV parks. They are classified as RVs for purposes of loans and building codes.

PHOTO: WWW.SIGNARMENIA.COM

Ready to roll. Modular and mobile homes typically arrive on site on wheels before being removed from the trailer and welded onto a foundation. This is often the only way they qualify for a certificate of occupancy and a conventional mortgage.

THE "HAVE MORE" PARADOX

The problem with ADU-centric ordinances is that they assist those who already own a property—not would-be owners who purchase or lease land, hoping to build small. Americans tend to think of themselves as class neutral, but housing policies such as these favor the favored. That's not to say the end result is undesirable. It allows families to put in a small house for aging parents, for example. On the other hand, it won't help a young couple stuck in an overpriced apartment move into home ownership.

And of course, because ADUs are frequently "add-on" structures, many owners are (understandably) inclined to use them as rental properties. (See "Case Study: A Florida Getaway".) In a time when middle-class incomes have flatlined while costs of living keep rising, such rentals can provide relief. Estimates suggest, for example, that Airbnb typically amounts to about a 14 percent income increase for those lucky enough to have the option.

Of course, nothing lasts forever, and short-term rentals are under siege in many cities. Boston politicos have suggested banning Airbnb rentals altogether (**https://bit.ly/2RlbM7S**). Portland, Maine, has limited the total number of short-term rental registrations to 300. In nearby South Portland, pressure from NIMBY neighbors resulted in a list of onerous requirements that cut off short-term rentals at the knees (**https://bit.ly/2NXbPc9**). The list of restrictions includes banning the rental of camper vans, tents, trailers and mobile homes.

Why is this relevant? Because zoning at the local level is often decided by mob rule. It therefore can change rapidly and unfavorably for tiny house owners. This is one of many reasons, in our opinion, why tiny homes—even those on foundations—*should retain their ability to become mobile again.* That way, if the sea level rises, a

continued on page 25

FIGHTING FOR FLEXIBILITY

A new tiny house classification that allows for fixed and mobile use deserves support.

I ASKED ALEX ONTIVEROS of Pacific West Associates, Inc. (PWA) to comment on the idea of creating a new classification for tiny homes that would allow them to be certified for both RV applications and fixed foundations. This concept, he says, has already been suggested to the International Code Council (ICC).

Here's Ontiveros on where the issue stands at present:

"We have been certifying RVs and RPTs for about 30 years under Pacific West Associates, Inc. (PWA) so we took it as a parallel step to certify tiny homes on wheels in either of those two categories for the time being in the interest of safety and providing a nationally recognized building code for jurisdictions to look at when this type of unit comes in.

We agree with the fact that RV certification and grouping of these units together places restrictions on them. Due to this, our parent company, PWA, has been engaged by the Tiny House Industry Association in committees to create a new code that would address the problems that labeling a THOW as an RV brings up. As with any other code, this will be an extensive process.

The 400-square-foot restriction has been in place since about 1979, intended to keep the manufactured home industry separate from the RV and RPT industries.

While having a TH labeled as a Manufactured Home is certainly a solution for the issue of occupancy, it does present challenges that the RV and RPT certifications do not. Manufactured Housing builders are subject to 100 percent visual inspection of their production. This means that either a third-party company or a state assigned inspector would have to have in-plant presence while each unit is being built. This can drive the cost up significantly for the builder and ultimately the consumer. Another consideration of this size of unit would be the ability to pack up and move around, as some people desire it with their THOWs. Transporting a 401-square-foot tiny house may require movement permits or additional licenses that not all TH owners may have, not to mention that transporting a 40-foot-long by 10-foot-wide (at best) unit would be a challenge for the average consumer.

> [It's time] "to create a new code that would address the problems that labeling a THOW as an RV brings up."
> – Alex Ontiveros

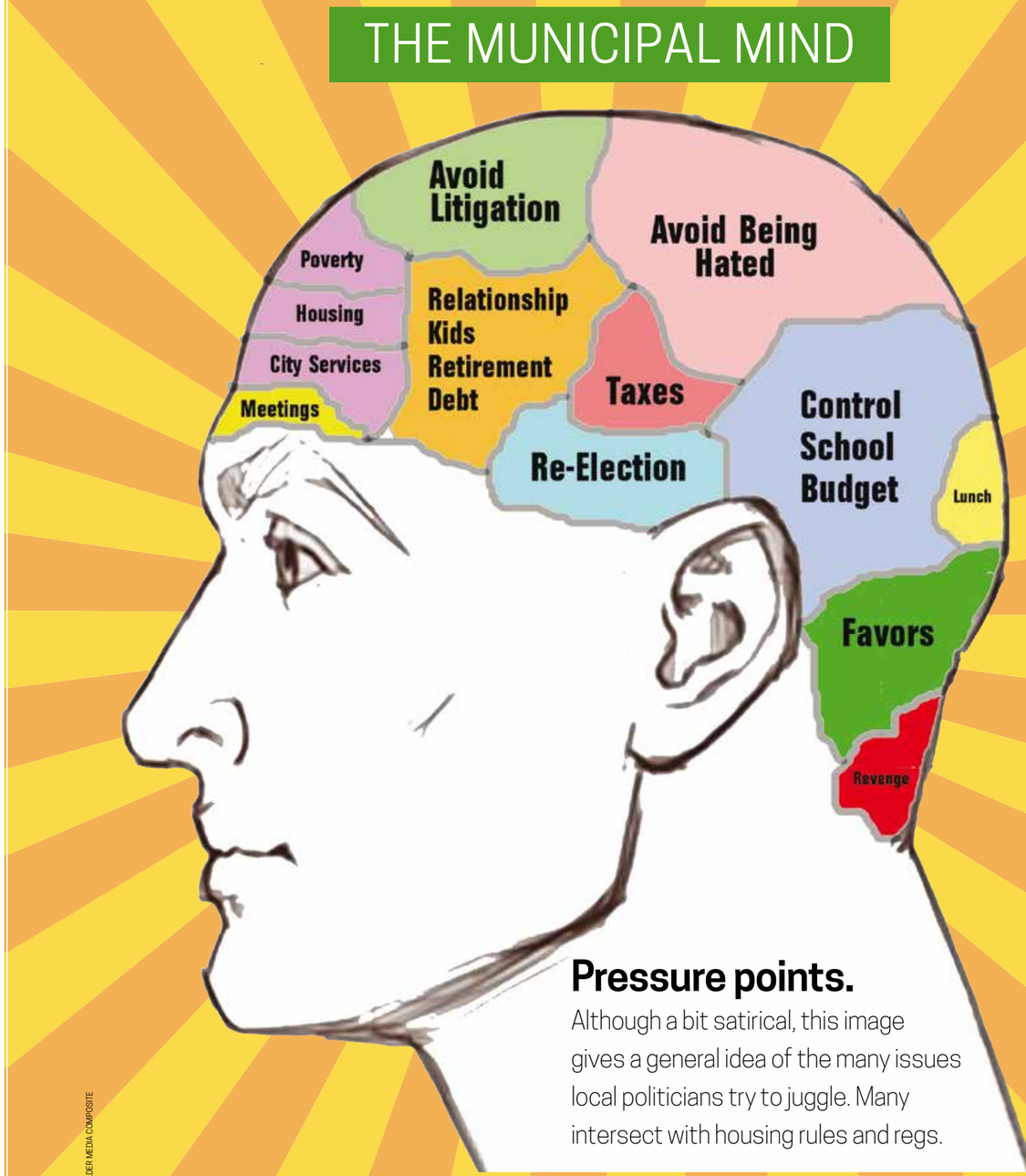
We have seen positive reception with RPTs as ADUs in Los Angeles, Fresno, Ojai, Jackson Hole and other jurisdictions in Colorado. These are by no means the only ones, but the most visible, to our knowledge.

The idea of a flexible tiny home has also been brought up. Some of the challenges we see would include building to a code inclusive enough to encompass most, if not all, building department requirements across the country. Securing units to a permanent foundation also has its own inspections that would be required as the TH rolls in.

These challenges are the reason why we have been engaged in the creation of a new code specific to tiny homes on wheels. Currently, IRC and its Appendix Q attempt to cover tiny homes on foundations, but historically IRC has not covered anything on wheels. We don't expect that they will for the time being."

For an example of some of the complicated wrangling going on behind the scenes as towns try to find a place for tiny homes, read this PDF (**https://bit.ly/2zNqBtd**) from a hired planning consultant working with the city of Lyons. Note, however, this was penned before the new tiny house section was added to the IRC.

Editor's note: *You heard it here first! Let's get out there and give organizations such as the PWA some support. Write to the ICC and let it know you think a new, flexible hybrid classification for tiny homes is essential for the next edition of the International Residential Code. The ICC takes proposals from anyone, and is required to consider all of them. Contact it (**https://bit.ly/2Nj5lJP**).*

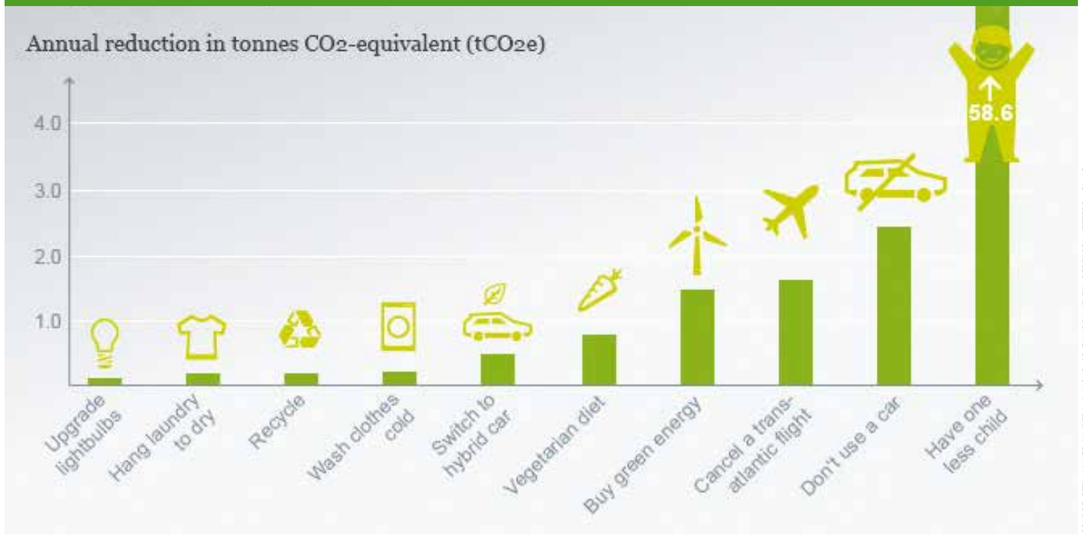


Pressure points.

Although a bit satirical, this image gives a general idea of the many issues local politicians try to juggle. Many intersect with housing rules and regs.

SOURCE: GREEN BUILDER MEDIA COMPOSITE

Ways to reduce your CO_2 emissions



SOURCE: SETH WYNES, KIMBERLY A. NICHOLAS, ENVIRONMENTAL RESEARCH LETTERS, VOL 12

Good karma. Living tiny is a great first step in saving the planet, but a lifestyle change can make a big difference in Earth's future.

BEWARE THE GREEN HALO

Tiny home owners who assume they have earned a sustainable dividend can end up trading one environmental harm for others.

