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

DOE ZERO ENERGY READY HOME™

U.S. DOE ZERO ENERGY READY HOME 2022 WINNER Housing Innovation Awards

Tim O'Brien Homes

The Mulberry
Madison, WI

BUILDER PROFILE

Tim O'Brien Homes
Pewaukee, WI; TimOBrienHomes.com
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FEATURED HOME/DEVELOPMENT:

Project Data:

- Name: The Mulberry
- Location: Madison, Wisconsin
- Layout: 4 bdrm, 5 bath, 2 fl, 4,736 ft²
- Climate: IECC 6A, cold
- Completed: April 2022
- Category: Custom for Buyer

Modeled Performance Data:

- HERS INDEX: without PV: 35
- Annual Energy Costs: without PV: $2,370
- Annual Energy Cost Savings: without PV: $1,550
- Annual Energy Savings: without PV: 13,200 kWh, Therms: 360
- Savings in the First 30 Years: without PV: $75,050

There aren't many high school students who can point to the house down the street and say "I built that." But, for about 60 fortunate Wisconsin high school students, working side by side with carpenters, electricians, and other trades to build a real home for real home buyers is part of the school day, thanks to a special partnership between Tim O'Brien Homes and four high schools in Madison and Milwaukee, Wisconsin.

This unique program has been recognized by the U.S. Department of Energy with a Housing Innovation Grand Award for Innovation in Workforce Development and Training. Tim O'Brien has built 75 homes certified to DOE's Zero Energy Ready Home program and has plans for 25 more in the year ahead. The builder constructs about 240 semi-custom and spec homes each year and high school students help construct four of them. The students spend three hours on the construction site each day and are involved in every facet of construction from ground-breaking in August through foundation pouring, framing, electrical, plumbing, etc., to ribbon cutting for the completed homes in January. "Their excitement about what they are accomplishing is so apparent. Parents tell us it's all their kids want to talk about," said Tim O'Brien, founder and president of Tim O'Brien Homes.

Family members get a chance to see what the students are building at a pre-drywall show-and-tell event held on a weekend about halfway through construction. Two familes were so impressed, they bought the homes built by their students.

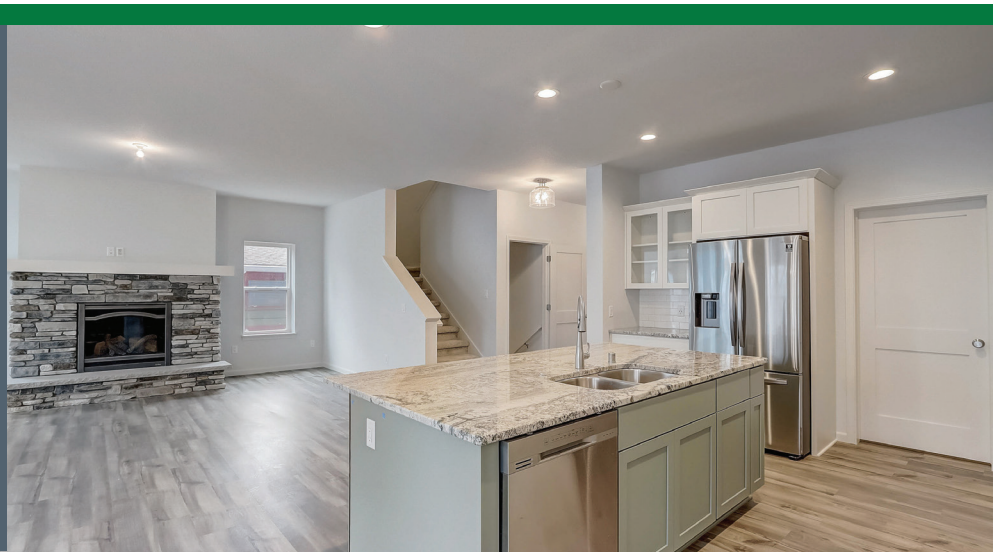
The program started in the Oconomowoc school district near Madison, Wisconsin, and has now spread to three other school districts: Oregon, New Berlin, and Franklin, Wisconsin. About 12 to 15 students are selected from each school to participate in the program each year and each school helps construct one home. Tim O'Brien has constructed over 25 homes with students so far, with no end in sight.

