



An Opportunity to Build Better



**WOLFWORKS**

Better Home. Better Life. Better Planet.

# TABLE OF CONTENT

**3**

Introducing Net Zero

**4**

Net Zero Moved the Goal Posts

**6**

Net Zero Benefits

**8**

Built Different. Built Better.

**12**

Naming the Challenges

**14**

Expertise Matters

# Introducing Net Zero

This is a story about where we live. It's the story of the energy we use to live there and the tantalizing prospect of actually producing all the energy we need on an annual basis – its a new way of thinking about building what are called **Zero Net Energy** homes.

The best place to start is to quote Dorothy: “There’s no place like home.” As shelter buildings protect us, provide comfort, and serve our practical needs.



As homes they delight and renew us – nourish our social relationships – and are often the hub of our active lives. To do all this they use energy – and we have been in the habit of buying all the energy we need to serve our home’s requirements in the form of fuel delivered and electricity produced by others – and we measure our use by the payments we make.

We use that energy mostly to provide thermal comfort, hot water, and another good chunk to operate mechanical systems and all our homes electrical stuff. As the expense of energy has increased homes have become more efficient thru building codes, energy saving programs, and innovative design methods like Passive House. Over time, the cost to produce electricity with PV’s, along with rebates and incentives, has made it possible to produce some of that energy on site, and mostly on roof tops. And as buildings become more efficient and PV’s more affordable a new goal line has come into view – the ability for a home to actually produce as much energy as it needs – these are called Net Zero Homes, or Net Zero for short.

# Net Zero moved the goal posts



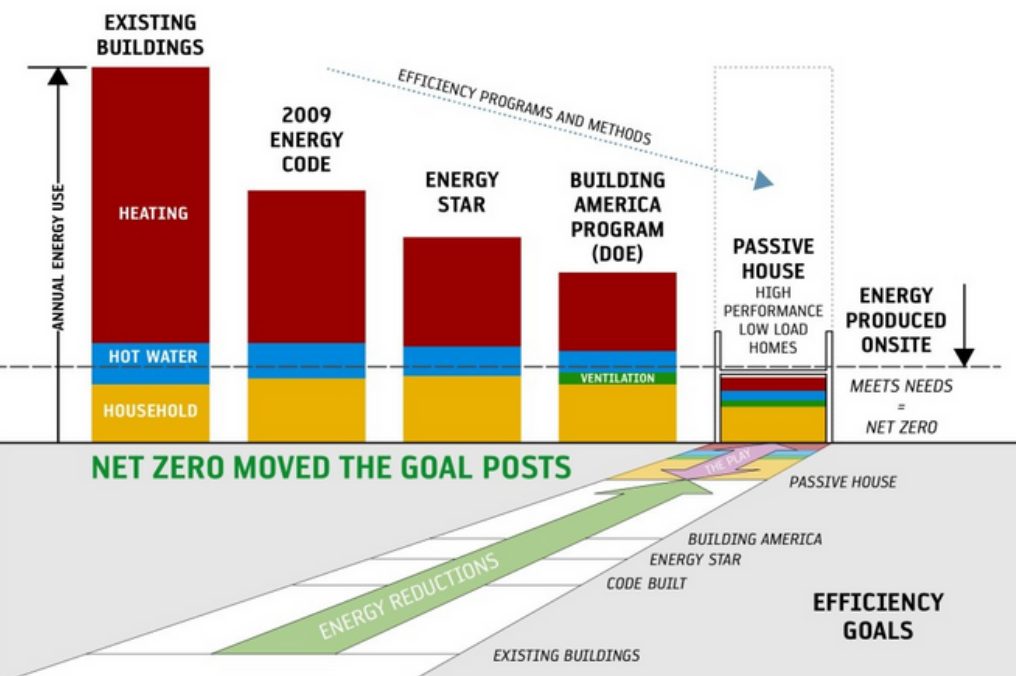
Net Zero has become our new goal line. So where did we receive the ball? Well, to employ that metaphor, let's say our existing buildings, the ones most of us live in, have the ball at the twenty, like after a kickoff. Our existing homes can be hard to keep comfortable, and cost a lot to do it. Because they don't work so well we depend on all sorts of workarounds. There are aisles at Home Depot with portable heaters, humidifiers and dehumidifiers, air cleaners and air conditioners, and of course, fans; all with their own additional energy costs. Its enough to tap our puritan ethic: turn down the thermostat and put on a sweater. We can take advantage of an energy audit and probably advance the ball about ten yards, or get serious and take on projects called Deep Energy Retrofits and get the ball to the fifty yard line, about as far as its possible to take an existing home.

