



# Innovation Leads to High-Performance Building Solutions

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**New systems and products designed to manage the building envelope, continuous insulation, and indoor air quality are coming down the pipeline. Here's some of the most advanced of these building science concepts being used in new homes today.**



The Dwell Development, a high-performance home in Seattle, won a recent DOE Housing Innovation Award. It blends recycled materials with a modern design while achieving a HERS score of 55.

**Considering climates.** Because house wrap is so key to managing the moisture in a wall, it is important that it work in conjunction with all components of the assembly.



**O**NE-FIFTH OF ALL ENERGY CONSUMPTION is used by buildings, and nearly half of that consumption is used to keep buildings cool, says Eric Werling, Building America program director for the Department of Energy (DOE). Because most Americans spend two-thirds of their lives inside their homes, it's important to continue making those buildings and the systems inside them as energy efficient—and healthy to live in—as possible.

The DOE's Building America Program was started more than two decades ago to figure out ways to make homes more efficient without increasing costs. Each year, Building

America focuses on a few key areas to study, with a goal of decreasing energy consumption by 50 percent. That goal has led to a number of new building codes, systems and processes for high-performance building.

Here, we review three areas of innovation the program addresses: envelope solutions, continuous and attic insulation, and indoor air quality (IAQ).

"When you look at the roadmaps for our program, you'll see it's a much more strategic plan for finishing the job of getting high-performance homes to be standard practice," Werling says. "Our roadmaps are not just designed specifically around technical challenges, but also market challenges."

## ENVELOPE SOLUTIONS

A tight building envelope, standard practice in high-performance building, is key to reducing energy loss inside a home. However, a tight envelope presents a new problem: the inability of moisture that occurs inside a home to escape. In response, Home Innovation Research Labs, one of Building America's research teams, is working to develop new insulation systems that can manage moisture and prevent heat loss or gain. Currently, Home Innovation Research Labs is working on three projects related to attics and continuous insulation, and is about to begin working on a fourth project on windows.

Home Innovation Research Labs is measuring how moisture moves in a home by studying how much moisture movement occurs in highly insulated walls and roofs. Though building envelopes are designed to keep moisture out, they consequently do not allow moisture to escape. The result can be mold, mildew and overall unhealthy IAQ.

To determine a solution, Home Innovation Research Labs is monitoring the performance of high-R-value walls in high-performance homes in different climate zones. The team uses sensors to monitor temperatures, ambient conditions, moisture levels of materials, and relative humidity levels inside the home and assemblies.

Home Innovation Research Labs is studying an extended plate and beam system as a way to overcome some of those issues. The system contains the best performance characteristics of continuous and deep cavity insulation methods.

Home Innovation Research Labs' proposed system includes wood structural panels on the exterior, which allow for better drying and provides transportation of prefabricated walls. It includes rigid foam between the framing and sheathing to add insulation and protect the cavity from condensation. The system also includes a standard, maintained drainage plane location and a nail-based surface.

Testing is being conducted to ensure compliance with code provisions and proper wall bracing. In the meantime, two houses are being built in Michigan by McIntyre Builders using the extended plate and beam system.

On the front line of the envelope solutions issue is house wrap.



**Successful testing.** McIntyre Builders agreed to test the extended plate and beam system on a home under construction. The company was so happy with the results, it decided to use the system on a second home.

"What today's builders need to achieve is an end wall that can deliver maximum performance in its protection against water and moisture intrusion, while allowing moisture to escape," says Bijan Mansouri, Technical Manager, TYPAR Construction Products. "This wall also needs to be energy efficient and meet local and national code requirements."

Because house wrap is so key to managing the moisture in a wall, it's important that it works in conjunction with all components of the assembly. "Builders need to understand that it is not one product in a house that affects its performance, but rather a system of products working together. The systems approach to house wrap means that all the products within the system are chemically compatible and perform at the same level.

"A building envelope that works properly and consists of components that are chemically compatible in extreme weather conditions is critical in moisture management," says Mansouri. For example, using the [TYPAR Weather Protection System](#) addresses every point of vulnerability, eliminating even the smallest entries for air and moisture intrusion.