While running the program is one way for Tim O'Brien Homes to give back to the community, O'Brien said it also helps the local construction industry by encouraging more young people to consider a career in construction. According to

ZERO ENERGY READY HOME U.S. DEPARTMENT OF ENERGY

The U.S. Department of Energy invites home builders across the country to meet the extraordinary levels of excellence and quality specified in DOE's Zero Energy Ready Home program. Every DOE Zero Energy Ready Home starts with ENERGY STAR Certified Homes Version 3.0/3.1/3.2 for an energy-efficient home built on a solid foundation of building science research. Advanced technologies are designed in to give you superior construction, durability, and comfort; healthy indoor air; high-performance HVAC, lighting, and appliances; and solar-ready components for low or no utility bills in a quality home that will last for generations to come.

Students learn high-performance home construction techniques while building these DOE Zero Energy Ready certified homes. They learn practices such as panelized wall construction with double staggered 2x4 studs on a 2x8 plate, raised heel trusses and foam sealing of top plates in the attic, Indoor airPLUS measures for good indoor air quality, and installation of high-efficiency HVAC, and ENERGY STAR rated lighting, appliances, and windows.



What makes a home a DOE ZERO ENERGY READY HOME?

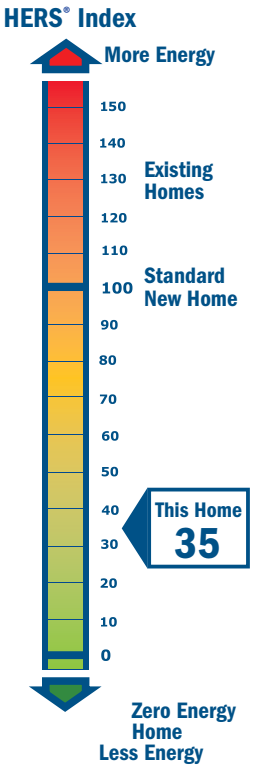
1 **BASELINE**
ENERGY STAR Certified Homes Version 3.0/3.1

2 **ENVELOPE**
meets or exceeds 2012 IECC levels

3 **DUCT SYSTEM**
located within the home's thermal boundary

4 **WATER EFFICIENCY**
meets or exceeds the EPA WaterSense Section 3.3 specs

5 **LIGHTING AND APPLIANCES**
ENERGY STAR qualified



6 **INDOOR AIR QUALITY**
meets or exceeds the EPA Indoor airPLUS Verification Checklist

7 **RENEWABLE READY**
meets EPA Renewable Energy-Ready Home.

O'Brien, "We've found that over 70% of the students who go through our building program will go into the trades or go on to college in a related field like construction management. That's over 200 individuals added to the labor pool." The others learn a life skill that will benefit them if they someday become homeowners.

O'Brien would love to see the program expand to other builders and more school districts across the country. He acknowledges safety is always a concern. The students are covered by school insurance and the school buys hard hats and safety gear for the students. A local tool manufacturer donates many of the basic tools each student uses. The teacher has to be on the job site 100% of the time. "We worked with a terrific teacher at the local school district, Steve Olson, who helped us establish program rules with the high school," said O'Brien. "Selected students must have first completed two years of classroom training in construction principles and skills at their high school." O'Brien notes they have been fortunate to find trade partners who are good at working with high school students and are willing to give them the on-site training in each facet of home construction that makes the program so valuable as a learning opportunity. Some of these trades are past graduates of the program. Olson said on one house this year both the plumber and head finish carpenter are former students. He noted that many of his students go on to the state's youth apprenticeship program in the trades, a school-based program that gives students high school credit for on-the-job training in the trades during their senior year of high school.

"Working with Tim and his contractors has been phenomenal. It's just gotten better and better each year. It's a plus for everyone. It's a plus for the schools because students are getting hands-on training opportunities, for the builders because they are helping to encourage students to consider the trades, and for the students because it could ignite a life-long passion for construction," said Olson, who offered "If you are a builder or school district interested in starting something like this, I would absolutely be willing to walk you through how we set up the program here in our school district," Olson's contact email is olsons@oasd.org.