A TINY HOUSE OWNER may want to use their new digs as a base station for a free-spirited, globe-trotting lifestyle—"a place to come back to." But this phrase sums up a vexing problem with human nature.

Studies (**https://bit.ly/2NiRzfG**) have shown that when people purchase products they perceive as "green," they often undergo a subtle psychological shift. They have now created a green "dividend" for themselves that rationalizes less-responsible behavior. For example, a tiny house owner may reduce their overall eco-footprint by two-thirds, but that reduction in greenhouse gases vanishes almost immediately as they use their new freedom (and money saved) to fly to South America or Nepal.

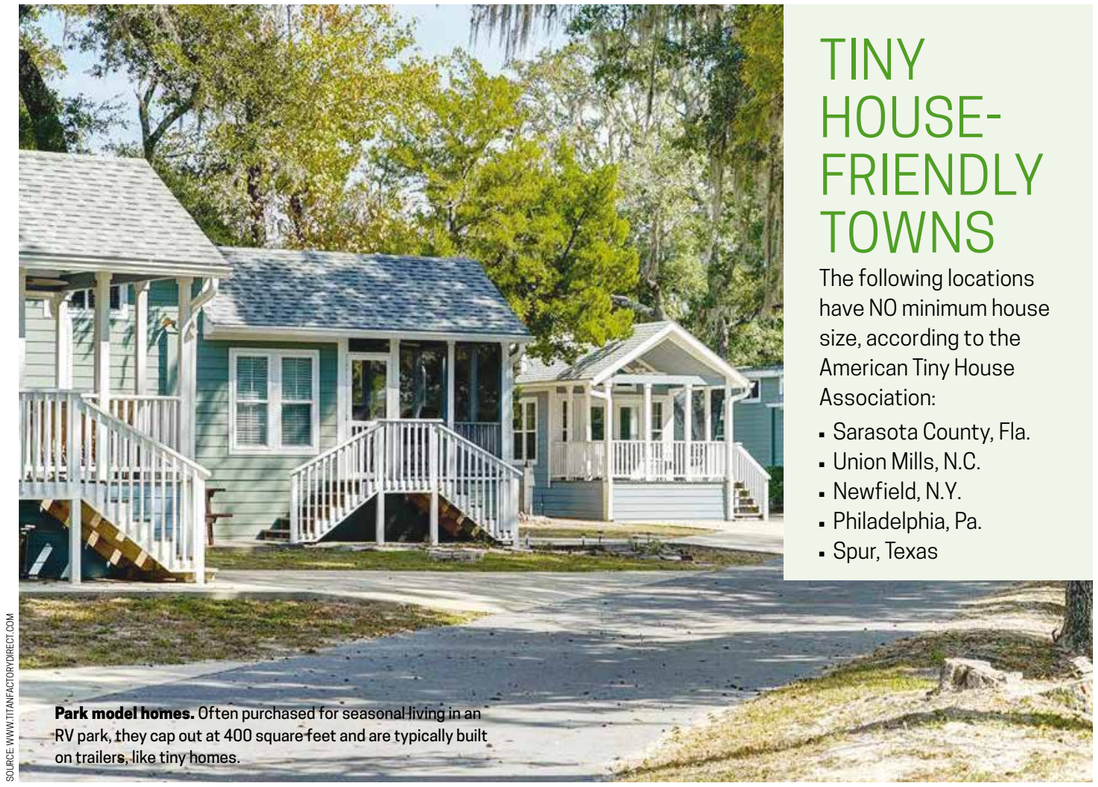
In other words, the only way a tiny house living really "saves" resources is if you actually live in it most of the time, and spend your creative energy locally, not pursuing far-flung journeys to exotic locations.

Also, *Business Insider* (**https://read.bi/2QpnsoV**) points out that "Increasingly, tiny houses have become larger, heavier and more expensive. The ideal of minimal impact on the environment is being lost, as businesses capitalize on the popularity of tiny homes. The distinction between tiny houses and luxury RVs is diminishing, causing some of the long-time leaders to abandon the movement."

It takes vigilance and honesty to keep tiny homes lean and green. For example, you may have bought into the stereotype that a young couple moving into a tiny homes will tread more lightly on the planet than their elders. Not so. Research (**https://bit.ly/2IyWNn7**) finds little or no difference in eco-friendly behaviors correlated with age.

To illustrate, let's begin with the awesome fact that tiny homes at their most optimized may create only 2,000 pounds of CO_2 per year (**https://bit.ly/2RmhFC3**), compared with a typical home, which produces about 28,000 pounds. That's no small difference. But this dividend shrinks rapidly if other "bad" behaviors continue: flying, driving, and eating meat, to name just a few (see graphic).

The bottom line: Living small can be a hugely positive lifestyle choice, with majorly beneficial positive impacts for ecosystems and residents. But it has to be approached with eyes wide open.



SOURCE: WWW.TITANFACTORYDIRECT.COM

Park model homes. Often purchased for seasonal living in an RV park, they cap out at 400 square feet and are typically built on trailers, like tiny homes.

TINY HOUSE-FRIENDLY TOWNS

The following locations have NO minimum house size, according to the American Tiny House Association:

- Sarasota County, Fla.
- Union Mills, N.C.
- Newfield, N.Y.
- Philadelphia, Pa.
- Spur, Texas

continued from page 22

wildfire threatens or local zoning conditions become untenable, owners have the option to pull up stakes and move somewhere friendlier to right-sized living. Others are also pushing this idea: Code changes are in the works that may make a hybrid tiny house possible (see "Fighting for Flexibility," page 22).

THE MUNICIPAL MIND

Advocates for tiny homes need to understand the priorities of policy makers. Beseiged by taxpayers for every attempt to shift away from "the way it's always been done," they tend to pick their fights carefully, taking the path of least NIMBY pushback. That path, for better or worse, typically leads them to take sanctuary in the bottom line. Whatever costs a lot of money gets pushed to the bottom of the priority list.

Property taxes, unfortunately, have become the primary financial engine that pays for city services. And city services almost never go down in price. To determine tax rates, cities assess properties and assign a value. In some places, such as Texas, the formula is pretty simple: Multiply the appraised value of the property by 1.5 percent. So for a $100,000 home you pay $1,500 annually. A tiny home might appraise for $30,000 or less. That cuts the potential property tax haul to under $500 annually.

In most municipalities, education (schools and related costs) account for about 80 percent of spending. Texas, for example, spends about $10,456 annually per student, according to the NEA (**https://bit.ly/2L4JpIa**). If that metric is typically the primary benchmark for approving new housing, you see why cities might push back. In places where affordable housing is hard to find, "one-off" tiny homes built on full-sized lots may be seen as poor use of valuable space. Urban planners like density and proximity, not scattershot development.

In some communities, proposing a "village" of tiny homes on small lots may break through the policy barriers. Alternately, tiny homes built in more rural areas can disappear into the local landscape.

But the metric isn't nearly that simple. Researchers on the impacts of new housing development have found that larger homes, for example, might appeal to larger families (introducing more students to educate). The current level of capacity in local schools also matters. Educating students in schools with empty seats costs far less than when classrooms are maxed out.

As with any good housing plan, the key to social and financial viability is mixed use—a combination of multi-family, small-lot developments and "one-off" single-family homes on individual lots.

For example, in Austin, a tiny home village is under construction. Village Farm (**https://villagefarmaustin.com/**) will include 152 agriculturally themed homes, many of which are a mere 399 square feet. GB

CHAPTER 02

HOW MUCH SPACE DO WE NEED TO BE HAPPY?

Your experiences and social status have a direct impact on what you consider “enough” living area.

SOURCE: WIKIPEDIA COMMONS

Early adopter. Henry David Thoreau's famous cabin on Walden Pond in Massachusetts was about the size of some tiny homes.

A RECURRING QUESTION (and criticism) of right-sized, or tiny house, living is whether people can really live comfortably in less than 400 square feet. What metric should be used to estimate the threshhold between comfortable and cramped? An obvious answer is "happiness," but, surprisingly, it's rarely considered directly when planners and pundits talk about how much living space a person needs.

Henry David Thoreau famously lived in a 10-by-15-foot cabin on Walden Pond, when he researched his famous book about simplicity. That's 150 square feet—about the size of a 20-foot travel trailer. If you've ever lived in a travel trailer with another person, you know that it's possible for two people to live in relative happiness in that much space. And yes, as you're probably thinking, it depends on the two people.

It also depends on cultural norms and expectations.

American attitudes toward how much space is enough, for example, are as fickle as attitudes toward privacy. According to a recent Pew study (**https://pewrsr.ch/1ZvtOWt**), they're willing to give up a lot of personal privacy if the conditions are right—such as with rewards programs and frequent flier deals—but loathe to share data for free.

"In extended comments online and through focus groups, people indicated that their interest and overall comfort level depends on the company or organization with which they are bargaining and how trustworthy or safe they perceive the firm to be," the study notes. "It depends on what happens to their data after they are collected, especially if the data are made available to third parties. And it also depends on how long the data are retained."

Another possible pivot point that influences acceptable housing size: keeping up with neighbors. According to research by (**https://bit.ly/2NtbF7o**) Clément Bellet, "Wealth inequality visible in house sizes fueled the mortgage boom that culminated in the 2008 financial crisis." He argues that since the 1940s, American house size has risen, but relative levels of happiness with housing have remained flat.

To take his analysis further, Bellet found that when bigger houses get built closer to smaller houses, house satisfaction is lower among the smaller households."

This line of research suggests that the perceptions of optimal home size are least partly rooted in comparison with the Joneses—not necessarily a "real" consideration of comfort or discomfort. Couldn't we take this line of reasoning to its logical logical conclusion? If you build small, and surround small homes with other small homes, residents will be happier with smaller spaces.

WHAT THE NEW BUILDING CODE SAYS ABOUT MINIMUM HOUSE SIZE

A few changes (**https://bit.ly/20K7ngg**) in the latest building code (IRC 2018) make tiny floorplans more flexible.

R304.1
Minimum Habitable Room Area

CHANGE TYPE: Modification

CHANGE SUMMARY: The requirement for one habitable room with a minimum floor area of 120 square feet has been removed from the code.

2015 CODE: R304.1 Minimum Area. Every dwelling unit shall have at least one habitable room that shall have not less than 120 square feet (11 m²) of gross floor area.

R304.2 Other Rooms. Other habitable rooms shall have a floor area of not less than 70 square feet (6.5 m²).

Exception: Kitchens.

No limits. Gone is the requirement that homes have one room of at least 120 square feet. Proponents of tiny houses argued successfully that the limit "was not based on scientific analysis or identified safety hazards," and code officials agreed to remove it.

The answer is, yes, it's already happening. It took off about five years ago, when so-called micro-apartments first became popular. Predictably, certain well-heeled messengers of the mainstream media were there to warn us off of the "dangers" of small living. *The Atlantic* cautioned that "Home is supposed to be a safe haven, and a resident with a demanding job may feel trapped in a claustrophobic apartment at night—forced to choose between the physical crowding of furniture and belongings in his unit, and social crowding, caused by other residents, in the building's common spaces."

If that sounds a bit stretched, the argument gets even more outlandish:

"For all of us, daily life is a sequence of events, he explains. But most people don't like adding extra steps to everyday tasks. Because micro-apartments are too small to hold basic furniture like a bed, table, and couch at the same time, residents must reconfigure their quarters throughout the day: folding down a Murphy bed, or hanging up a dining table on the wall."