As the core component of the TYPAR Weather Protection System, TYPAR BuildingWrap functions as a Type 1 air barrier with balanced water holdout, achieving an optimal perm rating. This means that while water is prevented from



**Thermal conduction.** Walls with cavity insulation can still have low R-values if studs are not isolated. They act as thermal conductors. A gap filled with insulation can mitigate this problem.

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entering the wall cavity, ideal levels of moisture vapor are also allowed to escape. This breathable functionality reduces the risk of standing water in wall cavities, which can potentially lead to mold growth and degradation of indoor air quality.

For an added layer of performance, TYPAR BuildingWrap combines tear strength, UV stability, and the ability to withstand performance-robbing surfactants like oils, tannins, and soaps that can compromise an ordinary house wrap's ability to block bulk moisture penetration.

In addition to TYPAR BuildingWrap, the TYPAR Weather Protection System includes a variety of weather-resistant barriers to choose from as well as flashings, construction tape and accessories



**Preventing energy loss.** Home Innovation Research Labs is developing solutions for insulation in existing homes' attics with cathedral ceilings, habitable space or those used for storage.

CREDIT: CREATIVE COMMONS



**The TYPAR Weather Protection System** includes TYPAR BuildingWrap, TYPAR MetroWrap, TYPAR Flashings, TYPAR Drainable Wrap, and TYPAR Construction Tape. Check into how TYPAR BuildingWrap can help you manage moisture in your homes today. Visit [www.typar.com](http://www.typar.com).

that are engineered to work together to provide great protection against nature's harshest elements.

By properly installing the complete TYPAR Weather Protection System, installers get the backing of a lifetime limited system warranty. "TYPAR offers a warranty above and beyond anyone else's in the industry," says Mansouri. "For single-family residences, we offer a lifetime limited product warranty, and on structures other than single-family we have a 15-year limited product warranty."

TYPAR is confident in offering such a strong warranty because not only does the company manufacture each component of its Weather Protection System in-house, it also offers clear instructions and ongoing education to make sure building pros know how to use and install the products correctly. "We provide lunch and learns for builders, architects, and designers to show them the difference between house wraps because they are not all equal," Mansouri emphasizes.

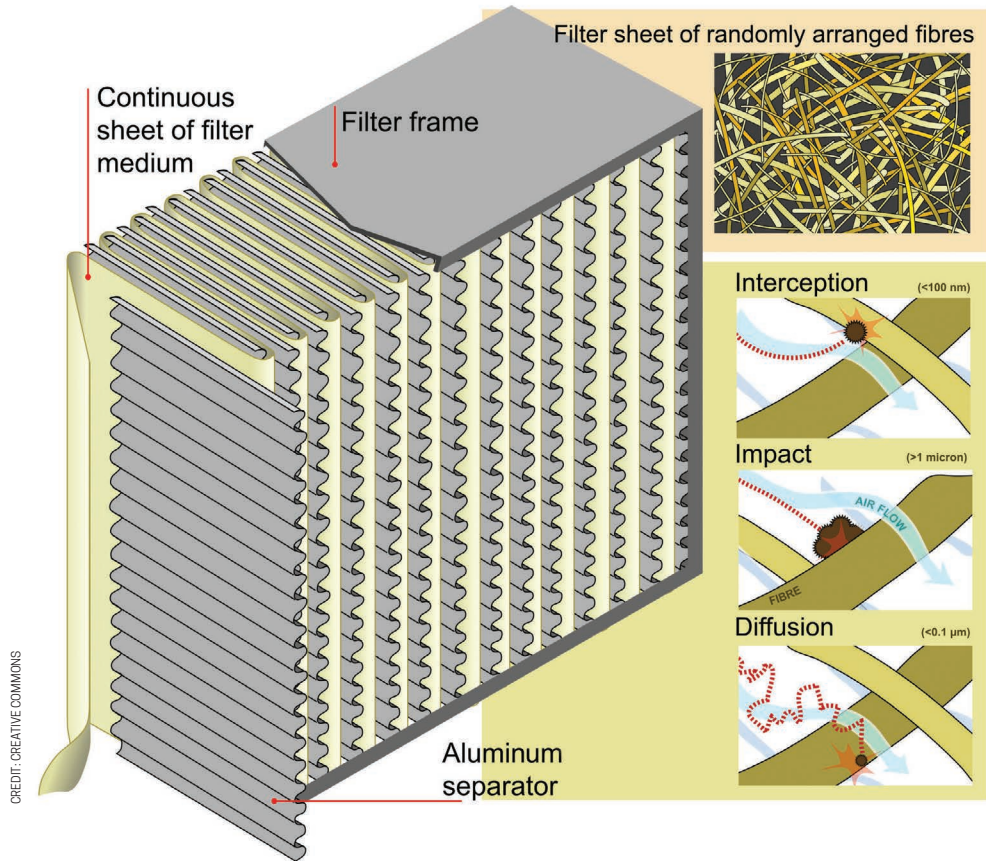
Additionally, TYPAR offers training programs to both residential and commercial builders to promote proper in-

