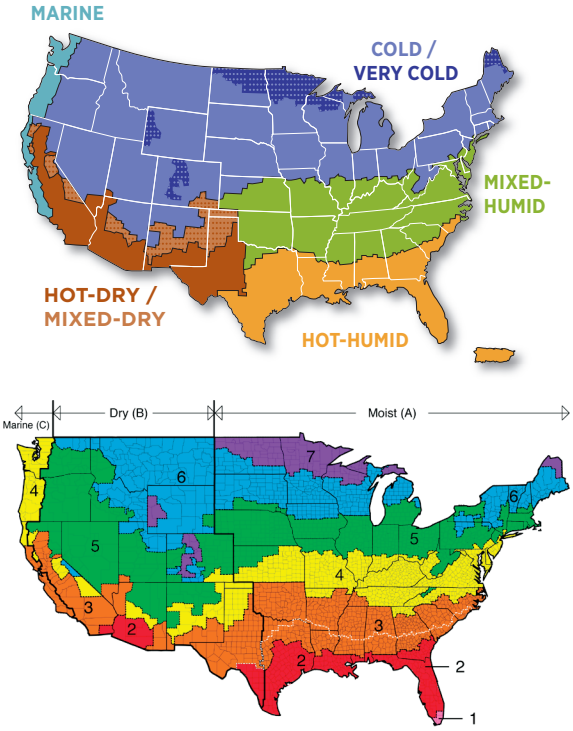
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

# Building America's Optimized Solutions for New Homes

# Marine Climate




## Climate Zone Maps

Map of Building America climate regions (top) for program reporting and IECC climate zones (bottom) as a reference for compliance information

The U.S. Department of Energy's (DOE's) Building America program has been a source of innovations in residential building energy performance, durability, and affordability for nearly 20 years. This world-class research program partners with many of the top U.S. home builders, contractors, and manufacturers to bring cutting-edge construction and design solutions and resources to market.

The most recent goal of the Building America program is to demonstrate how cost-effective strategies can reduce home energy use by more than 30%[1] in new homes, in all climate regions, by 2015. As part of the strategy to prove that this level of performance is achievable in the current market, DOE created a labeling program called the DOE Zero Energy Ready Home (ZERH) program.

Working together, Building America and ZERH programs have created a series of optimized solutions to demonstrate how builders have achieved, and often exceeded, these high savings goals. These optimized solutions provide guidance to all builders to cost effectively meet the 30% energy savings goal in their climate zones.

Building America's five major climate regions include cold/very-cold, mixed-humid, hot-humid, hot-dry/mixed-dry, and marine. These climate regions are outlined in Figure 1, along with a map of the International Energy Conservation Code (IECC) climate regions for comparison[2]. This document outlines the Building America recommendations for achieving 30% in the marine climate region.

Due to the tradeoff decisions that are made when building a home, there are hundreds of ways to meet the 30% performance goal. The performance levels listed in the marine climate table below, show just one way to cost effectively meet this goal. The far right column provides options for common building practices that could also be used to meet the performance goal.

Building America SM U.S. Department of Energy

Photo (top left): Seattle builder Martha Rose.

## DOE's Building America Solution Center

Decades of research in energy efficient design have led to the Building America Solution Center. Builders and contractors are encouraged to use this resource to improve the durability and performance of energy efficiency options listed in Table 1.

The Building America Solution Center provides access to expert information on hundreds of high-performance construction topics, including air sealing and insulation, HVAC components, windows, indoor air quality, and much more.

Users can navigate the Solution Center in one of four ways:

- Building components
- Labeling program checklists
- Alphabetically
- By publications

Registered users can also save customized content in their own field-kits!

Find what you are looking for on the Building America Solution Center website: ***basc.energy.gov***

## Table 1. Building America Optimized Solution: 30% Savings for the Marine Climate

| Measure | Performance | Options |
|---|---|---|
| **THERMAL ENCLOSURE** | | |
| **High-R Ceiling** | R-49 | • Unvented Attics<br>- Spray Foam Underside Roof<br>- Spray Foam and Permeable Insulation<br>- Exterior Rigid Insulation Over Sheathing<br>- SIP Roof<br>• Vented Attics<br>- Blown-in Insulation<br>- Batt Insulation |
| **High-R Walls** | R-21 cavity and R-10 continuous | • Single-Wall Cavity Insulation with Advanced Framing<br>- Spray Foam<br>- Spray Foam and Permeable Insulation<br>- Exterior Rigid Insulation<br>• Double-Wall Cavity Insulation<br>• SIP Walls<br>• Insulated Concrete Walls |
| **Crawlspace Foundation** | R-15 XPS | |
| **High-R Window** | R-3.7 | • ENERGY STAR® Certified Window<br>• R-5 Window recommended |
| **Air Tightness** | 2 ACH50 | • Air Sealing<br>• Air Barriers |
| **HVAC SYSTEM** | | |
| **Heating Equipment** | 10 HSPF | • Direct Vent Gas Furnace<br>• Air-Source Heat Pump<br>• Geothermal Heat Pump<br>• Ductless Mini-Split Heat Pump |
| **Cooling Equipment** | 22 SEER | • Air-Source Heat Pump/Air Conditioner<br>• Geothermal Heat Pump<br>• Ductless Mini-Split Heat Pump |
| **Whole-House Ventilation** | ASHRAE 62.2 | • Exhaust-Only Ventilation<br>• Supply-Only Ventilation<br>• Balanced Ventilation |
| **ENERGY EFFICIENT COMPONENTS** | | |
| **Water Heating** | EF>0.8 | • Gas Storage<br>• Gas Tankless<br>• Heat Pump Water Heater<br>• Solar |
| **Lighting** | ENERGY STAR | • CFL<br>• LED |
| **Appliances** | ENERGY STAR | |
| **Exhaust Fans** | ENERGY STAR | • Individual Room<br>• Central Exhaust |
| **Ceiling Fans** | ENERGY STAR | |

In depth descriptions, installation guidance and code compliance information for most of the options listed in Table 1 are available on the Building America Solution Center website (*basc.energy.gov*).