Articles like these are part of the reason that tiny living has taken a while to gain traction. They zero in on preconceived horrors of tiny living, without actual behavioral observation of the occupants. Experts note that living small often reduces, rather than expands, the number of everyday tasks we face. You can only pile so many dirty dishes in a small sink, so you economize. You can sweep a 160-square-foot tiny home in a fraction of the time it takes to clean the floors of a 2,000-square-foot house. Folding up a Murphy bed is a lot faster than making your bed every morning. And most people never even use a dining room table, no matter how big the house. The dining room is the least used room in the house (**https://bit.ly/2NtkZYA**).

That's not to say we want to live small for every phase of our lives. Many people shift back and forth between small footprint and bigger footprint living. It's organic and natural. Thoreau, for example, only lived in his cabin on the Pond for two years. He then lived with a friend for three years while he wrote his book, and after that worked in his father's pencil factory.

WHERE'S THE BOTTOM?

According to Quora, German architects in the 1920s and 1930s claimed to have developed livable pods that were only 32 square feet. That's on the low side, even by today's tiniest standards. So-called micro-apartments are popping up worldwide. They range widely in size, but that doesn't mean they're inexpensive. In Hong Kong in 2015, a 180-square-foot apartment sold for $500,000. Apartments in Rome (**https://ind.pn/2QxTuiE**) have been advertised that are as small as 45 square feet.

Social scientists and urban planners have set the bar for floorspace at different minimums in recent years. The 2012 International Residential Code (IRC), for example, mandated that any dwelling should have at least one room that's 120 square feet or more, and other rooms shall be 70 square feet. But that minimum was removed in the 2015 version of the IRC (**https://bit.ly/2E6fsYE**), partly in response to pressure from tiny house advocates. As TentCityUrbanism (**https://bit.ly/2E67rTE**) notes, this suggests that the absolute bare minimum for a code-compliant tiny house in the U.S. is now 88 square feet. That's one 70-square-foot room plus 18 square feet of bathroom to accommodate water closet, lavatory, bathtub or shower.

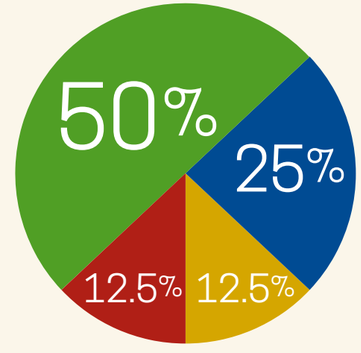
PHOTO: TUMBLEWOOD TINY HOUSE COMPANY

High style. Compact kitchens can look upscale, as this well-made *Cypress* model from Tumbleweedhouses.com shows.

STREAMLINING SMALL FLOORPLANS

ONE INTERESTING APPROACH to optimizing space is to look at actual behavior patterns and customize the space to reflect time spent. Tumbleweed (**https://bit.ly/2RxPD6v**) offers a formula for people interested in buying their mobile tiny house on wheels (THOW), also referred to as tiny house RVs.

They note that most people spend half their time in the bedroom, and that space needs to be reclaimed with a loft-type layout. Tumbleweed takes this a step further, and says that with a 172-square-foot model, if you ignore the upstairs sleeping loft, you can divide the space up more creatively. It looks something like this pie chart:



- **Great Room**: 50% / **86 square feet**
- **Kitchen**: 25% / **43 square feet**
- **Storage Closet**: 12.5% / **21.5 square feet**
- **Bathroom**: 12.5% / **21.5 square feet**

Maslov's hierarchy. While people may not require that every need be met to feel happy, needs on the bottom of the pyramid can't be ignored.

WHO DECIDES?

When you search online for how much floorspace a person needs, the one reference that seems to recur is a website called Engineering ToolBox (**www.engineeringtoolbox.com**), which says 100 to 400 square feet. Other modern sources such as the London Plan (**https://bit.ly/2Ryp69e**) have created an index of suggested minimal floorspace based on housing type and family size that is about the same range.

Suffice it to say the "optimal" living space is all over the map. Part of the reason for this is that the comfortable minimum is affected by a wide range of variables (and not just the personalities of the other people living with you.) These variables include the availability of outdoor patios, gardens and other amenities, shared public spaces and—notably—cultural norms and expectations.

THE HAPPINESS CONNECTION

One way to get at optimal living size is to overlay relative levels of happiness with shelter trends. Of course, shelter is just one factor in the overall satisfaction of a person. But if you refer back to Maslov's Hierarchy of Human Needs (shown above), shelter is one of the most basic physiological necessities. Until we feel well housed and well fed, we can't move on to more-complex psychological desires.

This is, incidentally, a question that only about 20 percent of the world has the resources and economic freedom to ask. The other two-thirds, according to the UN, live in less than 20 square meters each (about 230 square feet), and have little choice about the matter.

Note that none of the most-affluent industrialized countries made the top 10. So people in these 10 countries must live in big, elbow room mansions, right?

Of course not. Take Mexico, for example. A blistering article (**https://lat.ms/2Ay4VT6**) in the *LA Times* recently criticized an emerging housing type that emerged in Mexico called "mini-casas." A million homes sized at about 325 square feet were built and quickly occupied. If those million families skewed the national mood toward unhappiness, it's not apparent from studies of national contentment.

Other countries high on the "happiness" list also defy the stereotype that compact living equates with misery and overcrowding. In Bangladesh, the eighth-happiest nation on the planet with about 4.5 residents per unit, much of the population lives in compact homes and apartments built with traditional materials.

Somewhere lower on the happinesss spectrum are dense urban parts of the "developed" world that are faced with massive housing shortages. London has absorbed such an intense crush of population, for instance, that heat maps of the city show people packed into apartments and flats like prisoners in a slave ship—densities that make tiny house living seem palatial.

Culturally, some places seem more able to take tight living quarters in stride. If you look closely at living patterns in Bangladesh, for example, small personal living space is mitigated by the broader tapestry of shared communal spaces and close community ties.

Humans can live comfortably in very small spaces. But trying to generalize an exact figure for that "sweet spot" is disingenuous. Every nation, and every person, will have a different answer.

Incidentally, at Green Builder Media, we've launched a new VISION House® exhibition called The Align Project **(https://bit.ly/2QAJiWv).** Going on display in 2019, the project explores whether the typical U.S. citizen can live comfortably in 390 square feet of space, given a balanced relationship with the outdoors, the right design and an open-minded attitude. GB

The Happy Planet Index in 2017 identified the following 10 countries as the happiest:

Costa Rica
Mexico
Colombia
Vanuatu
Vietnam
Panama
Nicaragua
Bangladesh
Thailand
Ecuador

PHOTO: TINYHOMEBUILDERS.COM

Micro messy. A tiny apartment in Hong Kong feels even smaller with so much clutter covering every surface.

CREEPING CLUTTER

A cluttered space feels smaller and raises anxiety levels. Go spare, or go home (to your oversized house).

PART OF DETERMINING "RIGHT SIZED" SPACE DEPENDS on how disorganized and acquisitive the occupant is. Is she a grasper or a tosser? Does he let things go easily or is every object his "precious?" Katherine Lawrence of *DailyDeclutter.com* notes that "Often, the space constraints are from too much clutter, not lack of space. When a client has less than 500 square feet per family member, I know we will need to maximize their living space with organizational products."

CHAPTER 03

COMPACT WATER HEATING

Although a bit more expensive, a "triple threat" system of solar, electric and gas backup delivers under every scenario.

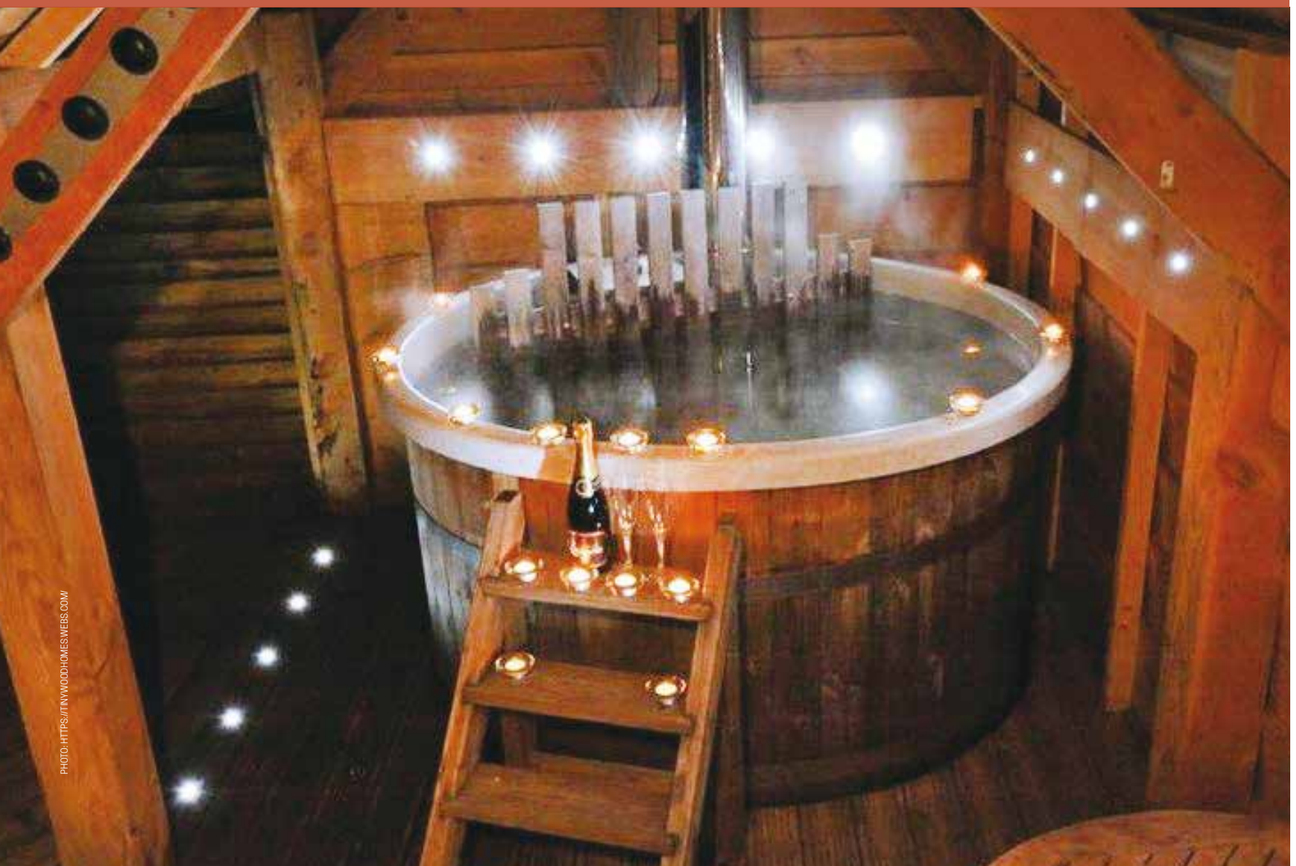


PHOTO: HTTPS://TINYWOODHOMES.WEBS.COM/

ONE OF THE SIMPLEST, lowest-tech systems we've seen for water heating on small homes is essentially a black tube mounted on the roof, that's heated by the sun, and gravity feeds hot water to your shower or sink. In southern climates, there are many variations on this concept, and at least one commercial product called *Road Shower 2* ***(Fig. 1)***.