New homes are different. A home built to the next version of the Building Code, in other words any home being built today, will be starting at the fifty; but also staying there. That is one thing about building a home. It is embedding its values IN time. Colonials, Victorians, Mid-Century Moderns; they each express the idea of home and its functions that people valued when they were built. Our McMansions say a lot about the past couple decades. Where are we headed? Well, further down the field.

Houses built to the Energy Star for homes standard get us into field goal range – around the 35 or 40 yard line. These are much higher performance homes and use significantly less energy than what we have been building. Can we advance further. Can we get inside the twenty to the red zone?

Well that is what Passive House accomplishes. This rigorous method of building what are called high performance, low load homes (inspired by the US solar movement from the '70's and re-engineered in Germany in the 90's) has returned to the US and is inspiring some of the most efficient homes in the country. We're ready to score!

Our next play will get us to the goal line – the miserly amount of energy a high performance home needs is so small that it can be completely satisfied by the PV's that fit on its rooftop – they're producing all the energy they need on an annual basis. This same amount of PV's on most homes will just satisfy the household electrical loads – nice, but not Net Zero.



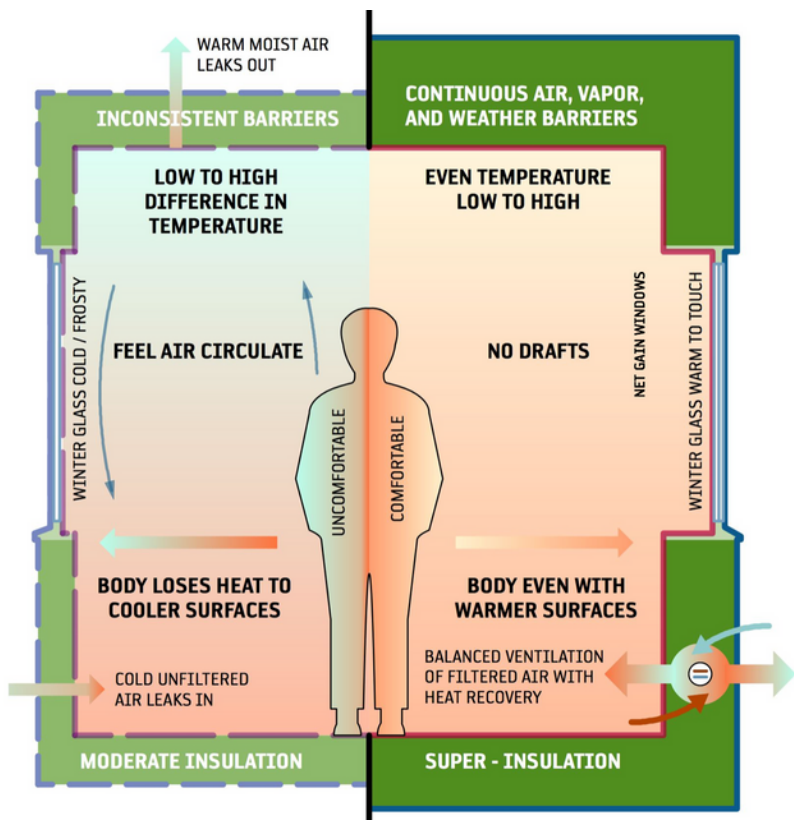
# Net Zero Benefits

So Net Zero homes are an impressive accomplishment, who wouldn't want an energy bill of zero! But energy efficiency isn't the only thing that makes these homes different. We're used to buildings that leak air, are different temperatures in different rooms, can feel stuffy or too dry, and may even be causing health problems – all the result of the way they were built. They may also be vulnerable to ice dams, mold or other indoor air quality issues, or even be causing building materials to rot.

High performance homes like Passive House do just the opposite. They are consistently comfortable at stable temperatures everywhere in the building, have a constant source of filtered fresh air contributing to health and cleanliness, and are robustly durable – no ice dams or mold – so long lasting and low maintenance. They use simple systems that are easy to maintain and make smart use of solar energy streaming thru large south facing windows. Floor plans are open and spaces are bright and cheerful. These aren't just optimized machines, they are delightful homes.