The case studies in this section demonstrate real-world examples of builders meeting the 30% goal. These case studies show that builders can reach the 30% savings target even if they don't meet all of the recommendations in Table 1. Tradeoffs are often based on local materials, labor costs, and market preferences.

## TC Legend Homes: Seattle, WA

The owners of a DOE Energy Zero Energy Ready Home in Seattle, Washington, are so happy about their high-performance net-zero energy home they have become "energy evangelists," blogging about the design and construction process, organizing a series of community talks on sustainability, and hosting several local green home tours since construction started in 2011.

As one of the first true net-zero energy homes in Seattle, the home has also garnered a lot of media attention from local TV and radio news shows and newspapers and national magazines and web sites.

The radiant heating system consists of PEX tubing in the first-floor slab, which circulates water that is heated by an air-to-water heat pump. The 3-ton heat pump has a capacity of 35,400 Btu/h with a heating efficiency HSPF (heating season performance factor) of 9.2 or a COP (coefficient of performance) of 3.0 to 5.5. Thanks to the home's open design, well-insulated shell, and air-mixing ventilation system, this first-floor hydronic heating system is all that's needed to keep even the second-floor bedrooms warm, with the exception of a small electric-resistance in-floor heating mat in the upstairs bathroom.

See the full case study online:
*http://energy.gov/sites/prod/files/2013/11/f5/hiawinner_tclegendhomes_100113.pdf*

## One Sky Homes: San Jose, CA

In a state that emphasizes residential energy efficiency and solar-electric generation, being designated the first true net-zero energy homes in California is an honor indeed. For the design-build team of Allen Gilliland and Bronwyn Barry of One Sky Homes in San Jose, California, the designation is one of many firsts on the project. The home is the builder's first home certified to the Passive House Institute standard and it was their first house certified to the high energy performance standards DOE's Zero Energy Ready Home (ZERH) program.

High efficiency starts at the ground level where insulated concrete form (ICF) blocks are used to create the foundation stem walls. The ICFs are 48x12x8-inch hollow blocks consisting of two 2.5-inch-thick layers of rigid foam that are held apart by plastic spacers. The blocks are stacked like Legos to form a hollow wall that is then reinforced with steel rebar and filled with concrete poured at the construction site. The blocks create a sturdy wall insulated inside and out.

One Sky Homes collaborated with Davis Energy Group, a research partner in DOE's Building America program. Davis Energy Group helped the builder meet the DOE ZERH criteria while testing several advanced building technologies, including a night ventilation cooling system that cut cooling costs by 98%.

See the full case study online:
*http://energy.gov/sites/prod/files/2014/09/f18/DOE_ZEH_OneSky_9-20-14.pdf*

## Zero Energy Ready Home

The Zero Energy Ready Home label establishes a framework for continuous improvement that will help propel the market toward net-zero energy performance. In the future, a consumer will have the option to buy an affordable Zero Energy Ready Home anywhere in the United States—a home that can seamlessly accept a small photovoltaic solar array to offset the energy use of the home over the course of a year.

Find technical resources and learn how to become a Zero Energy Ready Home partner on the Building Technologies Office website: *http://energy.gov/eere/buildings/zero-energy-ready-home*

## Dwell Development: Seattle, WA

Anthony Maschmedt's first DOE Zero Energy Ready Home (ZERH) is also his first Passive House, and, to his knowledge, the first Passive House built on speculation in the state of Washington.

This ZERH uses a double-wall enclosure that holds 14 inches (R-45) of blown cellulose. Instead of housewrap, a liquid air- and weather-resistant barrier was sprayed onto the OSB sheathing, then half-inch vertical battens were installed to provide an airspace and drainage plane behind the fiber cement siding.

The home's one mini-split heat pump is almost overkill given the low heating load, estimated at 4.0 Btu/ft²/hr or 7,580 Btu total for the 1,882-square-foot home, a heating energy cost of about $50/year. The air is circulated through the home by a heat recovery ventilator (HRV), which supplies fresh, filtered air throughout the main living areas and exhausts stale air from the bathrooms, laundry, and kitchen. The HRV uses a dedicated duct system with round metal ducts for maximum air flow efficiency.

See the full case study online:
*http://energy.gov/sites/prod/files/2013/11/f5/hiawinner_dwelldevelopment_100213.pdf*

Through targeted research, industry partnerships, and collaboration with related DOE residential initiatives, Building America works to make cost-effective, energy-efficient homes a reality for all Americans.

Along with energy savings, the program also focuses on solutions that lead to:

- Risk identification and mitigation
- Improved indoor air quality, which can benefit occupant health
- Higher comfort levels in all rooms throughout the home
- Durable and moisture-resistant building designs and renovation
- Increased builder profitability through reduced construction time
- Opportunities for new product designs that save energy, material, and installation costs.

1 Compared to the most recent House Simulation Protocols, roughly consistent with IECC 2009 and updated lighting, appliances and miscellaneous electric loads: *http://energy.gov/sites/prod/files/2014/03/f13/house_simulation_protocols_2014.pdf*

2 A detailed description of Building America climate regions is available at *http://energy.gov/eere/buildings/climate-zones*

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**For more information, visit:**
buildingamerica.gov

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The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.