Any number of other solar hot water heaters are available of course, but most require a storage tank inside the structure—more space than you may want to give up. This is the same limitation that applies to an electric hot water heater. There are several compact units on the market now that do a great job in a relatively small space, using 110 volt electric.

For example, Rheem makes a six-gallon electric heater that's well reviewed and retails for about $250 ***(Fig. 2)***.

Also, Bosch offers the *Bosch Tronic 3000 T 7-Gallon Electric Mini-Tank Water Heater* (not shown).

But if you want the flexibility to live off grid or take your home on the road, it doesn't hurt to have a gas-fired backup. A budget approach would be to acquire one from an expired RV at a junkyard. You many also end up with a "hybrid" heater that does both electric and gas heating. Or you can purchase an inexpensive conversion kit (**https://amzn.to/2zWngbk**) that allows you to plug in your water heater when you have an electrical hookup ***(Fig. 3)***.

But one criticism of this electrical water-heating systems is that you're wasting a lot of electricity to keep the water hot 24 hours a day, when you only need it occasionally. You have a couple of options. Put the plug on a timer, or install a smart switch you can control with your smartphone, and turn the water on and off at your whim.

If you use a lot of hot water, or plan to stay put most of the time, an on-demand propane gas water heater makes sense. This is a great technology, but for tiny homes, it's really only suited for areas that don't freeze, because you want to locate the unit outside your living space, as shown in this image of a Noritz on-demand unit posted on Tumbleweedhouses.com ***(Fig. 4)***.

SLOW THE FLOW

Key to any efficient, low-volume water system is the use of an extremely efficient showerhead. Most showers operate at 2.5 gallons per minute, but you want a 1.5-gallon-per minute-head. Thus, with a six-gallon tank, you can still take about a six-minute shower (because you're mixing hot with cold water). We've tested this model (**https://amzn.to/2zWwRz2**), and it works flawlessly. You hardly notice the flow constriction ***(Fig. 5)***.

While you're at it, go ahead and replace your kitchen and bath sink aerators with 0.5 gpm versions. We like the ones that allow you to switch between multiple flow rates in case you want to fill the sink quickly. The miserly setting is a silent governess for teenagers who like to run the water while they brush their teeth. GB

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CHAPTER 04

THE BUILDING SCIENCE OF SMALL

Putting readily available commercial systems to work in the Tiny House arena could raise the bar on strength and efficiency.

Light top. Aluminum roofing is just one material that can reduce tiny house weight.

PHOTO: TINYHOUSEROOF.COM

ARE LIGHTER, CODE-COMPLIANT TINY HOMES VIABLE?

We believe the answer is yes, with the right combination of products and engineering.

CAN TINY HOMES BE CONSTRUCTED TO SITE-BUILT STANDARDS at half the weight? The key is to look at the biggest weight offenders first: framing, roofing, sheathing, insulation and siding. Whittle down the pounds from there.

For one example, asphalt modified shingles weigh about 3 pounds per square foot. A 160-square-foot tiny house shed roof might weigh 480 pounds. By comparison, 16-gauge aluminum standing seam metal roofs weigh (**https://bit.ly/2Qy3NmU**) about 0.7 pounds per square foot, or 112 pounds. Installed properly, both materials can meet stringent building codes.

Then there's the steel framing alternative (see sidebar, page 37). The goal is to drop a tiny home's weight below 6,000 pounds, which is often the limit for standard pickup truck towing.

SPRAY FOAM AND TINY HOMES: A CLOSE FIT

A COUPLE OF YEARS AGO, we asked an RV dealer why spray foam isn't used more to make RVs more energy efficient. He suggested that the foam might disintegrate over time from road vibration.

The experts at Spray Foam Coalition looked into it. In general, their take is that spray foam is fine for any tiny house that won't travel much.

The weight of cured dense cell spray foam, at 2 inches thick, with an R-Value of about R-13, is 0.33 pounds per square foot. For an 8-by-12-foot trailer (plus 8-by- 20-foot shed roof), that adds about 158 pounds—not bad, considering the air sealing and strength benefits.

Here's the *Coalition's* take: "When a tiny house is on the move, maintaining structural integrity is key with the unpredictability of the road. A tiny home can be given a new lease of life with spray foam, it can stabilize vehicles during travel through closed cell foam. Spray foam is applied as a liquid, so it expands and seals all crack and seams to create an air-tight home.

"Tiny homes have big benefits, especially when built with strong building materials. As the tiny house popularity continues to grow, SPF proves to be a strong, reliable product that maintains the structural integrity of homes and buildings—no matter how big or small."

As a result, some tiny house builders have already committed to spray foam. For Byron Fears of Simblissity, in Lyons, Colo., spray foam is the "absolute best" way to insulate tiny homes.

For more information, check out **www.whysprayfoam.org.**

SUN-POWERED AIR CONDITIONING

As average temperatures increase due to climate change, fossil-free cooling is possible for tiny homes.

IT'S TIME FOR TINY HOMES TO GET OFF FOSSIL FUELS COMPLETELY, and go net zero. Solar-powered air conditioning offers a major step in that direction, especially in southern climates, but also as heatwaves roll across more-northerly states.

Lloyd Alter at Treehugger notes, quite succinctly, "it turns out that solar-powered AC is not some new technology, but simply a result of grinding out improvements in existing heat pump split units, combined with the continuing drop in the price of conventional solar panels, with a dollop of building energy efficiency improvements that reduce solar gain and resultant cooling loads."

Even the most-efficient space-cooling equipment requires a lot of juice—too much for most small solar arrays to provide in real time. A cloud goes by, voltage drops, and the equipment can be damaged or simply stops working. At least one

Smart andsolar A/C. Now in its fifth iteration, the HotSpot Energy's *ACDC12C SOLAR AC* system includes a variable speed operation that fluctuates with the day's solar production. Optional grid connection allows the unit to be used at night, and also "fills in" for power gaps during the day.

model (shown above) has overcome this limitation by allowing the compressor to operate at variable speeds.

However, for most mini-split systems the workaround is to use batteries. Unlike panels, batteries feed back current at a predictable constant rate. But here again, it's not that simple. The batteries have to be managed carefully. Overtax them and you may reduce their lifespan and damage their capacity.

Can you cool tiny homes with solar? Yes. But doing so successfully requires a careful balancing act between solar input, battery storage and electrical output—in combination with a well-insulated, energy-efficient building envelope. At present, a flexible system such as the *ACDC12C* is the turnkey option. But a competent solar installer could also help you design your own system.

Storm ready. RVs have their drawbacks, but when monster storms approach, they're able to roll out quickly, unlike most tiny homes.

PHOTO: FLICKR (CC)

OFF-THE-LOT RVs VERSUS TINY HOMES

Tiny house enthusiasts often fail to look closely at the good points of RVs. That's too bad, because although conventional RVs are limited in some ways, they have many positive attributes that can be integrated into tiny home systems.

PRO: YOU CAN MOVE

RVs are designed to travel—If you don't like your neighborhood, drive to a new one.

PRO: SELF-CONTAINED SYSTEMS

RVs don't require costly infrastructure such as wells, sewage or even electric hookups in some models.

PRO: NO COMPOST DUTY

Much as we like composting toilets, they do require a regular commitment and maintenance most people don't expect. They're definitely a better choice for a static tiny house than a rolling home. RVs don't generally offer compost options.

PRO: BUG-OUT READY

On the other hand, when inclement weather approaches, RV owners can quickly pull up jacks and flee at 70 miles per hour from whatever the impending menace is.

CON: MUNICIPAL BIAS

Many cities have rules intended to prevent long-term occupancy of RVs. Typically, if you live in an RV more than 14 days per year, you may get a citation from your city. Tiny homes, if built on a permanent foundation, may be seen as accessory dwelling units (ADUs) with no tenure limits on occupancy.

CON: STORM AND WEATHER VULNERABILITY

RVs are not made to weather major storm events, although due to the fact that they have to withstand driving speeds, most are more resilient than manufactured homes. Significantly, the popular "bump-outs" on large RVs are especially vulnerable. They're not made to handle snow loads or high winds.

CON: SEPTIC DUTY

You'll need a dumping station nearby to occasionally dispose of blackwater waste. This may cost a small fee each time.

FRAMING TINY HOMES WITH STEEL

Although it costs somewhat more up front, using a steel framing kit has many advantages.

COURTESY OF MICHAEL JANZEN

Michael Janzen, who partners with **Volstrukt Steel Framing**, lays out 10 reasons he uses steel kits.

1. Higher R.O.I. — Your return on investment is better because with wood framing most of the cost is in the labor. With steel tiny house kits, 80 percent of your investment stays in the quality permanent materials, not lost as a labor cost.

2. Lightweight and Strong — Steel's strength-to-weight ratio is 25 times higher than wood. A steel tiny house frame is 40-60% lighter than wood and 10 times the strength of a comparable wood frame. So it's half the weight and exponentially stronger.

3. Quick Assembly — At the factory, the steel framing is all pre-assembled into wall and roof panels. Once delivered to your job site you can assemble the panels in a day or two with the help of friends.

4. No Special Skills Needed — The pre-assembled steel frame tiny house kits don't require an experienced framing crew. All you do is fasten panels together at square angles and attach it to your foundation.

5. Pest/Rot/Rust Resistant — Galvanized steel comes with a barrier to moisture and rust and makes an incompatible environment (or meal) for pests like termites.

6. Thermal Bridging Defeated — Modern sheathing options like ZIP™ Systems provide the thermal break, structural sheer strength, vapor and air barrier all in one application.

7. Stonger Than Your Average Steel — The structural quality 20- to 22-gauge sheet steel in Volkstrukt kits is rolled through a series of dies and formed into C-sections, and not subject to fragile fold points.

8. ICC Compliant — The cold-rolled steel process used to produce these steel tiny house kits is ICC-compliant and IRC-compliant. Read this ESR-2361 PDF (**https://bit.ly/2QANzJx**) for more information about the FRAMECAD technology.

9. Highest Quality — An engineered frame means you can sail past the design phase and avoid the risks for cost increases and delays.

10. Experienced Designer and Manufacturer — Michael Janzen has been designing tiny houses since 2008. Volstrukt uses the industry leading cold-rolled steel framing technology to produce tiny house frames.

*Condensed and reprinted from a blog (**https://bit.ly/2Rvg10S**) by Michael Janzen.*

CHAPTER 05

CASE STUDY: FLORIDA GETAWAY

To pay for their tiny house dreams, many buyers are offering them as short-term rentals to pay down the mortgage.

THIS FLORIDA GEM offers the kind of million-dollar water view none but the wealthiest of us ever see, except perhaps when camping at a seasonal resort. The reason for renting this tiny unit is obvious, but short-term rentals such as this sometimes puts tiny house owners at odds with local planners, especially in areas short on housing.

Here's the owner's description. Note that she goes out of her way to remind renters how small certain rooms are, such as the bathroom:

"This "modern meets industrial" tiny house is a foundation build. Location is Polk County, Fla. (Babson Park on Crooked Lake). Took me quite a bit to go through the proper channels and get everything approved but this is a "legit" (legal) tiny house with permits pulled and certificate of occupancy issued.