## The difference between conventional and Net Zero Homes

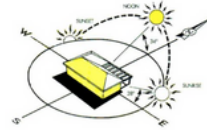
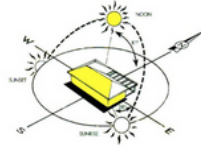


This graphic illustrates the difference between two types of building. Our conventional homes (the ones most of us live in) have modest levels of insulation, randomly leak air, and can be seasonally uncomfortable, in part because there are drafts and our bodies lose energy to cold surfaces. High performance Net Zero homes bake in the features that assure they are consistently comfortable, healthy, durable, and energy secure. Once we know how to build better, why would we ever build the old way?



# Built Different. Built Better.

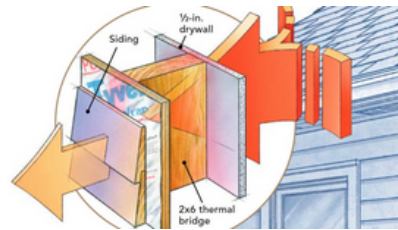
So how do these homes achieve such impressive performance? Well, to borrow from Apple's marketing campaign, they are "Built Different." They depend on five integrated strategies starting with a simple shape and orientation to the sun, inviting in the winter sun and shading it out in summer.



The building is enclosed with high levels of super insulation and conscious attention to the four critical "barriers." Like an explorer headed to the arctic they wear a thick coat; in this case one that completely envelops the building, even beneath the foundation slab.



This envelope is also "thermal bridge free." It avoids building details that have materials that can conduct heat from inside out. All this slows the rate at which the building loses energy to a trickle. This is why the indoor environment is so stable.

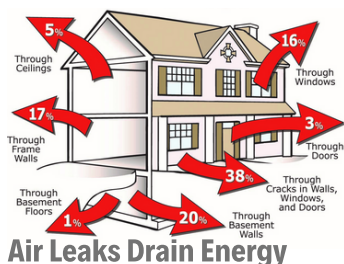


**Eliminate Thermal Bridges**

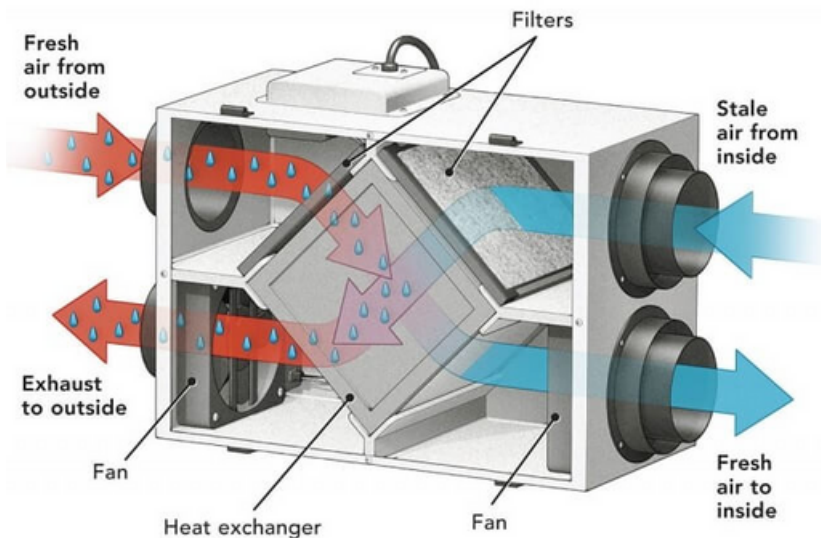
The carefully sized and located high performance windows gain more energy than they lose – actually outperforming the thick walls. This is therefor called net gain glazing and is part of the free heat that gives the building a big energy advantage. The other source of free heat is actually our own bodies – we generate heat – and so does our electronic equipment and our appliances. When the building loads get this small these free gains help.