stallation techniques and time-saving tips for all components of the TYPAR Weather Protection System.

Most importantly, TYPAR uses these training opportunities to address issues that arise when installing house wrap. "We are always reminding builders to consider the materials that are used with the wrap," Mansouri says. "For instance, the type of siding material you use as well as improper use of fasteners and nails can greatly impact the performance of the building wrap."

Mansouri also emphasizes that builders need to understand what materials to choose in order to meet building code requirements. "They should be asking themselves: 'Does this product meet the 2015/2018 building code?'" Unfortunately, I see it all the time, and builders do not know the most recent air and moisture barrier requirements for the building envelope."

As an industry innovator, TYPAR is constantly evolving and continues to rely on its in-house research and development centers to create better products. "Because we design and manufacture internally, we have the ability to create



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**Filter particles.** High-efficiency particle filters can help improve IAQ and lead to a higher score.

new and innovative products. For example, we are working on products that can drain moisture at higher rates, flashing that can perform at wider temperature ranges, and are exploring new ways to install house wrap faster with fewer penetrations,” says Mansouri. “We are always asking ourselves how we can increase energy efficiency to help improve the energy performance of today’s homes.”

### CONTINUOUS AND ATTIC INSULATION

There are many advantages to using continuous insulation instead of cavity insulation. First, walls with continuous insulation have high R-values, as no heat is lost or gained from steel studs (or wood). Second, continuous insulation reduces the chance of moisture damage, because water is unable to condense on the inside face of the sheathing, according to GreenBuildingAdvisor.com.

However, continuous insulation has led to issues with the installation of windows. Home Innovation Research Labs is working to develop performance information and establish criteria to evaluate windows with flanges supported by insulating materials. It’s testing a variety of windows and foam sheathing under two loading scenarios: temporal wind pressure loading and long-term gravity loading. This will assess the performance of a number of different combinations of windows, and foam sheathing types and thicknesses.

It’s no secret that much of a home’s energy loss is due to a poorly insulated attic. Improvements in insulation have largely resolved this issue in new builds. In retrofits, the problem isn’t as easily solved. Sometimes, better air sealing and installing extra insulation is enough to prevent energy loss. But those techniques are not options for many retrofits, such as those including attics with cathedral ceilings, habitable space or those used for storage.

For attics that are not easily insulated, Home Innovation Research Labs is looking into nail-based insulated panels as a solution. These panels consist of rigid foam insulation laminated on the face of a wood structural panel. The insulation provides more thermal performance, and the wood structural panel provides the rigid substrate for installing roofing membrane, according to the agency.

Home Innovation Research Labs is testing the systems in houses in two different climate zones—the hot and humid South Carolina and the much colder Michigan. Testing in different climate zones will help gauge the system’s moisture performance on homes in various locations.

### INDOOR AIR QUALITY

High-performance buildings can lead to problems with IAQ, so researchers are working on ways to solve the issues. A better building envelope and improved ventilation systems are important first steps in improving the problem. But without knowing exactly how good or bad air quality inside a home actually is, these problems can’t be measured. That’s why the Lawrence Berkeley National Laboratory has developed an IAQ scoring tool.

The scoring tool functions like a HERS score. It will take a series of measurements conducted by a third party to determine the home’s IAQ rating.

“In the world of IAQ, there are lots of claims and statements made about air quality in homes. Builders can say pretty much anything, and consumers won’t know any different,” says Iain Walker, lead of the residential building group for Lawrence Berkeley National Laboratory. “The scoring tool will be a technically sound third-party measurement of indoor air quality.”