One aspect of construction that Tim O'Brien brings to the table that Olson really appreciates is the builder's emphasis on energy-efficient construction. The students learn what is required to construct a home to the above-code requirements of programs like DOE's Zero Energy Ready Home program. "We hold competitions between the schools for the tightest home and cleanest home. A lot of caulk and foam goes into those homes before we test," said O'Brien. "The kids grow so much through the program. They are so proud of what they've accomplished."

There is a lot to be proud of in constructing a DOE Zero Energy Ready certified home. Every DOE Zero Energy Ready home must also be certified to ENERGY

Tim O'Brien's High School Construction Program brings high school students onto the job site to work along side the builder's staff and trades to help build a spec home start to finish. The program, begun in 2011, now encompasses four high schools and has helped over 400 students get real-world experience in the construction industry.

STAR for Homes, the U.S. Environmental Protection Agency's Indoor airPLUS program, and some aspects of EPA's WaterSense program. DOE Zero Energy Ready homes must also meet above-code insulation requirements, be blower door tested for air sealing, comply with moisture management guidelines, have ducts inside conditioned space, and use ENERGY STAR-labeled windows, lighting, and appliances. Homes must also have solar electric panels installed or have the conduit and electrical panel space in place for future installation of solar panels.

In 2022, Tim O'Brien received a DOE Zero Energy Ready Housing Innovation Award for a two-story 4,736 ft^2 home constructed in Madison, Wisconsin. The home has a Home Energy Rating System (HERS) score of 35 with no photovoltaic panels installed. O'Brien got exceptional performance on this cold climate home with an R-35 insulated double wall consisting of two 2x4 walls with staggered studs on a 2x8 bottom plate. The exterior wall is sheathed with $^{7}/_{16}$ -inch OSB topped with 1 $^{1}/_{16}$-inch graphite-enhanced EPS rigid foam. The 8-inch wall cavity is filled with dense-packed blown fiberglass. The walls are covered with draining house wrap and vinyl siding or masonry stone veneer.

The vented attic is air sealed with closed-cell spray foam at all top plates and holes, then insulated with 16.5 inches (R-50) of blown fiberglass. Raised heel trusses allow more insulation over the top plates. The interior surface of the basement walls is lined with 2 inches (R-10) of foil-faced rigid foam board. Finished portions of the basement also have a 2x4 framed wall with R-11 batt insulation.

This home was built using pre-fabricated factory-made panels, which reduces waste and weather-related delays. Advanced framing, air sealing and other details are included in construction drawings. The efficient floor plan has no floors over the unconditioned garage space and no cantilevers above outdoor spaces, which minimizes contaminant transfer and heat loss. Most of the home's ENERGY STAR-rated, double-pane, vinyl-framed low-emissivity windows face south for beneficial solar heat gain in the winter while deciduous trees provide summer shade.

In addition to spray foaming top plates and holes, caulking, and taping the house wrap and rigid foam seams, a whole-house aerosolized acrylic sealant was applied to this house while the house was pressurized. Together these air-sealing measures yielded a whole house air tightness of only 1.03 air changes per hour at 50 Pascals, well below the 3 ACH 50 specified by code.

To provide fresh air to the home, an energy recovery ventilator (ERV) was installed. The ERV was integrated with the air handler of the home's hybrid 97% AFUE gas furnace and 9.5 HSPF, 16 SEER air source heat pump heating and cooling system. Ducts are sealed throughout using mastic and all ductwork is within conditioned space.

HOME CERTIFICATIONS

- DOE Zero Energy Ready Home Quality Management Guidelines
- DOE Zero Energy Ready Home Program - 100% Commitment
- ENERGY STAR Certified Homes Version 3.0
- EPA Indoor airPLUS
- EPA Water Sense
- WI Green Built Home
- Wisconsin Focus on Energy
- RESNET EnergySmart Builder

ENERGY STAR

Building AMERICA U.S. Department of Energy

Every DOE Zero Energy Ready Home combines a building science baseline specified by ENERGY STAR Certified Homes with advanced technologies and practices from DOE's Building America research program.

Students work side by side with trades to learn carpentry, plumbing, and other skills.

A heat pump water heater provides hot water for the home. The whole home is EPA WaterSense certified to ensure efficient water usage, with low-flow fixtures and PEX piping with a central manifold to speed hot water directly to taps. Special effort was made in the design process to stack plumbing zones to allow for shorter plumbing and to place mechanical rooms centrally for more compact HVAC runs.