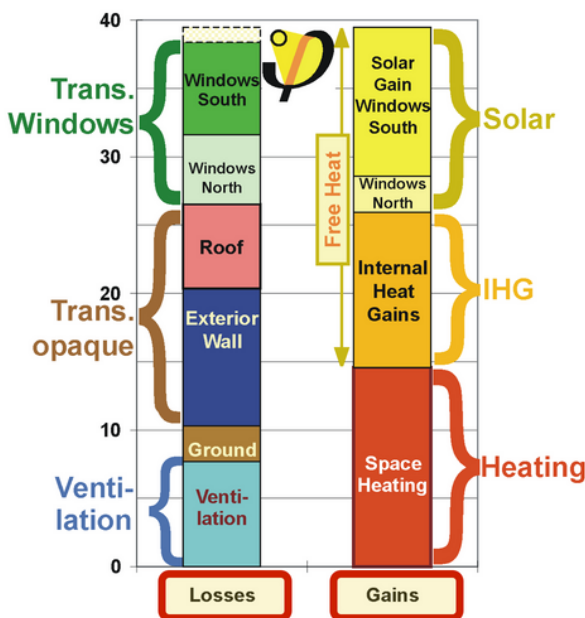
Most homes lose a substantial amount of energy thru air leaks at every surface and junction. These are called ventilation losses.



Net Zero homes are essentially air tight, eliminating what is otherwise a big liability. Unlike most homes that depend on unpredictable leakiness to provide fresh air these homes breathe using a system of balanced ventilation. It employs a constant and equal exchange of indoor and outdoor air at a rate that supports good health, with the added virtue of being able to capture the heat in the air that would otherwise be leaving the house and transferring it to the incoming air. This is called heat recovery ventilation and it is a remarkable technology.



## Understanding the Energy Balance



This graphic illustrates the energy balance that every home must account for. In this case it illustrates the balance for a Passive House.

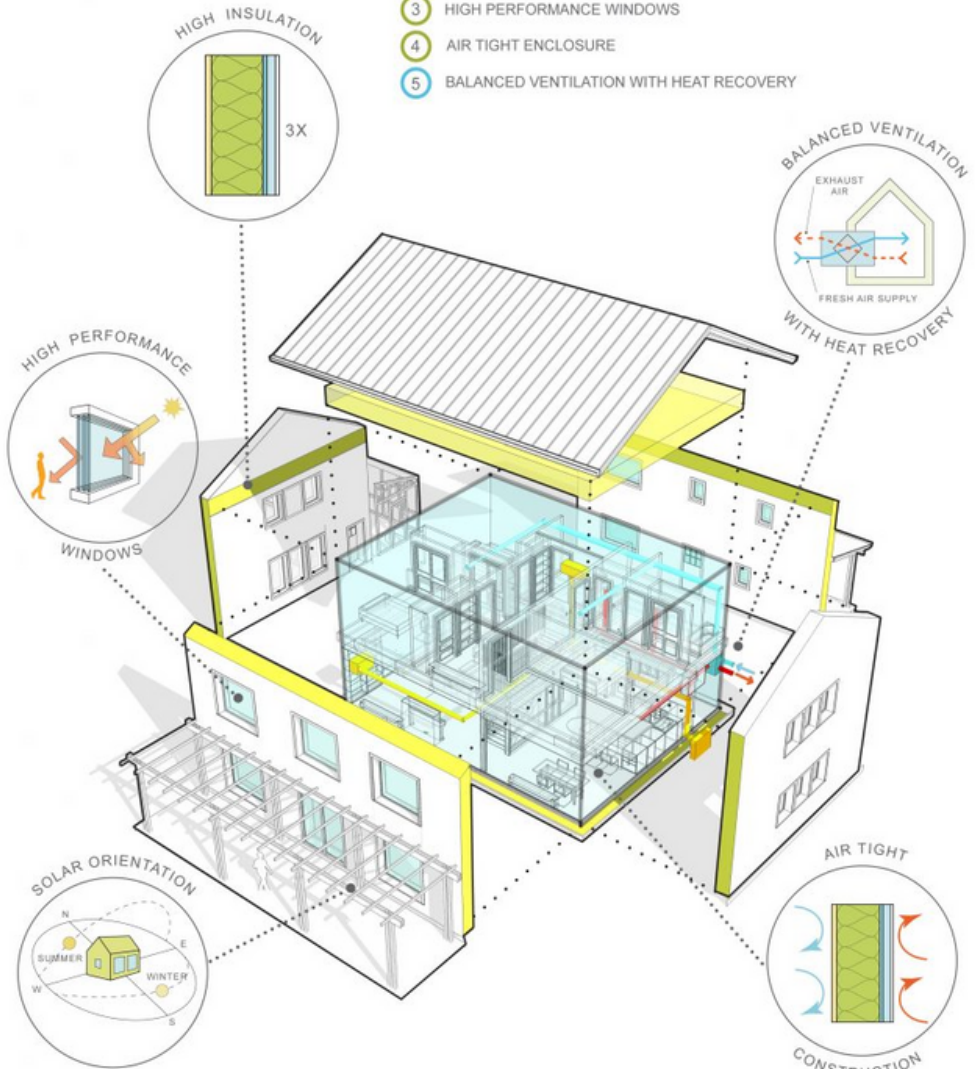
On one side of this ledger are tallied all the ways that a building "loses" energy. We call this the energy load. Think of these as the buildings energy "expenses." They are represented proportionally and labeled accordingly.