When developing new scoring systems, researchers typically use a relative score, meaning the score is relative to a reference home. For example, most energy scoring systems take energy ratings of a standard home and measure them against measurements from a comparison home to get the score. Because there is no current IAQ standard for researchers to use as a comparison, the Lawrence Berkeley National Lab is creating a rating system that’s absolute.

The score will depend on a number of house characteristics. Some will be more basic, like adhering to ASHRAE Standard 62.2 for ventilation, which includes factors such as installing exhaust fans in bathrooms and kitchens. Another is using a system that dilutes indoor emissions with

fresh outdoor air. It also will take into account using building materials that are low emitting, like VOC paints and certified wood products that are low formaldehyde. A homeowner could get a higher score if the home includes a radon control system, carbon monoxide detector and a whole-house filtration system to remove indoor particles.

“Particles are the number one pollutant in homes,” Walker says. “If you put in a good filter and have a control system that removes particles with heating or cooling, it would improve your score.”

The score also depends on moisture prevention. For example, a homeowner that seals the ground from the crawl space to prevent moisture entry would earn a higher score. Homeowners in humid climates would earn a higher score



# Protection From the Weather

**F**ROM THE ROOFLINE to the foundation, the TYPAR Weather Protection System safeguards homes and buildings from the damaging effects of moisture and air infiltration. The complete system includes TYPAR BuildingWrap, Drainable Wrap, and MetroWrap for commercial applications, as well as a variety of flashing options and construction tapes.

Collectively, the system acts as a barrier for wind-driven rain, bulk water and air that may penetrate cladding. When moisture

infiltrates the exterior finish, the TYPAR weather-resistant barrier works in conjunction with the integrated flashing to guide water back to the exterior. This reduces the risk of water intrusion that can lead to mold, mildew, or other indoor toxins, which can degrade indoor air quality.

When properly installed, the TYPAR Weather Protection System is backed by a lifetime limited system warranty that covers both labor and materials. For more information visit [www.typar.com](http://www.typar.com).



**Higher scores.** Installing a kitchen exhaust fan will help homeowners earn higher IAQ scores.

by installing a humidifier.

The score could be affected by the layout of the home. “In most new construction, the house has a garage attached. We put things like cars, gasoline powered lawn mowers, old cans of paints and chemicals in there,” Walker says. “If this is the case, homeowners can earn an improved score if they have done a good job of air sealing between house and garage.”

Walker believes sensors will soon be available that will measure pollutants inside a home, including formaldehyde, particle and moisture sensors. A home with these sensors would earn a higher IAQ score.

## REWARD FOR EFFORT

Climate change is driving people in all industries to rethink their energy consumption. The building industry is well on its way to high-performance and net-zero buildings. Now, the key is to make sure those buildings are not only energy efficient, but also realistic places for homeowners to live.

“We cannot go down the path of having homes that use very little energy, but are not healthy or safe to live in,” says Walker. “We have to do both, and we need tools that let people know they are doing the right thing, so they can try out different approaches.”

The DOE, its research teams and lab partners, and forward-thinking manufacturers are working toward blending these concepts and driving progress in the IAQ implications of construction materials and processes. By continuing to look for answers to these issues, the building industry can make meaningful progress toward reducing its carbon footprint.



# Building Wrap Solution

**T**YPAR BUILDINGWRAP IS a smart engineered weather-resistant barrier that provides optimal breathability for exterior walls by blocking air and water from getting in, but allowing moisture vapor to escape the wall cavity. This reduces the risk of standing water in the wall cavities that can potentially lead to mold growth and degradation of indoor air quality.

As the core component of the TYPAR Weather Protection System, TYPAR BuildingWrap combines industry leading tear strength, superior UV stability and the unrivaled ability to withstand performance-robbing surfactants like oils, tannins and soaps that can compromise an ordinary house wrap’s ability to block bulk moisture penetration. With the ability to function as a Type 1 air barrier, TYPAR BuildingWrap eliminates drafts in the wall, which helps reduce energy costs over time while providing a more comfortable indoor environment for building occupants.

By properly installing the complete system of TYPAR BuildingWraps, Flashings and Construction Tapes, installers get the backing of a lifetime limited warranty. For more information visit [www.typar.com](http://www.typar.com).