Interior dimensions are 12-by-24 (288 square feet) with a 100 square-foot loft with queen bed and sitting area (388 square feet total). Two bedrooms—one on the lower level (full bed).

Appears roomier than most due to high ceilings—14 feet—in the front sloping to 12 in the back which also provides a loft ceiling of 6 feet on one side sloping to 4 feet on the lower side. Concrete floors were stained to complete the sleek "industrial" look.

Features a 5-by-5-foot bathroom with a 33-inch corner shower, locker "console" table pops up and serves as dining for four. Locker also offers ample storage. Concrete counter top, leftover roofing material used as a back splash, used metal dental wash station was turned into great kitchen cabinets and pantry.

Home is eventually going to be my retirement home but for now is posted/listed on Airbnb (https://bit.ly/2PkLbXc)." GB

CHAPTER 06

GALLERY: TINY HOMES FOR SALE

These homes, listed on www.tinyhomebuilders.com in August, 2018, demonstrate the highly creative world of tiny house design and custom structures.

ESCAPE TRAVELER XL, Woodstock, GA
$89,000 • 1 bed, 1 bath • 344 Sq Ft

CUSTOM ONE-OF-A-KIND TINY HOME, Sheldon, ND
$50,000 • 1 bed, 1 bath • 260 Sq Ft

TINY HOUSE ON WHEELS, Webster, MA
$69,000 • 3 beds, 1 bath • 350 Sq Ft

HARVEST MOON GYPSY STYLE TRAILER, Twain, CA
$21,000 • 2 beds, 1 bath • 120 Sq Ft

NEW TINY HOME, HEBER CITY, UT
$33,900 • 1 beds, 1 bath • 240 Sq Ft

CUSTOM TINY HOUSE, San Marcos, CA
$53,450 • 2 beds, 1 bath • 378 Sq Ft

BUNGALOW, Carlsbad, CA
$34,450w • 1 bed, 1 bath • 198 Sq Ft

"ZEN DEN" FEATURED ON TINY HOUSE NATION, Tenino, WA
$89,000 • 1 bed, 1 bath • 320 Sq Ft

PORCHLIGHT FROM HIDEAWAY TINY HOMES, Denver, CO
$65,900 • 2 beds, 1 bath • 288 Sq Ft

THE SOLAR, SAN ANTONIO, TX
$29,500 • 1 bed, 1 bath • 160 Sq Ft

BEACH HOUSE ON THE BEACH, Savusavu Town, Vanua Levu
$36,800 • 1 beds, 1 bath • 190 Sq Ft

A TINY HOME TO HELP TINY TOTS, Dearborn, MI
$48,000 • 1 beds, 1 bath • 280 Sq Ft

CHAPTER 07

THE RIGHT (SMALL) STUFF

The combination of low-tech ingenuity and high-tech capabilities can solve many of the living challenges with small spaces.

THREE TECHNICAL WONDERS TO SET YOU (GRID) FREE

New and improved technologies promise to make tiny homes more resilient and self sufficient. Here are some of our favorites.

1. Induction Cooktops

Unlike other glass-topped electric cooktops, induction systems heat the pan directly. They capture 90 percent of the energy from the unit, whereas both gas and glass top electrics lose up to 40 percent of their heat around the pan. What this means is that a cast iron pan is hot enough to fry an egg in 9 seconds.

A well-designed solar setup with batteries and 1,000-watt inverter could operate a single burner top, such as the 800-watt model shown. Multiple burners would likely be too power intensive for off-grid use.

2. Lightweight Peel and Stick Solar for Standing Seam Panels

Although you might think Elon Musk invented the idea of solar panels that look like roofing, building integrated photovoltaics, or BIPV, have been around for decades. But some of the latest ones are the most flexible—literally. New PV products are flexible, and you can adhere them directly to a metal standing seam roof. Metal is ideal, because it's also one of the lightest types of roofing that meets high wind requirements.

3. Solar Refrigeration

Although you can buy off-the-shelf solar powered DC coolers, these don't have the oomph most people want for full time living.

But as an intrepid RV owner proved recently (**https://bit.ly/2EyML73**), do the math right, and you can install a full-time, off-the-grid refrigerator that requires just two 100-amp hour 12-volt batteries. Here's the small refrigerator (**https://amzn.to/2NsbeKr**) that worked for them. The unit has an operating range of 30 to 60 degrees Fahrenheit.

FLEXIBLE FURNISHINGS

Tiny living can be far more comfortable when furnishings perform multiple functions. Here are several of the best multi-purpose solutions we've seen.

Ana White Tiny House Guest Bed

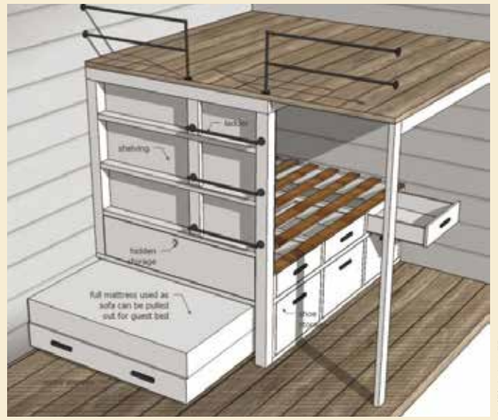


PHOTO: ANA WHITE

Tub Beneath a Murphy Bed

PHOTO: TREMKER TRAILERS

Pullout Kitchen Countertop *Worktop Plus*

PHOTO: MAGNET CO

Foldaway Pia Pop-Up Kitchen

PHOTO: DZZCONCEPT

Ozzio *Smart Living* TV Wall Unit Plus Seating for Six

PHOTOS: OZZIO (ITALY)

CHAPTER 08

NEW CODE FOR SITE-BUILT TINY HOUSES

The residential building code makes specific rules about minimum sizes in site-built homes (which include tiny dwellings). The new Appendix Q in the IRC 2018 code addresses ceiling heights, fire egress and stairways in tiny homes.

APPENDIX Q TINY HOUSES

This provision contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User note about this appendix: Appendix Q relaxes various requirements in the body of the code as they apply to houses that are 400 square feet in area or less. Attention is specifically paid to features such as compact stairs, including stair handrails and headroom, ladders, reduced ceiling heights in lofts, and emergency escape and rescue opening requirements at lofts.

SECTION AQ101

GENERAL

AQ101.1 Scope.
This appendix shall be applicable to tiny houses used as single -dwelling units. Tiny houses shall comply with this code except as otherwise stated in this appendix.

AQ102.1 General.
The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 of this code for general definitions.

- **EGRESS ROOF ACCESS WINDOW**. A skylight or roof window designed and installed to satisfy the emergency escape and rescue opening requirements of Section R310.2.
- **LANDING PLATFORM.** A landing provided as the top step of a stairway accessing a loft.
- **LOFT.** A floor level located more than 30 inches (762 mm) above the main floor, open to the main floor on one or more sides with a ceiling height of less than 6 feet 8 inches (2032 mm) and used as a living or sleeping space.
- **TINY HOUSE.** A dwelling that is 400 square feet (37 m) or less in floor area excluding lofts.

SECTION AQ103

CEILING HEIGHT

AQ103.1 Minimum ceiling height.
Habitable space and hallways in tiny houses shall have a ceiling height of not less than 6 feet 8 inches (2,032 mm). Bathrooms, toilet rooms and kitchens shall have a ceiling height of not less than 6 feet 4 inches (1,930 mm). Obstructions including, but not limited to, beams, girders, ducts and lighting, shall not extend below these minimum ceiling heights.

Exception: Ceiling heights in lofts are permitted to be less than 6 feet 8 inches (2,032 mm).

SECTION AQ104

LOFTS

AQ104.1 Minimum loft area and dimensions.
Lofts used as a sleeping or living space shall meet the minimum area and dimension requirements of Sections AQ104.1.1 through AQ104.1.3.

AQ104.1.1 Minimum area.
Lofts shall have a floor area of not less than 35 square feet (3.25 m).

AQ104.1.2 Minimum dimensions.
Lofts shall be not less than 5 feet (1,524 mm) in any horizontal dimension.

AQ104.1.3 Height effect on loft area.
Portions of a loft with a sloped ceiling measuring less than 3 feet (914 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required area for the loft.

Exception: Under gable roofs with a minimum slope of 6 units vertical in 12 units horizontal (50 percent slope), portions of a loft with a sloped ceiling measuring less than 16 inches (406 mm) from the finished floor to the finished ceiling shall not be considered as contributing to the minimum required area for the loft.

AQ104.2 Loft access.
The access to and primary egress from lofts shall be of any type described in Sections AQ104.2.1 through AQ104.2.4.

AQ104.2.1 Stairways.
Stairways accessing lofts shall comply with this code or with Sections AQ104.2.1.1 through AQ104.2.1.5.

AQ104.2.1.1 Width.
Stairways accessing a loft shall not be less than 17 inches (432 mm) in clear width at or above the handrail. The width below the handrail shall be not less than 20 inches (508 mm).

AQ104.2.1.2 Headroom.
The headroom in stairways accessing a loft shall be not less than 6 feet 2 inches (1,880 mm), as measured vertically, from a sloped line connecting the tread or landing platform nosings in the middle of their width.

AQ104.2.1.3 Treads and risers.
Risers for stairs accessing a loft shall be not less than 7 inches (178 mm) and not more than 12 inches (305 mm) in height. Tread depth and riser height shall be calculated in accordance with one of the following formulas:

1. The tread depth shall be 20 inches (508 mm) minus four-thirds of the riser height.
2. The riser height shall be 15 inches (381 mm) minus three-fourths of the tread depth.

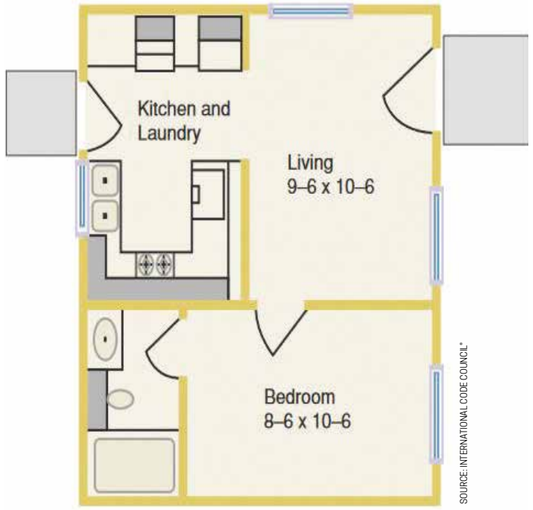
AQ104.2.1.4 Landing platforms.
The top tread and riser of stairways accessing lofts shall be constructed as a landing platform where the loft ceiling height is less than 6 feet 2 inches (1,880 mm) where the stairway meets the loft. The landing platform shall be 18 inches to 22 inches (457 to 559 mm) in depth measured from the nosing of the landing platform to the edge of the loft, and 16 to 18 inches (406 to 457 mm) in height measured from the landing platform to the loft floor.

AQ104.2.1.5 Handrails.
Handrails shall comply with Section R311.7.8.

AQ104.2.1.6 Stairway guards.
Guards at open sides of stairways shall comply with Section R312.1.

AQ104.2.2 Ladders.
Ladders accessing lofts shall comply with Sections AQ104.2.1 and AQ104.2.2.