On the other side of the ledger are the "gains." In a high performance home we are able to take advantage of the "free" gains provided by the sun, our bodies, and the heat generated by appliances. The remainder is provided by small and efficient heating and cooling system.

By minimizing the losses, we required significantly less energy to meet this balance, making it much easier to produce that energy from the sun.

## RPA PASSIVE HOUSE PRINCIPLES

- 1 SOLAR ORIENTATION
- 2 HIGH INSULATION
- 3 HIGH PERFORMANCE WINDOWS
- 4 AIR TIGHT ENCLOSURE
- 5 BALANCED VENTILATION WITH HEAT RECOVERY



This graphic from Richard Pedranti in Philadelphia is a clear illustration of how high performance homes are built

# Naming the Challenges

So let's name the challenges. Let's answer cost right off because that is a question everyone rightly asks. The added construction costs are, not surprisingly, for more insulation and better windows. There is some additional framing, but there is also a much smaller and simpler mechanical system. All totaled these add appx. 5% to the cost of building the home compared to conventional code built construction, though we are comparing apples to oranges here. To keep this in context, of the appx. 500 line items that go into a building budget, only 10 are spent on these features.

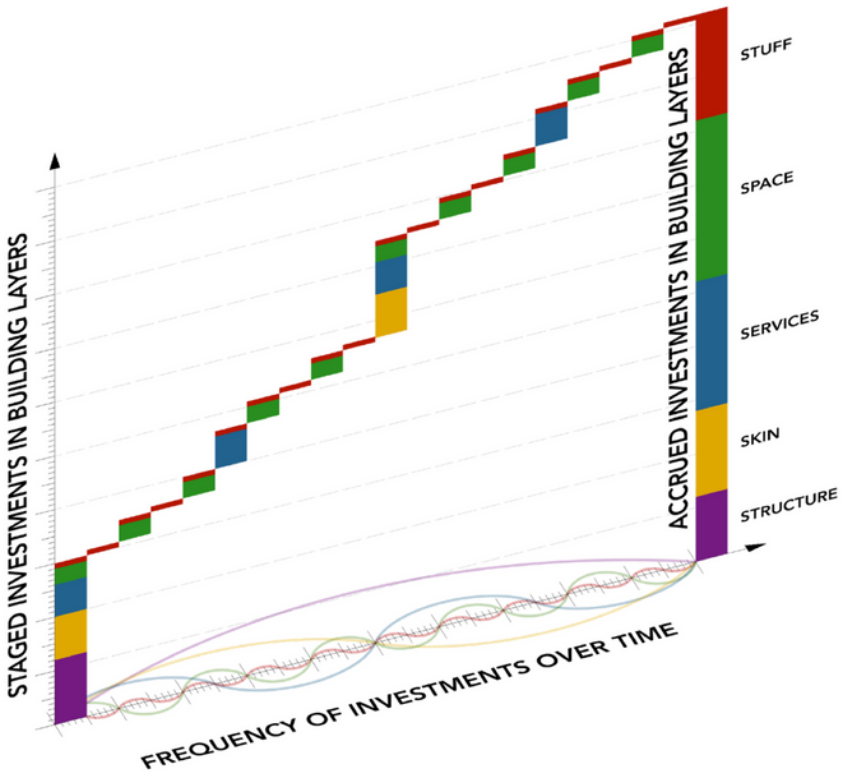


In addition to the cost to construct the building, the PV system, with rebates and tax credits, requires an investment of \$10–15K. What you are buying with these up front investments is a predictable energy operating budget of zero! The capitalized annual savings over 30 years amounts to appx. \$150K (depending on the project).

That level of performance is now embedded in the building for as long as it lasts. When making decisions about how to design and construct a new home, we have one chance to "bake in" all these features.