For disaster resilience related to wind bracing for tornadoes, continuous 7/16-inch OSB sheathing was installed on the exterior walls and trusses were engineered and braced with uplift-resistant screws installed on every truss. All homes are equipped with a sump pump to handle localized flooding and an active radon mitigation system was installed in the basement.

Tim O'Brien's education efforts extend to home buyers, other builders, and their own staff. The builder conducts about five Green Construction Tours each year where they take prospective home owners and sales staff and other members of the public through a home just before insulation and drywall to talk about the systems-based approach to home building. They encourage attendees to ask questions, especially about why they build the way they do. Tim O'Brien uses DOE Zero Energy Ready Home information in many of their marketing and consumer education pieces, including a High Performance Homebuyers Guide they developed to describe their homes' high performance home features, certifications, and third-party testing. "Another key part of this guide is that we go over incremental costs, showing the true total cost of homeownership," said O'Brien. To help homeowners understand how to maintain their high-performance home, including features like the homes' increased airtightness and the importance of the ERV in maintaining good indoor air quality, they developed a series of Homeowner Maintenance videos. O'Brien also invests in training of their staff, bringing in experts in building science to educate construction and sales staff.

In addition to the High School Build program, Tim O'Brien Homes has played a big role in starting the McKenzie Regional Workforce Center. This is a partnership between the Boys and Girls Clubs of Dane County and the Madison Area Builders Association (MABA) to provide a skilled trades curriculum focusing on guiding young adults to careers in construction and skilled trades. This program has been so well received by the local community that it is being used as a template for other Boys and Girls Clubs across the country. Tim O'Brien Homes also participates in an annual event for grade schoolers called Kids Building Wisconsin. They help sponsor the event and host a booth where kids can work with staff to construct small projects.

O'Brien says of their workforce and education efforts, "It's become part of who we are and what we do." The builder's efforts have paid off with home buyers too. Over the past 6 months, the builder achieved a Total Homebuying Experience satisfaction score of 87.7% in the national Avid Ratings homeowner survey.

Photos courtesy of Tim O'Brien Homes

KEY FEATURES

- **Walls:** Staggered stud, 2x4′ 16″ o.c. on 2x8 plates, R-35 total: 7.5″ wall cavity filled with R-30 dense-packed blown fiberglass, 1-1/16 graphite EPS, 7/16″ OSB, draining house wrap, vinyl or stone veneer siding.
- **Roof:** Gable truss roof: self-adhered membrane at eaves and valleys, synthetic underlayment, architectural shingles. Aluminum sot vents, ridge vents.
- **Attic:** Vented attic: 16.5″ R-50 blown fiberglass; 7″ raised heel trusses. ½″ R-3 closed cell spray foam over sill plates, chases, and can lights. Ridge vents.
- **Foundation:** Insulated basement: all walls have 2″ R-10 foil-faced rigid foam on interior. Finished walls also have 2x4 framing and R-11 fiberglass unfaced batt.
- **Windows:** Double-pane, argon-filled; low-e2; vinyl-framed; U=0.27; SHGC=0.26.
- **Air Sealing:** 1.03 ACH50. Whole house sealed with aerosolized acrylic sealant.
- **Ventilation:** ERV, tied to central air handler. MERV 11 filter on return, MERV 8 on intake.
- **HVAC:** Gas furnace, 97 AFUE; central air-source heat pump, 16 SEER, 9.5 HSPF.
- **Hot Water:** Heat pump water heater, 72 gallon, 3.5 EF.
- **Lighting:** 100% LED, clerestory windows.
- **Appliances:** ENERGY STAR microwave, dishwasher, refrigerator.
- **Solar:** Solar ready, conduit and plywood for inverter box installed.
- **Water Conservation:** Whole house EPA WaterSense-certified. Central manifold, PEX pipe.
- **Energy Management System:** Programmable thermostat.
- **Other:** Radon detector, air cleaner. Electric vehicle charger in garage. High school training program. Locally sourced doors, windows, and cabinets.

DOE Zero Energy Ready Home requirements, comprehensive quality management, and third-party testing enable Tim O'Brien Homes to confidently offer home buyers a 5-year energy usage guarantee.

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