AQ104.2.2.1 Size and capacity.
Ladders accessing lofts shall have a rung width of not less than 12 inches (305 mm), and 10-inch (254 mm) to 14-inch (356 mm) spacing between rungs. Ladders shall be capable of supporting a 200-pound (75 kg) load on any rung. Rung spacing shall be 3.75 uniform within /inch (9.5 mm).



Small dwelling complying with minimum area requirements

New rules. A tiny house floorplan compliant with IRC 2018 space restrictions.

AQ104.2.2.2 Incline.
Ladders shall be installed at 70 to 80 degrees from horizontal.

AQ104.2.3 Alternating tread devices.
Alternating tread devices accessing lofts shall comply with Sections R311.7.11.1 and R311.7.11.2. The clear width at and below the handrails shall be not less than 20 inches (508 mm).

AQ104.2.4 Ships ladders.
Ships ladders accessing lofts shall comply with Sections R311.7.12.1 and R311.7.12.2. The clear width at and below handrails shall be not less than 20 inches (508 mm).

AQ104.2.5 Loft guards.
Loft guards shall be located along the open side of lofts. Loft guards shall be not less than 36 inches (914 mm) in height or one-half of the clear height to the ceiling, whichever is less.

SECTION AQ105

EMERGENCY ESCAPE AND RESCUE OPENINGS

AQ105.1 General.
Tiny houses shall meet the requirements of Section R310 for emergency escape and rescue openings.

Exception: Egress roof access windows in lofts used as sleeping rooms shall be deemed to meet the requirements of Section R310 where installed such that the bottom of the opening is not more than 44 inches (1,118 mm) above the loft floor, provided the egress roof access window complies with the minimum opening area requirements of Section R310.2.1.

CHAPTER 09

LOANS FOR TINY HOUSE FINANCING

Obtaining financing for a tiny house varies by the type of construction and mobility of the project.

1 RV Lending

If you are looking for a THOW, consider an RV Industry Association-certified tiny home. These are considered RVs for the purposes of lending, which helps open up a wide range of lending companies. For example, US Bank, LendingTree, SunTrust and Southeast Financial all provide RV loans. Southeast Financial (**https://bit.ly/2zXgthv**) does not provide financing unless you are currently a homeowner, so they may not be the best option for everyone.

2 Tiny Home Loan Specialists

LightStream (**https://bit.ly/2NtMLnW**), a division of SunTrust Bank, is a loan company that provides tiny home-specific financing. This is one of the few tiny home specific loan products on the market.

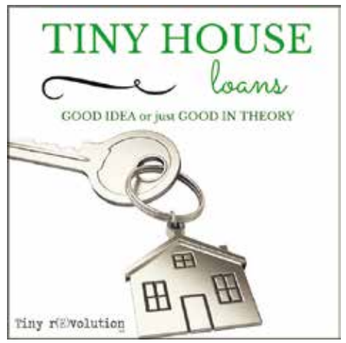
Other options include RockSolid Funding (**https://bit.ly/2zX7Wvb**), which specializes in trailer and recreational equipment financing, and Bildsworth International (**https://bit.ly/2Por0ba**).

Also, First Southwest Bank (**https://bit.ly/2OKtxyY**) provides RV or travel trailer loans for tiny homes, but only in their market.

3 Tiny Home Builder

Some tiny home companies provide in-house financing services. These include:

Tumbleweed (**https://bit.ly/2QCz20f**)
Escape (**https://bit.ly/2C2VBXB**)
Indigo River (**https://bit.ly/2NqyLLD**)
Tiny House Chattanooga (**https://bit.ly/2RynqfJ**)
SunWest Tiny Homes (**https://bit.ly/2PiJbyP**)



4 Personal Loans

If the first three options aren't accessible for you, consider a personal loan. There are two options: a secured loan (requires collateral), and an unsecured loan (does not require collateral). SoFi (**www.sofi.com**) and Prosper (**www.prosper.com**) have been known to provide personal loans for financing a tiny home. Both companies provide unsecured personal loans to borrowers.

5 VA loans

VA loans (**https://bit.ly/2NulEct**) are possible as a financing option for tiny homes, but you can't use this type of loan unless the home sits on a permanent foundation. This means your tiny house has to meet site-built building codes all the way through the build process. Also, USAA (**https://bit.ly/2C1iQ4u**) won't qualify you for any mortgage under $50,000.

6 FHA Loans

The FHA's rules, according to Jefre C. Outlaw of Sprout Tiny Homes, are rather circumspect about what constitutes a tiny home. They require only that "a home be marketable in the area and have adequate space necessary to assure suitable living, sleeping, cooking and dining accommodations and sanitary facilities." He adds that the FHA requires all manufactured homes to have a "minimum size of 400 square feet to qualify for FHA financing." A tiny house is not a manufactured home, but it's generally a lot smaller and less expensive than a conventional home, and the loan will still require it be built on a foundation. Banks often add additional fees to loans of $40,000. Here's how it works, from **mortgagereports.com**:

> *"Low loan amount surcharges catch many borrowers off-guard…if it costs $1,000 to process, underwrite and fund a home loan, and the profit on a $400,000 mortgage is $2,000, the lender makes money if it gets a 0.5 point origination charge. But if the loan is just $40,000? That 0.5 point origination fee is only $200, which means the lender would lose $800 by funding that loan. So either lenders stop making smaller loans, or they have to charge more to cover their costs. So in this case, there might be a 'low loan amount' add-on of three more points. The total origination would be $1,400, allowing the lender to cover its costs and earn $400 on the loan."*

Orient express. Kasita's *Orient* smart home platform is a technology-driven step toward the "Intuitive Home" era.

COURTESY OF KASITA

The Align Project: Align Your Technology

As we move toward the 'Intuitive Home,' a tech-filled smart home like the *Orient* becomes increasingly hard to turn down.

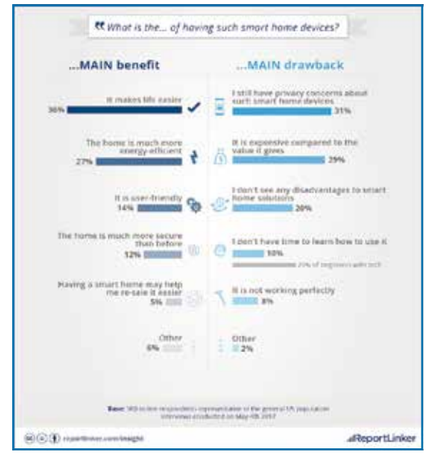
BY JULIET GRABLE

HERE'S THE VISION: You return home after a long day at work. Lights fade on in a pleasing combination of soothing greens and blues; your favorite chillaxing music queues up. You've plugged in your electric car, but your charger knows to delay charging until rates are lower, or your smart inverter/battery system may tell the charger to draw from the storage battery instead. In the background, devices are talking to each other and automating all kinds of tasks, freeing us to do other things while saving energy and money.

Such is the promise of the Internet of Things. But there have been a few bumps on the evolutionary road toward what Jason Jaynes, head of technology for Kasita, calls the "Intuitive Home."

When it comes to the inner sanctum of our homes, people are cautious. They don't want more complication added to their lives, and they don't want Google ogling them (or *Alexa* giggling at them), especially in their living room or bedroom. iQor's *Customer and Product Experience 360 Survey* (**https://bit.ly/2NHkZ03**) reveals the frustration of early adopters of smart home technology as they "struggle with setup and installation issues and disjointed technical support involving multiple people at multiple companies." Often, the frustration leads to people giving up on the devices, the report notes.

Similar findings are elsewhere. People surveyed by ReportLinker cited privacy concerns as the No. 1 drawback to smart home technology. And a poll (**https://bit.ly/2yllZcC**) of 2,000 homeowners conducted by home security provider Ooma found that 72 percent of people with such systems worry that companies will use smart home advances to invade their privacy. In addition, nearly a quarter (23 percent) said they turn off their system when they have guests to avoid being "spied on."



Who's watching me? According to a ReportLinker survey, privacy concerns are the biggest drawback of smart home devices.

SOURCE: REPORTLINKER.COM

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT

BY Kasita

TOWARD THE INTUITIVE HOME

These issues are likely growing pains. First, according to Jaynes, there was the "Mindless Home." People purchased individual smart home devices and brought them into their dwellings. Most required a separate app to control, and the devices couldn't necessarily "talk" to each other. The evolutionary boneyard is littered with start-up companies that brought their devices to the market, only to die a quick death.

More recently, we've entered the era of the "Managed Home," thanks to platforms like Apple *HomeKit* and Amazon *Alexa*, which enable a more seamless experience.

"The onus is still on the owner to go out and get the devices, but there's the option to control everything through a single app or using voice control," says Jaynes.

One of the goals of The Align Project, a joint venture between Austin-based modular home company Kasita and Green Builder® Media, is to demonstrate the potential of smart home technology. Kasita debuted its *Orient* smart home platform at Solar Power International in Anaheim, Calif., in September. This platform is a solid player in the Managed Home era, but it also offers a glimpse of where we are heading—what Jaynes calls the "Intuitive Home."

Kasita's approach, where the owner's entire experience is considered, is a key factor toward enjoyment, according to Jaynes. "The user doesn't have to install anything, configure anything or program anything."

Jaynes notes that the smart devices are already there, and control everything from temperature and lighting to security and entertainment. But "the space has the responsibility to respond to our settings," rather than the other way around.

Early on, *Kasita* partnered with Loxone, which offers a complete smart home ecosystem managed through its *Miniserver*. The company manufactures more than 150 products, but others can be integrated.

> "Let's say the occupant is ready for bed. Using the voice control capabilities enabled through Amazon *Alexa*, they tell *Orient* to 'run Bedtime,' and the entire house automatically adjusts: the doors lock; the lights shut off; the temperature moves to the desired sleep setting and the shades come down. All of that functionality comes out of the box with Kasita."
>
> -Jason Jaynes, Head of Technology, Kasita

COURTESY OF KASITA

What's your pleasure? Filled with smart devices, *Orient* has the capability of responding to the homeowner's settings.

Kasita has wrapped *Orient* around the Loxone system—in particular, Loxone's highly efficient and powerful lighting system and touch controls, which can be used to control lighting moods, music and shades.

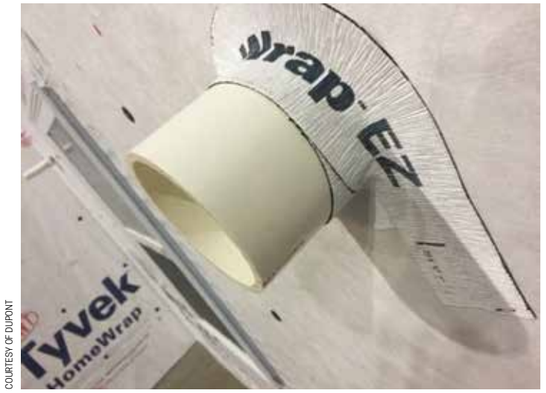
Orient is a cloud-based platform, which in theory allows users to take their preferences with them from one *Kasita* to another. The platform builds in privacy by using "anonymous" profiles—in other words, the space may "know" about a set of user preferences and settings, but it will not be able to leverage those preferences and settings to identify the individual.

Jaynes adds that people can choose to opt out of having their data collected.

Here's another important point that may comfort those who have yet to warm to smart home technology: In Kasita, the *Orient* platform is available to assist the user, but it is not required to function. Every feature can still be controlled manually.