Building conventionally commits the home to a lifetime of fluctuating energy expenses of thousands of dollars each year, every year! The true cost of ownership includes the energy expenses for maintaining and operating a home.

## Make smart choices about the parts that last the longest!



This graphic tells an interesting and important story. It is taken from Stewart Brand's important book "How Buildings Learn" and is intended to show that we invest in the "layers" of a building at different frequencies over time. What this means is that, while we invest the most up front in a building's structure and its skin, those investments are long lasting. Over time, the more frequent investments we make in the other layers (services, space, and stuff) end up dwarfing those first investments. This is why it is so important to "bake in" high performance from the outset.

# Expertise Matters

Expertise matters in these projects and an integrated project team is essential. The successful construction of a Net Zero home depends on designers with a solid grounding in building science and a construction manager who can communicate technical details and coordinate with the trades. At Wolfworks we are certified Passive House designers and builders.

Net Zero homes also involve some new players: an energy engineer (just as we wouldn't imagine building without structural engineering), a specialist in solar systems, and a third party to verify compliance with programs that provide incentives like Energy Star, EnergizeCT's New Residential Construction Program and the CT Zero Energy Challenge (which Wolfworks has won four times!). The incentives can amount to \$10K (plus more for award winners!).

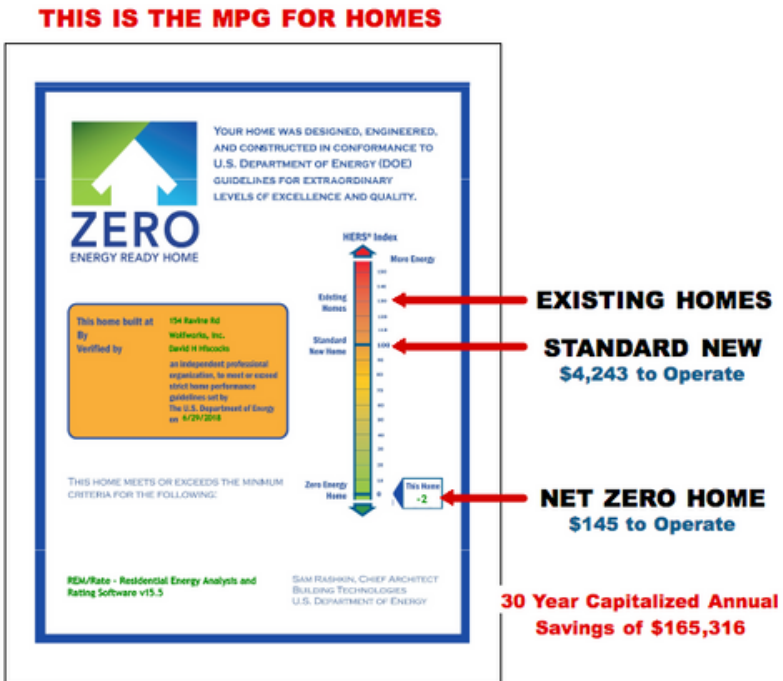


**COMMUNICATION AND  
COORDINATION ARE CRITICAL**

This third party applies the metric for the buildings HERS report, an important benchmark that rates building efficiency in comparison to that code built home. HERS stands for Home Energy Rating System; think of it like a cars MPG rating, but for a house. These raters assure the buildings will perform as promised.

# We need an MPG for Homes

Our Net Zero Home projects all receive the equivalent of that familiar energy rating we depend on when purchasing vehicles and appliances. Think about how this will demonstrate the remarkable value of a Net Zero Home when compared to the rest of what is on the market!



This brings us to realtors, banks and appraisers. While more and more states are requiring a HERS report as part of an MLS listing so that home buyers can compare energy use when shopping for homes, these industries have been slow to catch up with the effect that no utility cost has on both loan qualification and long term value. For an industry that relies on comps of similar buildings that have sold, there are too few of these remarkable buildings for them to compare – a real Catch-22. We work with lenders to help them understand the equations that make investments in Net Zero home make sense.

Let's build more Net Zero Homes!



# BUILD BETTER

BETTER HOME  
BETTER LIFE  
BETTER PLANET

Net Zero is the new goal line. We know how to reach it because we already are. No matter where you are on the field, there's a way to march toward that goal. We'd love to help you get there!

Get in touch if you are ready.



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