MATERIALS TECHNOLOGY

Though smart home technology is showcased throughout The Align Project, equally important is the materials technology represented in everything from the exterior cladding to the *Corian* countertops. Some of these materials are brands that have proven their staying power and earned bragging rights when it comes to durability, performance and environmental sustainability. Two examples are DuPont *Tyvek CommercialWrap* and Trex *Transcend* decking.



COURTESY OF DUPONT

All wrapped up. DuPont's *FlexWrap EZ* is designed to withstand extreme temperatures and 270 days of UV exposure, making it suitable for residential and commercial applications.

It's a wrap

Tyvek has become to housewrap what Coke is to soft drinks. Made with non-woven, high-density polyethylene, the material has unique properties—it's durable, lightweight and water resistant, yet breathable—and these have made it a mainstay for builders. *Tyvek CommercialWrap,* used in The Align Project, adds extra wind and UV resistance, making it a good choice for the tough conditions on commercial jobsites.

DuPont continues to develop accessories and products that enhance the performance of *Tyvek*. For example, the company's *FlexWrap EZ*, introduced just this year, is a self-adhered flashing intended for smaller penetrations. It comes in a 2-¾-inch-by-15-foot roll and can be used around HVAC vents, plumbing pipes, gas lines, and electrical wires and outlets, making it a single solution for multiple trades.

"People don't pay as much attention to the smaller penetrations," says Julie Short, marketing analyst at DuPont. But, she adds, sealing around these can collectively contribute to an exceptionally airtight envelope.

Smart water

The Align Project features several innovative ways to save water, ensure water quality and protect the home. One of these is *Flo*, a smart leak detection device that is installed on the main water supply line. By running daily tests, *Flo* can detect small leaks that, drop by drop, add up to thousands of gallons of wasted water.

Flo keeps tabs on three metrics: flow, water pressure and temperature. The system will send a real-time alert to the homeowner's phone if a leak is detected. It automatically shuts off water in the event of catastrophic failure.

Immediately after installation, *Flo* goes into "learning mode," getting a baseline on normal water usage for that particular home. Thereafter, *Flo* runs daily tests. The user can also set goals for weekly usage, and the app will send an alert if the usage total is exceed.

Flo Protect, an additional subscription service that costs $5 per month, provides fixture-by-fixture water usage data. This service also comes with live chat support and a guarantee: The company will pay the deductible, up to $2,500, for any homeowner insurance claim.

Smarter than Average; Plays Well With Others

WHEN IT COMES TO SMART HOME DEVICES, it can be challenging to separate the wheat from the chaff. Here are some points to consider:

1. Is it compatible with smart home ecosystems?
2. Is it intuitive/easy to install and operate?
3. Does it save energy, water or other resources?
4. Will it contribute to the safety, security and enjoyment of the home?

And here are three examples of smart home technologies featured in The Align Project that fit the bill:

Tabuchi *Eco-Intelligent Battery System (EIBS)*: This all-in-one storage battery and hybrid inverter comes with energy monitoring software that not only allows the homeowner to track energy use, but enables techs to troubleshoot issues. The system manages energy from a home's solar array, the battery and the grid to optimize energy use and savings. You can also customize the system. For example, some might choose to prioritize cost savings, while others might want to ensure maximum storage energy in anticipation of power outages.

COURTESY OF AWAIR

***Awair 2nd Edition*:** Like its predecessor, this device keeps tabs on volatile organic compounds, carbon dioxide, humidity and temperature, but it also monitors fine dust, or particulate matter, which can be absorbed by the bloodstream and cause respiratory problems. *Awair 2nd Edition* comes with an easy-to-read LED screen which displays the overall "Awair Score." It will also send your smartphone an alert if any one of the five metrics is out of the healthy range. The device is compatible with many smart home ecosystems, including *Alexa*, *Google Assistant*, *Nest* and *IFTTT*.

Andersen *Yale Assure Lock*: This smart lock enables keyless entry and accommodates up to a dozen unique PIN codes. You can monitor, lock and unlock the door with your smartphone, and receive notifications when someone enters or exits. A voice assistant will guide you through a quick set-up. The lock integrates with Amazon *Alexa* for voice control. Z-wave and Bluetooth modules are included, but ZigBee and *HomeKit* modules can be purchased as well.

COURTESY OF FLO TECHNOLOGIES

Going with the 'Flo'. *Flo* integrates with Amazon *Alexa* and *Google Assistant* but does not require an internet connection to function.

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT BY Kasita

The Align Project Intelligent Home

We see value in smart home technologies that saves energy, water and other resources, while truly improving quality of life. Here's a round-up of some of the technologies featured in The Align Project.

Tabuchi *Eco-Intelligent Battery System*

This all-in-one storage battery and hybrid inverter manages energy and connects with other smart home devices.

COURTESY OF TABUCHI

Andersen Windows *VeriLock* and *Yale Assure Lock*

VeriLock sensors which let occupants know if windows and doors are open, closed, locked or unlocked. Users can remotely control and program the *Yale Assure Lock*, a keyless entry.

COURTESY OF ANDERSEN

Loxone Smart Home Automation

Loxone's *Miniserver*, lighting, and controls are integrated into the *Orient* smart home platform.

COURTESY OF LOXONE

Rheem *Professional Prestige* Hybrid Heat Pump Water Heater

This ENERGY STAR-qualified water heater comes with *EcoNet* Wi-Fi-connected technology, and a free mobile app which allows for customizable temperatures, vacation settings, energy savings and more.

Rheem

This ENERGY STAR-qualified mini-split system from Rheem provides comfortable space heating and cooling and can be integrated with smart thermostats for even greater efficiency.

COURTESY OF RHEEM

Flo Smart Leak Detection System

Flo will send real-time alerts to the homeowner's phone if a leak is detected and automatically shuts off water in the event of catastrophic failure.

COURTESY OF FLO TECHNOLOGIES

Awair 2nd Edition

Awair 2nd Edition monitors five components of indoor air quality—fine dust (PM2.5), chemicals (VOCs), CO_2, relative humidity and temperature—and will send an alert when one of these is out of the healthy range.

COURTESY OF AWAIR

Voltea *DiEntry* Residential Water Purification System

This system can be tuned to provide on-demand purified water from all faucets of the home, and requires no salt or chemicals.

COURTESY OF VOLTEA

J Geiger *R Series* Shading System

These fabric shades are integrated with Kasita's Loxone smart home system and Amazon *Alexa* voice control.

COURTESY OF J GEIGER SHADING

Delta *AC Mini*

This EV charger has Wi-Fi connectivity and can perform charging when electricity rates are lower.

COURTESY OF DELTA

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT

BY Kasita

Experience The Align Project

CONSUMER ELECTRONICS SHOW
January 8-11, 2019
Las Vegas, NV

DESIGN & CONSTRUCTION WEEK
February 19-21, 2019
Las Vegas, NV

CREDIT: KASITA

Can we chart a new course? The Align Project says YES.

Key facets of an aligned lifestyle that you'll learn more about include:

ALIGN Your Space: The 100 Percent House

Most of us use only 5 percent of the large homes we were told we needed. What if instead, we optimized our living spaces to create a home that's 100 percent useful? The *Kasita* house, with its precision-engineered design and modular construction, uses good design to optimize space and reflects how people actually use their homes.

ALIGN Your Finances: Investing in Resilience and Efficiency

Many of the choices we make about our homes sacrifice durability, resilience and efficiency for short-lived cost savings. When we put in a carpet that lasts five years instead of hardwood floor that lasts a century, we sabotage our future. To align our finances, we must focus on reducing predictable costs, not creating future sinkholes for our money.

ALIGN Your Technology: Mastering Our Machines

At what point do high-tech gadgets stop serving you and start sucking away your valuable time and life energy? How can we be seamlessly "connected" all the time without feeling watched and violated? We'll dig into research about where and how people are using technology, and explore which innovations are truly helping people improve the quality of their lives and which are merely trendy gizmos destined to be mothballed.

ALIGN Your Mobility: Destination Deconstruction

What if, when thinking about getting from point A to point B, we focused on the journey instead of the destination? This shift in focus could affect everything from the type of vehicle we drive to the type of neighborhood we choose to live in. Join us as we explore the topic of mobility from a human-centric perspective, considering the implications for everyone from city planners and car makers, to the users themselves.

ALIGN Your Future: Aging With Dignity

Devices and products are now available that monitor vital signs, improve access or mobility around the homes, and ensure safe and healthy spaces. Combine these with a compact, portable, flexible housing option like *Kasita* and you have the ultimate strategy for a home that changes with you.

Tool Test: The Solar Jobsite

New tools and battery systems bring the off-grid solar jobsite a step closer.

BY MATT POWER, EDITOR-IN-CHIEF

WHEN RYOBI UNVEILED its new *18V One+ 10-Inch Miter Saw*, the time seemed right to test the viability of an all-solar-powered jobsite. I already owned a number of the Ryobi tools that use the same battery, along with a Ryobi *P131* in-vehicle charger (a must), so I had them round out the suite for me with the miter saw, a *P5231* orbital jig saw, a five-inch random orbit sander *P411*—and a plug-in, six-port battery supercharger.

My friend Oscar van Loveren is a well-informed solar dabbler and airline pilot. He walked me through the basic mathematics of watts, amps and capacity when it comes to solar charging. He agreed that 200 watts of photovoltaic should be enough to bring a 100-amp, 12-volt battery up to charge over the course of a sunny day.

I included a 12-volt marine battery in my solar setup to act as a buffer. That way, when the sun went behind a cloud, my tool batteries would keep charging. Direct charging of Ryobi tools from PV panels (with a charge controller) is possible, but less consistent.

With the 12-volt battery at full charge, Oscar and I determined that I could expect to re-charge my Ryobi heavy duty tool batteries about three times per day, without draining them beyond the 50 percent capacity of the base battery. At times when the sun was shining, the 12-volt battery wouldn't lose any charge at all as I tapped the power for my tool battery charger.

Another reason I chose the 12-volt battery "buffer" is that the Ryobi *P131* is designed for car cigarette lighters. It was an easy, flexible hookup. I just attached a pigtail with a female socket for a 12-volt charger to my 12-volt battery. The charger plugged right into the socket.

CREDIT: MATT POWER

Photovoltaic workhorse. Ryobi's solar power-driven *18V One+ 10-Inch Miter Saw* offers a way to tackle numerous cutting and carving projects without using fossil fuels.

Longevity factors

One step I took before my day of field testing the tools with solar was to show up on site with all of my tool batteries and my 12-volt battery at full charge. Why not start on third base?

My field test added up to about eight hours of building a small, 16-foot boat storage shed. During this build, I put various tools through different kinds of cuts and uses, including cutting 2-by-4 and 2-by-6 framing lumber, 9/16-inch plywood and some pressure-treated 4-by-4 posts, and lots of drilling and deck screws.

Oscar pointed out that perhaps the biggest variable in a working solar jobsite is how heavily you use the tools. Are you single-handing the job, or are two people tapping the same power supply? Repetitive tasks are among the biggest battery drains. Ryobi says the new miter saw will make cut 400 4-by-4s. That's many more than I asked it to handle, but I did test it on compound angles of 2-by-6 and 2-by-8 planks, and never had an involuntary shutoff. Of course, the miter saw is using two batteries, not one, so it should last longer than smaller hand tools. But if you drain both, you've used two-thirds of your daily solar budget. It's best to keep batteries in constant rotation on the charger. I found that five batteries was the magic number for my all-day project.

Straight and narrow

When you think about it, cutting a piece of plywood sheathing is probably the biggest job you will ask of your cordless kit. Ripping one piece of 8-foot, 9/16-inch ply is probably equivalent to cutting about 30 2-by-4s, depending on the wood moisture, blade sharpness and so on. That's asking a lot in one pass, but it can be done. In fact, I was able to make three or four cuts like these without incident—although I did not push the tool further.

It's easy to get into a bind, however, if you treat the cordless tools in the rough-and-tumble way you might a plug-powered circular workhorse. One key to successful battery-driven carpentry is the use of sharp blades and straight cuts. Resistance is the enemy of battery-powered tools and will cause them to simply shut off until you reset. So, for example, when cutting sheets of plywood with the Ryobi circular saw, you want to keep the blade precisely on track. This is sometimes also true of the company scrolling saw if you try to round a corner too tightly.

The tools are more forgiving, of course, when the batteries are topped off. Remember: Keep one on the charger at all times.

Sometimes choosing a different tool for the job proved to be the easiest solution. In the case of my Ryobi cordless drill, I was having trouble with the tool shutting off when I used it to operate the screw on my aging trailer support jacks. I switched to the company's impact driver, which handles such resistance better, and haven't had the problem again.

COURTESY OF RYOBI

Rough and ready. The five-inch P411 is good for about 20 to 30 minutes of serious sanding with one standard battery.

Balancing demand and supply

During my day of heavy cutting with the miter saw, occasional use of the circular saw and jig saw, serious demand on the cordless drill, an hour or so of sanding with the palm sander, pushing 3-½-inch exterior deck screws through dimensional lumber, and batteries in constant rotation on the charger with the sun shining, I never reached a point where I couldn't power my tools. In fact, I didn't even have to recharge the miter saw batteries. Only the drill battery and the circular saw had to be switched out once each.

Still, if I were going to work a job like this day after day, I'd throw my tool batteries into a bag and take them home each night. Then I'd put them on one of Ryobi's six-battery chargers overnight. That would give the 12-volt base battery time to top off in the morning.

I'm eagerly waiting for the missing link in Ryobi's prosumer tool portfolio: a cordless table saw. For now, I'm comfortable recommending its existing tools as an off-grid solution when a noisy gas generator isn't desired or feasible. They're not as powerful or forgiving as AC tools, but they're ideal for small projects, when you just want to grab a tool and go. They also give you major bragging rights: You can tell your clients you're so green, you don't even burn fossil fuels to run your tools. **GB**

COURTESY OF RYOBI

Power up. Ryobi's orbital jig saw can handle small-diameter curves, but you'll need to start with a full battery.

COURTESY OF RYOBI

Stay on target. The 18-volt circular saw works best with a sharp blade and straight path.

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Codes With a Side of Climate

Codes are designed to keep homeowners and building occupants safe and protected. They also play a critical role in protecting the environment.

BY SARA GUTTERMAN

THE CONNECTION BETWEEN codes and the climate may, at first blush, seem oblique. However, the two are intricately connected. Codes are designed to make homes and buildings stronger, safer, healthier and more durable. They're designed to improve performance and energy savings. And in so doing, codes play a pivotal role not just in protecting lives, but the planet as well.

Buildings have a dramatic impact on the environment: They consume almost 40 percent of the energy produced in the U.S., and they release nearly half of our nation's carbon emissions. After vehicles, buildings are the second largest source of ozone-depleting chemicals like volatile organic compounds (VOCs) and nitrogen oxides (NOx).

According to the *Salt Lake Tribune*, "About a third of pollutiongenerating chemicals come from buildings, including older, less insulated homes with inefficient furnaces and water heaters. Changing building codes won't force older homes to be more efficient, but it will make new homes—homes that will be around for another 50 years or more—adhere to 21st century clean technology. The added cost is marginal, and homebuyers want cleaner homes."

Enhanced energy codes go a long way in reducing the environmental footprint of homes and buildings. The 2012 International Energy Conservation Code (IECC) represents a 30 percent increase in building efficiency in comparison to the 2006 code, resulting in decreased carbon emissions and resource use. Subsequent versions of the code make incremental increases beyond the 2012 code.

While it's important to celebrate the recent advancements in energy code, the codes that address air quality remain sorely inadequate.

Toxins and pollutants from buildings adversely affect the air we breathe—both inside and outside. According to the EPA, indoor air is often two to five times more contaminated than the air outside, which is particularly important since we spend, on average, 90 percent of our time inside. And emissions from buildings have contributed to a sharp decline in outdoor air quality in cities across the country, causing a spectrum of health ailments from watery eyes to searing headaches to fatal heart attacks.

Unfortunately, special interests and building professionals whose only concern is lowest upfront cost have hijacked the code process for too long, with the quest for profit trumping the fundamental purpose of codes: to protect the health and safety of people. This obtuse mentality, which has been the bane of the building industry for decades, must change immediately if we have even a remote chance of addressing the realities of our changing climate.

When it comes to code development, we must expeditiously apply a new assessment methodology that certainly considers upfront cost but also incorporates environmental impact, resource use and emissions. If the damage caused to homes and buildings by the intensification of extreme temperatures, catastrophic weather events and wildfire hasn't convinced us yet that we need stronger codes, then perhaps the sharp rise in childhood cancer rates and other terminal illnesses will.

Codes are the fundamental building blocks for our future. "Building to code" can no longer represent what is simply enough to "get by." If the purpose of codes is to provide protection for inhabitants, shouldn't those of us in the codes arena feel the obligation to raise the bar high enough to adequately address issues of health, resiliency, resource use and environmental impact?

Ultimately, it will be up to us to set our priorities: Will we continue to make decisions about codes that pad the coffers of the builders, or will we leverage them for their fundamental purpose of protecting the people and places that we love the most? **GB**

AD INDEX

COMING NEXT ISSUE

GREEN BUILDER®

Super Structures, Super Heroes

Green Builder's annual Green Home of the Year competition highlights projects that are leading the enviro-friendly charge through technology, net zero, design and other resources. Also, meet GB's Sustainability Superhero.

GREEN BUILDER® MEDIA PRESENTS

THE ALIGN PROJECT

BY Kasita

RENDEZVOUS WITH REALITY

THE ALIGN PROJECT is a one-year demonstration project designed to challenge entrenched ideas about how we live in the U.S. and offer suggestions for how we can align our lifestyles with our changing socio-economic and environmental realities.

Whether we like it or not, the changing climate is demanding a sweeping overhaul of the way we live. Fortunately, advances in high-performance products and enabling technologies are providing viable solutions for enhanced efficiency, resiliency, sustainability, and connectivity.

The centerpiece of The Align Project is Kasita's small-footprint, net-zero, connected independent dwelling unit. The precision-engineered home takes advantage of every square foot of space and comes with Kasita's smart home technology platform, which seamlessly integrates devices, appliances, lighting, and mechanical systems.

Recognizing that sustainable living extends beyond the home, The Align Project also focuses on revamping our cities, energy infrastructure, mobility solutions, and finances, highlighting sustainable choices that align with our moral compass to ensure a flourishing future.

Visit The Align Project

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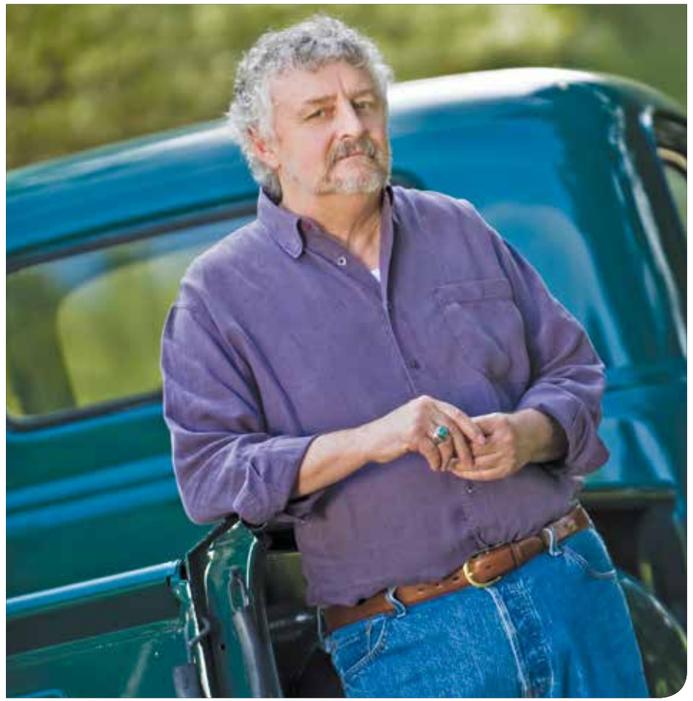
FROM THE TAILGATE

New Offerings for the Sustainable Minded

By Ron Jones

Welcome Again to the Restless Heart



NOT LONG AGO I JOKED with a group of people that being a builder must be comparable to being a serial killer: You can go silent for a while, but that "next one" is always lurking around the backroads of your mind. Maybe the analogy isn't really that far-fetched when you stop and think about it.

If you're a builder, you never get over the urge to just build something. And sometimes the itch goes all the way down your arm to your hand, and you can almost feel the weight and balance of the hammer wrapped in your fingers.

I built my last project for clients several years ago, but I still can't drive by a jobsite without taking a close, long and critical look to see at what's going on. Plus, I am able to take care of my insatiable urges by working on our own internal projects and the demonstration houses we've presented around the country in conjunction with extraordinary builders over the past decade.

Still, because my creative juices and imagination have always been driven by responses to the landform, every piece of ground is to me like every chunk of marble must be to a sculptor: completely irresistible. And thus it is that the bluff above the river on the back end of our property slips unexpectedly into my thoughts with increasing regularity.

The first snows have already blanketed the high country. Even though we still have daily access to our projects up there, I know it is only a matter of weeks before we spend much more of our time here, left to seek our stimulation and satisfaction in these more-civilized environs. And so, the bluff keeps calling me back.

Staring down at the bends and runs of the river from above, it is easy to estimate the height of the bluff at a hundred feet. But looking out horizontally at the opposite bank, through the tops of the cottonwoods on the far shore, 60 seems more likely. Why not split the difference and imagine the vertical drop to be 80? After all, it's just daydreaming at this point.

And from that lofty perch the mind begins to embrace the view corridors; the way the sunlight plays differently on the rushing waters from season to season. The sounds of the currents reach up and blend with the breezes in an ebb and flow that seems so deliberate, yet so natural, as if some master composer had chosen the perfect notes and chords—which is, of course, precisely the case.

That is when the images of rooflines, sturdy supports and cantilevered decks begin to appear. Concrete piers and steel beams begin to respond, and the shape of the structure starts to form mentally: The view from a certain bank of windows, the feel of the air spilling up over the top edge of the bluff, the moonlight magically reflecting off the stillness of the deep pools, the magnetism of an outdoor fire feature on a November evening, the coolness of a refreshment to complement the warmth of the summer sun.

The value of a vessel lies in the space it creates. All the elements are present; they need only to be expertly arranged. Opportunity has teased once more. The builder is restless. **GB**

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